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WOOL PRODUCTION IN CANADA

By S. B. Slen

Courtesy National Film Board

Harvesting wool with power machinery

EXPERIMENTAL FARMS SERVICE
CANADA DEPARTMENT OF AGRICULTURE
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WOOL PRODUCTION IN CANADA

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INTRODUCTION

Canada's sheep and wool industry dates back practically to the beginning of her agriculture. The first sheep were brought from France about 1650 to serve as a source of food and clothing. Since that time sheep have followed settlement to all parts of agricultural Canada and have played an important part in the economy of the country.

On the whole Canada is well adapted to sheep and wool production, and through the years this form of production has been profitable. From the earliest days the wool produced in Canada has played an important role in clothing both civilian and military populations and has contributed, first to home industries, and then to a substantial commercial textile industry.

Wool production has fluctuated considerably as indicated by the data in Table 1 which shows production, exports, imports, and consumption for certain years since 1920.

TABLE 1.—Estimated production, exports, imports, and consumption of wool, 1920–1957[1]

Year	Production			Exports	Imports	Consumption
	Shorn	Pulled	Total			
	(thousand pounds)					
1920	11,306	3,598	14,904	6,289	12,260	20,875
1930	12,800	3,854	16,645	4,424	24,093	36,323
1940	11,549	3,346	14,895	2,681	86,170	98,384
1941	11,630	3,624	15,254	3,025	93,070	105,299
1942	12,867	3,610	16,477	384	114,428	130,521
1943	13,939	3,889	17,818	2,316	104,364	119,866
1944	15,128	4,151	19,279	15,520	52,690	56,449
1945	14,513	5,113	19,626	11,927	59,506	67,205
1950	7,904	1,333	9,237	4,328	82,241	87,150
1951	5,700	1,182	6,882	2,656	69,012	73,238
1952	6,378	1,313	7,691	3,639	49,537	53,589
1953	6,659	1,962	8,621	3,756	63,088	67,953
1954	6,810	1,670	8,480	2,865	41,487	47,102
1955	6,446	1,595	8,041	2,883	53,954	59,112
1956	6,372	1,707	8,079	3,594	58,226	62,711
1957	6,050	1,825	7,875	3,917	47,331	51,289

[1] Source: Dominion Bureau of Statistics.

It is noteworthy that since 1920 annual raw wool production has never been able to meet the requirements of Canadian consumption. Peak production occurred in 1945 when 20 million pounds of wool were produced but in the following year production began to decline and this trend continued until 1951. In 1953 wool production amounted to 8.6 million pounds which represented an increase of approximately 10 per cent above the previous year. Since that time total wool production has remained at approximately 8.0 million pounds per year. However, at present there are signs of a revival of interest in sheep and wool production in Canada.

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Because annual consumption always has been considerably greater than production it has been necessary to meet this deficit by importations, chiefly from Australia, New Zealand, Great Britain, and the United States. In spite of this situation several million pounds of Canadian wool are exported annually because better prices can be obtained in other markets for those particular types.

Progress has been made in improving production per sheep as indicated by the data in Table 2.

TABLE 2.—Average grease fleece weights by provinces for the years 1920–1957[1]

Year	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
	(pounds)									
1920	5.3	4.6	5.2	5.5	7.3	7.1	6.9	7.3	6.4	6.3
1925	5.7	4.9	5.6	5.9	7.6	7.3	7.4	7.9	6.8	6.7
1930	5.9	5.1	5.7	6.1	7.8	7.3	7.5	7.5	6.9	7.0
1935	6.2	5.4	6.1	6.0	7.9	7.0	7.8	7.6	7.0	7.2
1940	6.4	5.6	6.6	6.2	8.1	7.7	8.2	7.8	7.1	7.4
1945	7.0	5.6	6.2	6.3	7.6	6.9	8.0	8.8	7.3	7.6
1950	8.0	6.1	6.8	6.7	8.2	6.9	8.4	8.7	7.6	7.7
1955	7.1	6.0	6.4	6.5	7.7	6.4	7.5	8.1	8.1	7.4
1956	7.1	6.0	6.6	6.5	7.6	6.8	7.8	7.8	7.7	7.3
1957	7.2	6.0	6.3	6.6	7.2	6.3	7.5	7.9	7.7	7.2

[1] Source: Dominion Bureau of Statistics.

These data show that there has been a relatively large increase in the average fleece weights in Canada since 1920. This increase has amounted to approximately 20 per cent which is considerably greater than the improvement made in most forms of agricultural production during this period. Another interesting feature is that the average fleece weights for Western Canada have been heavier than those for the East, with Alberta having the highest production per head. This in part is a reflection of the breeds or types of sheep that have been raised rather than of the ability of sheepmen to improve production. The sheep raised in the East always have been predominantly mutton breeds, which have a relatively low average fleece weight, while in Western Canada a large percentage of the sheep have been of the range breeds. In the development of these breeds for range conditions relatively more attention has been given to wool production.

WOOL GROWTH

Wool is a fiber or modified hair that grows from the skin of sheep. It is formed as a living substance and, as such, its growth is regulated by the inherited characteristics of the sheep and by the general condition of the sheep producing it. Therefore, the amount and quality of wool produced can be changed through management, breeding, and feeding practices.

The individual wool fiber grows from a small depression, known as a follicle, in the skin. The follicles are well supplied with blood vessels which carry to the fiber the food materials necessary for its growth. The actively growing part of the fiber is in the follicle, and as material for the fiber is formed it pushes the previously developed material out of the follicle in the form of a fiber.

Surrounding each wool follicle are two kinds of glands known as the suint and sebaceous (wax) glands which supply protective materials for the fleece. The suint glands secrete a material, often called sweat salts, which prevents the fibers from being damaged by sunlight. The sebaceous glands secrete wool grease which forms a protective covering on the fiber and prevents mechanical damage through rubbing.

Wool growth is a continuous process and normally the fiber is not shed. However, some of the Down and Longwool breeds tend to shed some wool in

the spring. On occasion it has been suggested that wool grows more rapidly immediately after shearing than at any other period of growth but this is not true. As long as the animal receives an adequate amount of feed under similar conditions the rate of growth will be uniform. Sheep have been found after five years carrying full fleeces. However, a sudden change in feed, exposure to sudden storms, or a high fever, may cause a sheep to lose its fleece but this is not normal (see Fig. 1).

