



An Australian Representative

WOOL

THE RAW MATERIALS OF THE WOOLEN
AND WORSTED INDUSTRIES

BY

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SECOND EDITION

REVISED BY EDWARD W. FRANCE

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TO

Mr. Theodore C. Search

IN GRATEFUL APPRECIATION

OF HIS INTEREST IN

TEXTILE EDUCATION

THIS VOLUME IS

RESPECTFULLY DEDICATED

BY THE AUTHOR

PREFACE

The following pages have been prepared for use as a text book in connection with the course of study in "The Raw Materials of the Wool Industries" at the Philadelphia Textile School. Numerous books on general textiles and on woolen and worsted spinning touch lightly on the raw materials of these important branches of the textile industry in a general way, but in none of them has the subject been covered in the detailed manner which its importance deserves, hence an effort is here made to follow the various raw materials of the woolen and worsted industry from their origin to the point where actual machine processing begins.

Considerable information was obtained from the Report of the Tariff Board on Schedule "K" in 1912; Matthews' "Textile Fibers"; Wright's "Wool-growing and the Tariff"; and various United States government reports and pamphlets by the Animal Husbandry Division. The statistics contained in the Appendix are mostly from the Bulletins of the National Association of Wool Manufacturers.

A large number of excellent photographs, generously furnished for illustration by Hon. John Bright, Canadian Live Stock Commissioner, are highly appreciated. The sheep and goat pamphlets issued by his department, cover their subject in a thorough manner.

Information of great value, including the various classified lists of sheep, was generously furnished by Mr. W. T. Ritch, the well-known Australian wool expert. Several passages were taken from the report to the Canadian Government in 1911 by Messrs. W. A. Dryden and W. T. Ritch on "The Sheep Industry in Canada, Great Britain and United States." Mr. F. M. Jennings, at present with the Canadian Live Stock Branch and for many years Instructor in The Wool Grading and Sorting Course of the Philadelphia Textile School, furnished considerable valuable information.

A large portion of the introduction is from a lecture delivered before the Franklin Institute by Mr. Theodore C. Search, former President of the Pennsylvania Museum and School of Industrial Art.

The descriptions of various breeds of sheep were improved by reference to Dr. Carl W. Gay's recent book, "The Principles and Practice of Judging Live Stock." Several passages are quoted from Dr. Gay's book, and acknowledgment of the privileges extended by the author and publisher is a pleasant duty.

Thanks are also extended to the Bureau of Animal Industry of the United States Department of Agriculture; the Commercial Museum, Philadelphia; and numerous individual sheep breeders