Fig. 1.—Normally, wool grows at a fairly uniform rate and is not shed. However, poor nutrition, sickness, or sudden changes in feed may cause sheep to slip their fleeces and consequently reduce the amount of wool for sale.

The rate of wool growth is directly related to the amount of feed available. Work at the Experimental Farm, Lethbridge, Alta., has indicated that increasing the protein content of the ration from 7 per cent to 10 per cent increased raw wool production by 16 per cent. Work at the University of California showed that sheep on a sub-maintenance ration produced 2.5 pounds of raw wool while those on a fattening ration averaged 8.6 pounds. On poor rations some of the follicles fail to function, the fibers from the other follicles are finer, and as a result wool production is lowered.

CHARACTERISTICS OF WOOL

Wool is the oldest textile fiber known to man, having been used as such by the Babylonians as early as 4,000 B.C. Its unique physical and chemical characteristics have been responsible for its great versatility and lasting popularity. Although a great deal of effort has been expended, scientists have not been able to produce a synthetic fiber to replace wool. It is possible to produce from wool a larger variety of fabrics with a greater affinity for dyes than from any other known textile fiber.

Fineness of Wool

The fineness or thickness of the fiber is the most important single dimensional characteristic of wool, greatly influencing its economic value. The degree of thickness will determine whether the finished fabric will be a fine dress material

or a coarse floor covering. In the wool trade fineness is judged visually and it is on this basis that the grades of wool are determined. The relationship of Canadian to English and American grades of wool based on fineness is shown in Table 3 (p. 14).

From a casual observation it would appear that the fibers growing on a sheep's skin are relatively uniform in thickness. However, the fiber thickness may vary from 10 to 70 microns (1 inch = 25,400 microns) within the same fleece (see Fig. 2). Rambouillet fleeces usually average 20 to 25 microns in fiber thickness whereas Lincoln wool will average 35 to 40 microns.

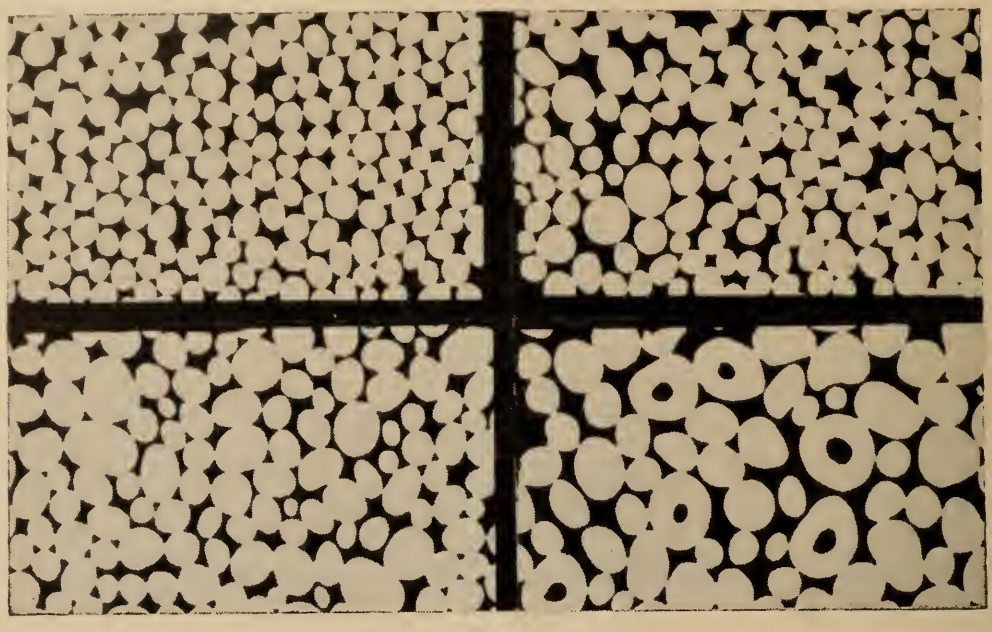

Fig. 2.—Cross-sectional views of fibers showing (1) uniform diameter and shape in fine wool, (2) non-uniform fine wool, (3) non-uniform coarse wool, (4) medullation. Fibers of uniform diameter, oval shape, and freedom from medullation are important in selecting breeding sheep.

Length of Fiber

Good length of fiber is not only essential for the production of a superior worsted yarn but is related directly to the amount of clean wool present in a fleece. Length of fiber is determined to a large extent by the breed of sheep, that is, it is largely an inherited factor but it can be influenced by nutrition. Experiments have shown that a high plane of nutrition will increase the fiber length as much as 170 per cent when compared with that produced on a low plane of nutrition. For maximum production the animal must be well fed.

The following minimum, unstretched lengths are required for the various grades of wool before they can be classed as staple wool.

Fine	2 inches
Fine medium	2½ inches
Medium	3 inches
Low medium	3½ inches
Low and coarse	4 inches

Strength of Fiber

To withstand the stress of manufacture and produce a strong, long-wearing fabric, wool must possess a certain amount of tensile strength. To be classed as a strong wool a high percentage of fibers must pass through the carding, combing, and spinning processes without breaking.

Western wool produced under normal range conditions, where the sheep have received sufficient feed, usually will have adequate strength. However, there are two conditions that may cause a lack of strength. One condition is known as tender wool and in this case the fiber is weak throughout its entire length. This is usually due to the sheep having some chronic disorder, being on a low plane of nutrition for an extended period, or because of old age. The second condition is a "break" or a definite weak spot at a particular location on the fiber. This is noted readily when the wool is stretched, as it breaks squarely across the staple. Sudden illness, starvation during a bad storm, or over-feeding of concentrates are mainly responsible for this condition. In Eastern Canada some difficulty is experienced with a fleece "break" at lambing time. As a result it has become common practice to shear as soon after lambing as possible so that shearing will occur at the break and thus the effect of the break will not be apparent in the fleece.

Crimp

Crimp is the term used to designate the natural waviness of wool fibers. The number of crimps, depending on the degree of coarseness, will vary from approximately 1 to 30 per inch. The more numerous crimps are present in the finer wools. Wool with a distinct crimp will spin more easily and produce a finer and stronger yarn with less wastage than a poorly-crimped wool. Uniformity of crimp is associated with uniformity of fineness and length, and is a sign of superior quality.

Color

The normal color of wool from the improved breeds of sheep is white but a small percentage of it may be brown, black or gray. Generally, the manufacturers' requirements demand that the wools used in processing should scour out completely white so that the future color of the fabric will not be affected by the natural color of the fibers. The presence of dark or off-color fibers in white fabrics causes them to dye unevenly and, in addition, makes them unsuitable for pastel coloring.

The black-faced breeds (Suffolk, Hampshire, etc.) tend to have black or brown fibers mixed with the white portion of the fleece on their legs and head and occasionally throughout the main portion of the fleece. Unless these dark fibers are removed the finished product will not be perfectly white nor will it dye evenly.

Felting Properties

The capacity to felt, one of the characteristics peculiar to wool and only a few other hair fibers, is attributed primarily to the presence of scales on the surface of the fiber and to its crimpy nature. Under the influence of heat, moisture, alkali, and pressure the fibers form a wool pad or cloth that can be used for wearing apparel. Common items illustrating this type of manufacture are felt hats, felt boots, felt socks, and felt cloth. Woven goods also may be subjected to manipulation and pressure in hot, soapy water to produce a felt surface. This process of finishing cloth, known as felting, is commonly employed in the manufacture of meltons and billiard cloth.

Elasticity

Elasticity is the ability of wool to return to its original form after having been forced out of shape by pressure. This is one of the peculiar characteristics of wool that makes it superior to other textile fibers. Highly elastic wool will produce a yarn that will withstand the stress of manufacture more readily, and the garments produced will hold their shape better than those from wool lacking this property. In general fine wools are more elastic than the coarser types.

Yield and Shrinkage

Yield is the amount of clean wool that remains after scouring, expressed as a percentage of the original grease weight. For example, a ten-pound grease fleece producing five pounds of clean wool has a yield of 50 per cent. In other words, yield represents that portion of the raw fleece available for manufacturing purposes. Shrinkage is the weight that wool loses when scoured, expressed as a percentage of the original grease weight. Shrinkage results mainly from the removal of dirt, manure, seeds, burrs, chaff, straw, suint, and wool grease. Since the wool processor is interested only in the quantity of clean wool present in the clips that he buys, he is able to pay proportionately more for the lighter-shrinking wools. For an illustration of shrinkages by grades see Table 5 page 16.

HARVESTING THE WOOL CLIP

Time of Shearing

In Canada, shearing normally is carried out once a year, that is, in the spring after lambing has been completed. However, the exact time of shearing will vary with availability of shearers and the onset of warm, dry weather. It is inadvisable to shear before the weather has become relatively warm, unless adequate shelter is available. Removing fleeces before the danger of late spring storms is over involves the risk of heavy death losses, particularly on the open range in Western Canada. Shearing before warm weather arrives also is more difficult as the grease and dirt in the fleece tend to clog the equipment. However, a few warm days will cause the yolk in the fleece to soften and the shears will operate much more easily. Shearing should be done as early as possible so that the sheep will have time to grow sufficient wool to protect them during the following winter. If shearing is deferred the skin tends to become itchy and this causes sheep to rub. They may roll on their backs and unnecessary death losses may result.

Fundamentals of Good Shearing

In Western Canada (especially in the range areas) shearing normally is done by professional or highly experienced workers who shear sheep for several weeks each year. However, in the eastern and western farm flocks shearing often is done by the owner or by a neighbor who has acquired a certain amount of skill through practice. Skilled operators are essential since good shearing requires that a sheep be handled carefully and that it not be injured while the wool is being removed. If the shearer is experienced the sheep will not struggle while being shorn. An unskilled operator will have considerable difficulty in preventing the animal from struggling.

In shearing there should be no "second cuts" (see Glossary, page 20) as this reduces the length of fiber and consequently its economic value. Also, it is desirable that the fleece be removed in one piece so that it can be tied properly for market.

Great care must be exercised in shearing the udders, particularly of yearling ewes, as it is very easy to cut off the end of a teat and permanently spoil that portion of the udder. If a sheep is seriously cut with the shears the wound should be treated with a disinfectant and, if necessary, sewn.

Methods of Shearing

Hand shearing and machine or power shearing are the two methods in general use. The former involves the use of shears that are operated manually whereas the latter makes use of power-driven shears resembling much-enlarged barber clippers (see cover picture).

There is still some prejudice against power shearing although there is no valid reason for it. Some ranchers feel that this method leaves insufficient wool on the skin to prevent sunburn, or, if storms occur, to prevent the sheep from becoming chilled. This can be overcome, at least in part, by using thick combs in the machine, thus leaving more wool on the skin. Normally, power shearing is faster than blade shearing and is easier on the sheep because it is handled for a shorter time. With trained shearers using power shears the wool is removed with a minimum number of second cuts thus increasing the value of the wool clip. The danger of injury with power shears is no greater; sheep may be cut seriously by either method if the operators are inexperienced or careless.

Shearing Sheds and Equipment

Where large flocks are kept it often is desirable to have a separate, permanent shearing shed. However, any building having a waterproof roof can be used. The lambing shed usually is the most suitable building available for shearing and is one that can be converted readily for this purpose. Provision should be made within the shed for large pens to hold the sheep before shearing; a catch pen for each shearer; a smooth, board shearing floor; and space for sacking and storing wool. Slatted floors are desirable in the holding pens to keep the wool as clean as possible. Through their use the sheep are raised off the ground and have no opportunity of coming in contact with litter or manure on the shed floor. Details of a temporary shearing arrangement using removable floor sections and board panels may be obtained from the Experimental Farm, Lethbridge, Alta.

Preparation of Wool for Market

The main fact to keep in mind in the marketing of wool is that the manufacturer, who is really the purchaser, makes use of the wool only, and not of the foreign material present in the fleece. He buys fleece wool on the basis of its clean wool content, and, with the exception of lanolin, everything else is waste material. Consequently, it is in the interest of the wool producer to keep such waste material to a minimum by all possible, practical means. Careful preparation of the fleeces will result in higher returns from the wool.

The ideal procedure is as follows. When the fleece has been removed from the sheep it should be spread skin side down on a slatted or wire-topped table (Fig. 3). All manure tags and stained pieces in the fleece should be removed and packed separately. Damp tags should never be rolled inside the fleece as they will cause discoloration of any wool with which they come in contact. Face and leg pieces should be separated from the fleece. In the black-faced breeds these areas usually contain black or gray fibers that are particularly objectionable to the manufacturer as they cannot be used in white or pastel-colored goods. Burry, chaffy, or strawy portions of the fleece also should be removed and packed separately.

When the low-grade wool has been removed, the most valuable portion is now ready to be tied. One side of the fleece should be folded in one third of the way and then the other side should be folded in to cover the first fold. The fleece should then be rolled tightly from breech to shoulder to expose the best portion for inspection when graded, (Fig. 3). The rolled fleece should be tied with a paper twine especially made for the purpose; never with binder twine or store string. Paper twine is used because it is easily removed and any particles entangled in the wool disintegrate in the scouring process, whereas other twine may leave fibers that become mixed with the wool and later appear as imperfections in the finished fabric.

Black or brown fleeces should be kept separate, and also the tags and skirtings from such fleeces.

Most producers may feel that this procedure is too complicated. Modifications may be made if these essential points are remembered: (1) wet tags cause damage to surrounding wool in a fleece; (2) strawy, burry, and chaffy fleeces are rejects, whereas if the affected parts are removed by the producer only these parts are degraded; (3) a well-rolled, well-tied fleece leaves a good impression on the buyer; (4) binder twine should never be used to tie a fleece.

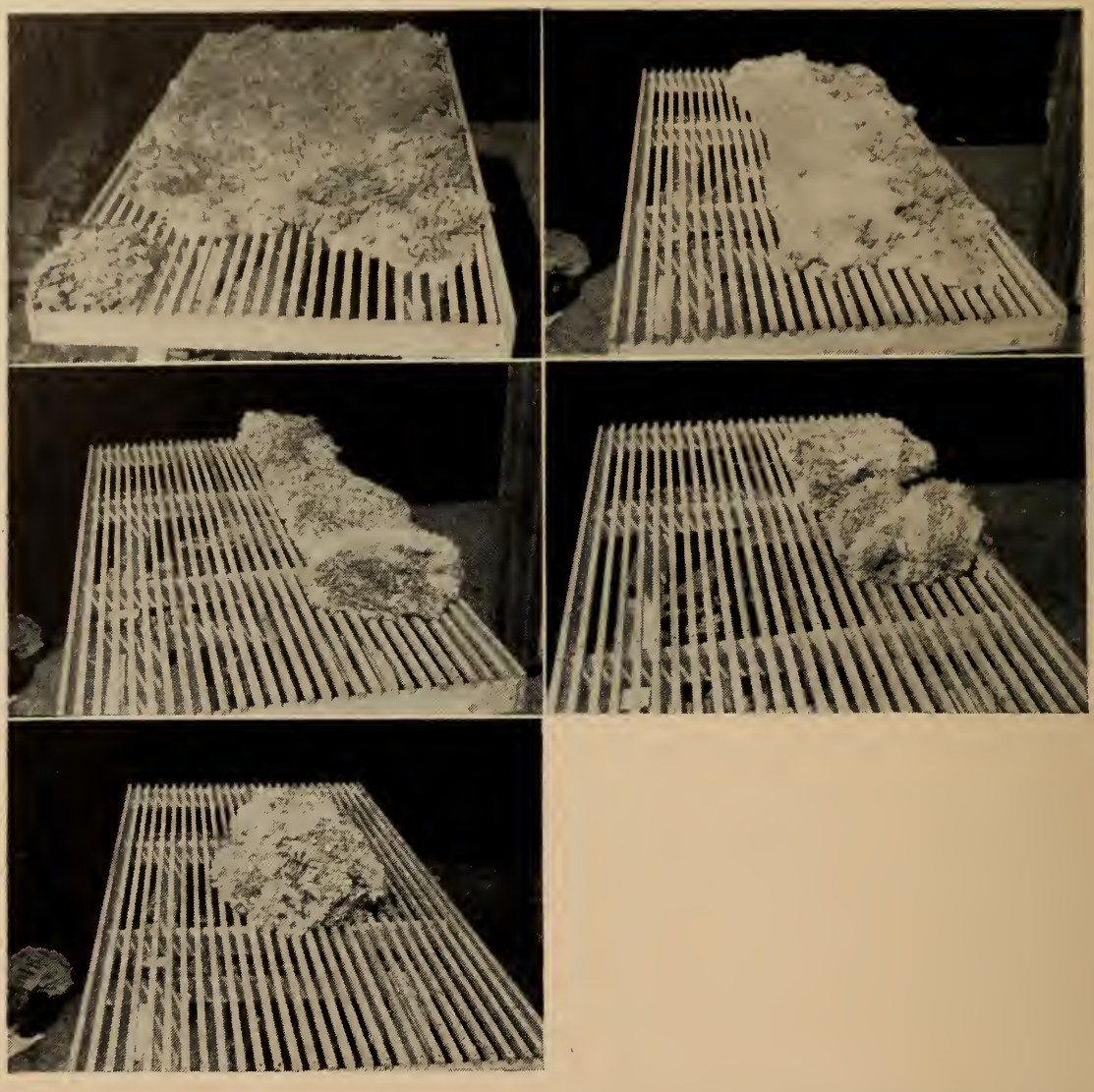

FIG. 3.—Good wool preparation. After the low-grade wool has been removed one side of the fleece should be folded in one-third of the way, then the other side should be folded in to cover the first fold. The fleece should then be rolled from breech to shoulder and tied tightly.

When the fleeces have been prepared for market they are ready for packing in large wool-bags. The upper portion of these bags should be soaked to prevent slippage while being filled, and also should have a handful of tags tied in each bottom corner to facilitate handling of the bags when they are filled. The bag should be mounted on a sacking stand with the upper end supported by a ring that holds it open (see FIG. 4). The fleeces should then be placed in the bag and tramped in firmly. Tight packing permits maximum loading of shipping cars and facilitates handling. When filled, the bag should be released from the ring and sewn with a bag needle and cotton twine. One bag will hold approximately thirty fleeces and when filled will weight between 225 and 350 pounds. Storing the packed wool is an important consideration if it is not to be shipped to market immediately. Wool can be held in storage for relatively long periods of time if kept dry and protected from insects.

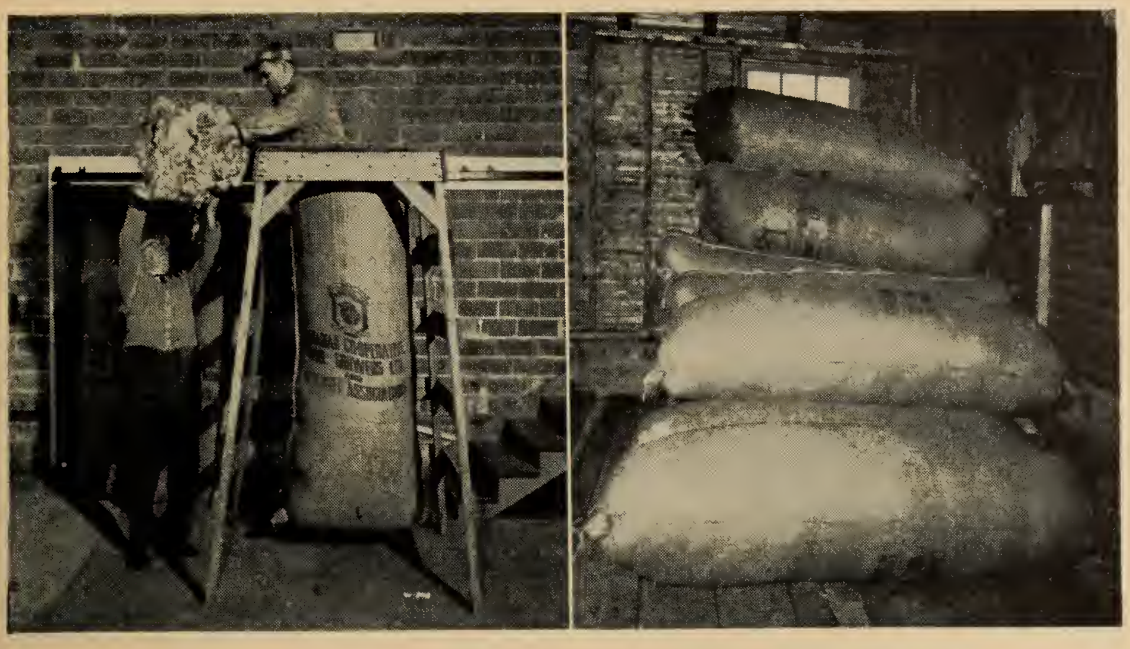

FIG. 4.—For filling, the wool-bag should be suspended on a sacking frame and the fleeces tramped in as tightly as possible. This permits maximum loading of shipping cars. Note the "ears" at the corners of each bag to facilitate handling.

Wool Branding of Sheep

Where branding is necessary the sheep should be moved to holding pens as soon as they are shorn and marked with the owner's brand for identification. It is essential that the sheep be branded with a material that will keep the brand clearly legible for at least one year but, on the other hand, will scour out in the processing of the wool by the manufacturers. Considerable damage to both machinery and materials results from the use of an insoluble paint. These added costs of manufacture reduce the price paid by the manufacturer for wool.

Soluble branding fluids are available at all wool growers' supply houses and only such materials should be used. A minimum number of brands should be placed on the sheep and the fluid used as sparingly as possible. Materials such as tar, lead paint, and crank-case oil should never be used.

Many ranchers prefer to spray for ked control while the ewes are still in the corrals. However, if this is done too soon after branding blurring will occur and the flock may have to be rebranded. The best procedure is to brand first and wait until it is dry before spraying.

THE MARKETING OF WOOL

Classification of Wool

Wool is classified or graded to assist in determining its value and use and to facilitate its sale. Normally, this grading is based on the diameter or thickness of fiber, length of fiber, suitability for particular forms of manufacturing, and the breed of sheep from which it is produced (FIG. 5). However, in Canada, wool also is classified on the basis of origin as follows:

Western range wool—obtained from range flocks,
Western domestic wool } obtained from farm flocks.
Eastern domestic wool }

The wool in these three main classes then is graded on the basis of fiber thickness as shown in Table 3. Also included are comparable English and American grades.

TABLE 3.—Comparable Canadian, English, and American Grades of Wool

Canadian	English (Bradford)	American
Fine	64′s, 70′s, 80′s	Fine
Fine medium	58′s, 60′s	Half-blood
Medium	56′s	Three-eighths blood
Low medium	47′s, 50′s	Quarter blood
Low	46′s	Low quarter blood
	44′s	Common
Coarse	36′s, 40′s	Braid

Within each grade the wool is classified according to shrinkage, length of staple, strength of fiber, and quality. In range wools the main shrinkage classes are: Choice X, Choice, Average X, and Average. Domestic wools are classified as bright, semi-bright, and dark, depending on color, condition, and shrinkage. The length grades of wool are staple and clothing. Staple wools are over two inches in length (unstretched) and are suitable for worsted manufacture, while those classed as clothing are under two inches and are used in the woollen industry. On the basis of these various factors the price per pound to the grower is determined.

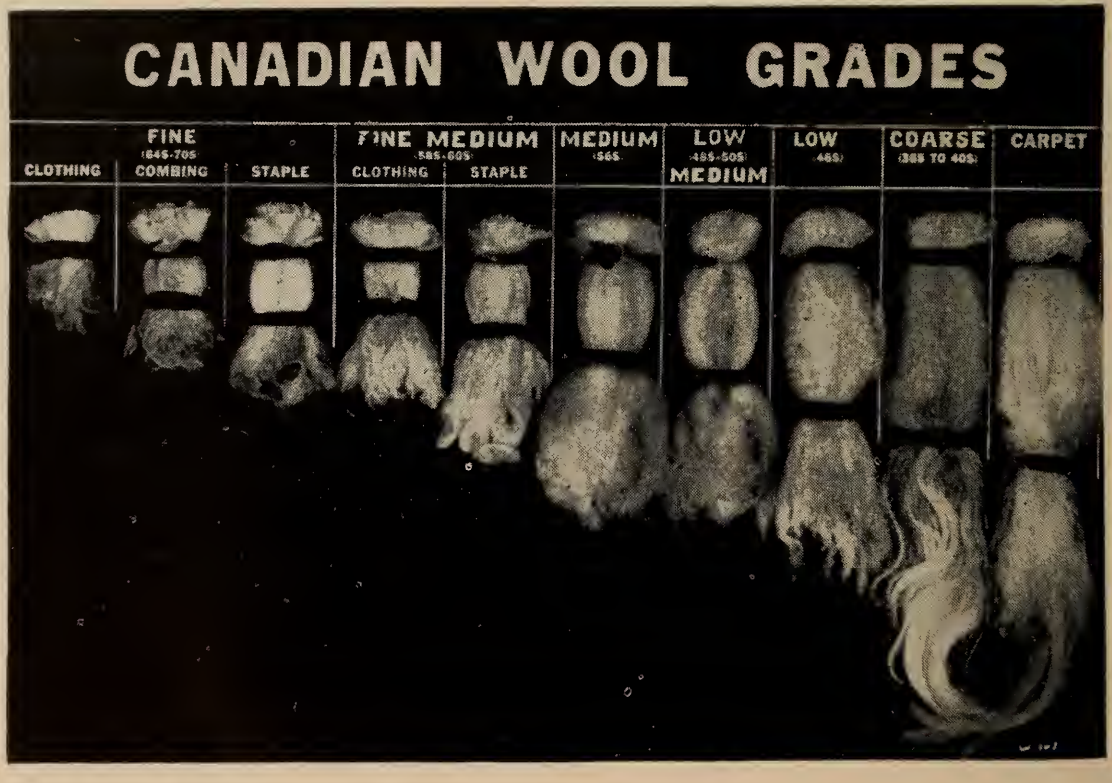

FIG. 5.—The wool grades shown above indicate the general relationship of fineness to length. Note the difference in length between clothing and staple wools. The majority of range wools grade fine, fine-medium, and medium while the domestic wools grade medium, low medium, low, and coarse.

From the standpoint of the manufacturer there is a very general classification of wool based on use, namely, apparel wools which include those used for all types of clothing, and carpet wools which are used for floor coverings.

In addition, there is a broad classification based on wool type; fine, medium, coarse (longwools), crossbred, and carpet. The majority of the common breeds

of sheep fall into these divisions. A classification of the breeds on the basis of wool type is shown below.

Fine wool	Rambouillet, Merino
Medium wool	Hampshire, Suffolk, Shropshire, Oxford, Southdown, Devon Closewool, Ryeland, Dorset Horn
Longwool	Leicester, Lincoln, Cotswold, Romney Marsh, Border Leicester
Crossbred wool*	Corriedale, Columbia, Panama, Targhee, Romeldale, Romnelet, Montadale
Carpet wool	Scottish Blackface, Navajo, Asiatic breeds.

*These have resulted from crossing fine and longwool breeds.

Wool Marketing

In Canada prior to 1914 wool was marketed in a very haphazard manner. Most of the wool was handled by dealers, junkmen, traders and even butchers who acted as middlemen between the growers and the manufacturers. The growers had practically no knowledge of the value of their wool and consequently had little or no alternative but to accept the price offered.

As a result of recommendations by a special commission appointed by the Canada Department of Agriculture to investigate the sheep and wool industry in Canada, Great Britain, and the United States, grading of wool was begun by the Livestock Branch in 1913. The Commission also recommended that Canadian wool be marketed on co-operative lines. In 1914 wool growers began to organize associations for the co-operative marketing of wool, and by 1916, twenty-six associations were handling the growers' wool. However, this method of marketing was still handicapped by a number of factors. As a result of a meeting in 1918 of leading sheep breeders and wool growers from every association the Canadian Co-operative Wool Growers Limited was incorporated. The primary purpose in organizing this agency was to promote the well-being of the Canadian sheep industry by selling wool on a graded basis in order to obtain the highest market value and by improving the product through proper care and preparation. As a result of its activities this organization has had a marked stabilizing effect on wool marketing in Canada.

At the present time approximately 80 per cent of the annual Canadian wool clip is consigned to the Canadian Co-operative Wool Growers Limited, either through its affiliated associations or directly by those who are not members of a local association. The remainder of the wool is purchased chiefly by wool buyers who represent mills or by local hide and fur dealers.

Like the prices of most agricultural commodities those of wool have fluctuated widely during the past 40 years. This fact is well illustrated by the average net prices of shorn wool for the years 1918 to 1957 as shown in Table 4. Immediately succeeeding World War I wool prices reached a high of 62 cents per pound

TABLE 4.—Average net farm price per pound for shorn wool, 1918 to 1957[1]

Year	Price	Year	Price	Year	Price
1918	62	1931	8	1944	27
1919	60	1932	5	1945	28
1920	21	1933	10	1946	28
1921	13	1934	10	1947	28
1922	17	1935	11	1948	29
1923	20	1936	14	1949	29
1924	25	1937	15	1950	54
1925	25	1938	11	1951	74
1926	23	1939	14	1952	36
1927	22	1940	19	1953	38
1928	25	1941	22	1954	38
1929	20	1942	26	1955	35
1930	11	1943	27	1956	38
				1957	41

[1] From Canada Year Book.

which remained as a record until 1951 when the average price soared to 74 cents. This record resulted mainly from unprecedented competition on the world markets for wool to meet military commitments. However, the following year prices dropped to less than half those of the record year.

In addition to yearly variation in wool prices paid, there are differences in the prices paid to different growers in the same year. The main reason for this is the large differences in the shrinkage contained in the various clips. (see Shrinkage, below). It is obvious that two fine-staple clips of equal grease weights, one having a shrinkage of 60 per cent and the other 55 per cent, do not contain the same amount of actual clean wool. Since clean wool is the basis on which final settlement is made it is evident that the grease prices of these two clips will be different. The following formula is used to calculate the relative grease values per pound of the two clips.

$$\text{grease price per pound} = \begin{pmatrix}\text{clean}\\ \text{price}\end{pmatrix} \times \begin{pmatrix}\text{percentage}\\ \text{yield}\end{pmatrix} - \begin{pmatrix}\text{handling charges}\\ \text{and freight}\end{pmatrix}$$

Let us assume that the price of clean wool per pound is $1.00 to the manufacturer and the handling and freight charges are 5 cents per pound. Then the value of the clip shrinking 60 per cent (40 per cent yield) would be:
Grease price $= (1.00 \times .40) - .05 = 0.35$ per pound.
The value of the clip shrinking 55 per cent (45 per cent yield) would be:
Grease price $= (1.00 \times .45) - .05 = \$0.40$ per pound.

These figures show that although the clean value per pound of the wool in the two clips is the same, the grease prices paid to the growers differ by 5 cents because of differences in the amount of impurities.

A difficult problem in wool marketing is the determination of the shrinkage of grease wool. In Canada this is done by estimating the amount of impurities by color, weight, and handle. In the United States much of the wool now is bought and sold on the basis of the core test, in which representative samples are obtained from a number of bags of wool with a coring machine, and scoured in a laboratory to determine the shrinkage. This figure is used in calculating the raw wool price. However, in order that the shrinkage may be determined in this manner, eight to ten bags of wool in any one grade are required. Unfortunately, this handicaps the use of this method on Canadian wools in so far as the grower is concerned but it could be used satisfactorily once the various grade lines have been established.

Table 5 shows the estimated average shrinkages of the grades of wool as published in the "Canadian Wool Grower", June, 1942.

TABLE 5.—Estimated average shrinkages of Canadian wool by grades and classes

—	Eastern Domestic			Western Domestic			Western Ranges	
	Maritime	Quebec	Ontario	Bright	Semi-bright	Dark	Choice	Average
	%	%	%	%	%	%	%	%
Fine combing.....(64's-70's)	—	—	—	—	—	—	60	64
Fine medium combing.....(58's-60's)	—	—	—	—	—	—	56	59
Medium combing.....(56's)	39	41	43-44	45	50	—	51	54
Low medium combing.....(48's-50's)	38	40	41-42	42	46	—	45	48
Low combing.....(44's-46's)	38	40	40	40	44	—	43	45
Coarse.....(36's-40's)	38	39	40	40	42	—	40	42

1. These shrinkages are for well-shorn fleece wool comparatively free from heavy tags and vegetable matter. Sale prices for greasy fleeces always are based on clean wool content.
2. Clothing grades will shrink about two per cent more than their corresponding combing grades.
3. Western Domestic "Dark" grades are made only when wool is unusually dark in color or heavy with soil particles.

CRUTCHING OF EWES BEFORE LAMBING

Many sheepmen crutch ewes shortly before lambing to increase the number of lambs raised and to improve the quality of the wool clip. Crutching involves the removal of the wool on the udder, on the belly area immediately in front of the udder, between the hind legs up to the tail, and, if necessary around the eyes. By this operation about one-half pound of stained pieces and tags is removed. Four to six weeks before lambing is the most suitable time to crutch, but it may be done at any time up to lambing. Care must be exercised in handling the pregnant ewe; that is, the shearers should avoid struggling with the ewes or leaning heavily on them as this may cause an abortion or difficult lambing. Some operators crutch their own ewes, but it is preferable, in large outfits, to hire experienced shearers as the cost is small compared with the benefits derived.

Crutching has been practiced on the flock at the Experimental Farm, Lethbridge, and found to have the following advantages:

1. The danger of infection of the ewe at lambing is reduced. In cases of difficult lambing, assistance may be rendered much more easily.
2. Losses from new-born lambs sucking on sweat locks or dung tags, rather than on the teats, are reduced.
3. Lamb losses from wool balls are minimized.
4. Eye soreness in lambs is reduced.
5. It reduces the danger of maggots after lambing and before shearing.
6. The value of the wool clip is greatly increased by the removal of the sweat locks and tags. The crutchings from range flocks normally are dry at this time, as a result, there is practically no stained wool in the clip. Part of the crutchings from farm flocks usually are wet and therefore should be separated from the dry ones to obtain maximum returns.

SELECTION FOR INCREASED WOOL PRODUCTION

Wool is important as a protective covering for the sheep during the winter months and also accounts for a fair portion of the revenue from the sheep enterprise. Therefore, it deserves consideration in a sound breeding program. Certain characteristics of the wool fiber are related directly to the amount and value of wool, and thus it is relatively easy to select for high wool production particularly when replacing breeding stock. The characteristics to observe are fineness of fiber, length of staple, density of fibers on the skin, and fleece weight.

Fineness of fiber determines the grade of wool produced and thus the price per pound that will be received by the grower. Normally, the finer wools bring a higher price than the coarser types although in rare instances this may not be true because of an abnormal demand. From the growers' standpoint it is important that he select a breed of sheep that will produce the type of wool most acceptable to the market and that still will protect the animal from the rigors of winter. In a wool improvement program uniformity of fineness between different body areas (i.e. breech and shoulder) also is very important as it is indicative of good breeding. From the manufacturing standpoint, uniform wool does not require so much sorting before processing.

Staple length is another fleece characteristic that is related to economic value since all wool within a particular grade must be of a certain length to obtain the highest price. Also, staple length is related directly to the amount of wool grown, that is, sheep with longer stapled wool will have heavier fleeces. Length of wool is a highly heritable characteristic and considerable improvement in fleece weights can be obtained by selecting on the basis of this character. Uniformity of fiber length on the different body regions also should be considered as it reduces losses in combing processes and ultimately means a greater return to the grower.

Selection on the basis of density (the number of fibers growing on a given skin area) also is essential in a wool improvement program. The greater the density the greater will be the amount of wool produced. Large differences exist between sheep in the same flock and with a little experience it is possible to detect the superior sheep. This may be done by grasping the fleece at two or three points along the side and back and judging which sheep produces the larger amount of wool by the quantity held in the hand.

Raw fleece weight is a good index of total wool production since it measures the combined effects of fineness, length, and density. As a result, satisfactory improvement can be made by selecting on this basis. The most accurate culling can be done at shearing time by actually weighing the fleeces and marking the low-producing ewes for fall shipment. If this is not practical an alternative method is to cull in the fall by handling the ewes through a chute and picking out the ewes with short-stapled, open fleeces, hairy breeches, and those that are off-type and of poor quality. Also, ewes with too much face cover should be culled to eliminate wool blindness as this condition markedly affects lamb production (Fig. 6).

Fig. 6.—The sheep on the left is open-faced while the other is wool blind. The United States Sheep Experiment Station, Dubois, Idaho, has found that open-faced range ewes weaned 11 per cent more lambs and 11 more pounds of lamb per ewe bred than ewes with covered faces.

GLOSSARY OF COMMON WOOL TERMS

Apparel Wool.—Wool used in the manufacture of clothing as opposed to carpet wool.

Blacks, or Black Wool.—Gray, brown, or black fleeces which are graded fine, medium, and coarse. Their value is considerably lower than white fleeces.

Blood.—The terms $\frac{1}{2}$ blood, $\frac{3}{8}$ blood, $\frac{1}{4}$ blood, and low $\frac{1}{4}$ blood, are American grades of wool. These names indicate degree of fineness and now have no relation to the breeding of the sheep from which the wool was shorn although originally they indicated the amount of Merino breeding present in the native sheep.

Braid.—The coarsest grade of the United States grades of wool. It is equivalent to the Canadian grade called "coarse".

Breech Wool.—Wool, usually the coarsest in the fleece, from the rear and lower parts of the hindquarters.

Bright Wool, Semi-bright, and Dark.—Sub-classes of domestic wool designating the color, condition, and shrinkage.

Bucks or Buck Wool.—The wool from rams. It has a characteristic odor and usually has a higher shrinkage than ewe wool.

Burry Wool.—Wool that contains burrs. Such wool has a higher shrinkage, must be carbonized before it can be used, and as a result is worth less than burr-free wool.

Carbonizing.—A process by which burrs and other vegetable matter are removed from wool by chemical treatment (usually acids). Wool that requires this treatment is called carbonizing wool.

Carpet Wool.—A coarse wool used primarily in the manufacture of floor coverings but some also is used in coarse wearing apparel; i.e. Scottish Blackface wool.

Character.—A term denoting a uniform and distinct crimp in wool fibers.

Clean Basis.—In the United States price quotations are made on the basis of the amount of clean wool contained by a particular lot of wool; i.e. clean basis. In Canada the percentage yield of clean wool is estimated and then the grease wool price is calculated from this estimate and the value of the clean wool per pound.

Clip.—Refers to the wool produced from one flock or to the total annual national or world production.

Clothing Wool.—Wool that is too short to be combed (under 2 inches in length), and hence is used in the manufacture of woolen and felt goods. This wool is not so valuable as combing or staple wool.

Coarse.—The coarsest (36's-40's) of the Canadian wool grades and equivalent to Braid in the American system.

Condition.—Refers to the amount of grease and dirt in wool. Wool that is heavy in condition will have a high shrinkage when scoured.

Cotted Fleeces or Cotts.—These are fleeces in which the fibers have become matted or felted together while on the sheep. They occur more commonly in the coarser wools than in the finer types. The condition may be caused by unfavorable weather conditions, sickness, and lack of yolk to protect the fiber.

Crimp.—The natural waviness of the wool fiber.

Crutching.—A process of removing the wool from the udder, between the hind legs, and breech prior to lambing in order to improve the wool clip and reduce lamb losses. The wool removed is known as crutchings.

Dead Wool.—Wool removed from sheep that have been dead for some time. It usually is defective, has a strong odor, and sells at a lower price. Murrain wool is that from decayed carcasses and is practically useless and of no value.

Defective Wool.—Wool that contains burrs or has been damaged by insects, disease, fire, or water so that it has a lower value after scouring.

Domestic Wool.—Refers particularly to wool produced on farms in contrast to that produced on the range.

Down Wool.—Medium wool obtained from those breeds of sheep originating in the downs of England.

Felting.—The interlocking of wool fibers caused by the action of heat, moisture, chemicals, and friction.

Fine Wool.—The finest grade of wool, normally obtained from the Merino or its sub-breeds.

Fleece.—The wool from one sheep.

Frowsy or Mushy Wool.—Wool that is dry, weathered, and wasty.

Grease.—See wool grease.

Grease Wool or Raw Wool.— Wool as it is shorn from the sheep and before scouring.

Kemp.—A short, brittle, chalky white fiber found mixed in some fleeces. It is a serious defect because it lacks strength and will not take dyes the same as wool.

Lanolin.—Refined wool grease used in the cosmetic and lubricant industries.

Locks.—Pieces of wool that become detached from the fleece in shearing or handling.

Longwool.—Wool from certain British breeds; i.e. Lincoln, Leicester, Cotswold, etc.

Pelt.—A wooled sheepskin.

Pulled Wool.—Wool that is removed from the skins of slaughtered sheep.

Scouring.—A process of removing dirt and grease from wool by means of a solution of soap and sodium carbonate.

Second Cuts.—Short pieces of wool produced by cutting the staple twice in shearing.

Semi-bright.—Domestic wool that lacks brightness because of the environment under which it was grown. It has a higher shrinkage than bright wool but is just as white after scouring.

Shearling.—English term for yearling sheep after it has been shorn. Common method of naming age of sheep in Canada is: one-shear, two-shear, three-shear, etc.

Shrinkage.—The loss in weight due to scouring, expressed as a percentage.

Skirting.—Removal of the inferior and heavy shrinking portions of a fleece after it is shorn to improve the quality of the clip. Commonly practiced in Australia.

Spinning Counts.—English system of wool grading based on the number of hanks of yarn that can be spun from one pound of clean wool. A hank is 560 yards long.

Stained Wool.—Wool that has been stained mainly by urine. As a result it cannot be scoured completely white and is subject to a price discount.

Staple.—Means the same as combing wool. Also refers to a bundle of wool fibers that cling together naturally in the fleece.

Suint.—The water-soluble perspiration salts found naturally in the fleece. It forms a portion of the yolk.

Tags.—Heavy manure-covered locks of wool.

Tare.—Weight of wool sacks deducted before settlement is made for the wool.

Tender.—Wool that is weak and breaks easily. The causes of tender wool are pour nutrition or sickness.

Virgin Wool.—Wool that is used in fabrics for the first time in contrast with wool that has been reclaimed from previously-made materials.

Wasty Wool.—Wool that will lose much in manufacturing because it is weak, short, or tangled.

Wool Grease or Fat.—A greasy material produced by the fat glands in the sheep's skin that coats the wool fibers. Wool grease and suint together are known as yolk.

Woolens.—Fabrics made from uncombed wool.

Worsteds.—Fabrics made from combed wool.

Yield.—The percentage of clean wool after scouring: 100—shrinkage=percentage yield.

Yolk.—The natural secretions of sheep's skin, i.e., suint and wool grease combined.

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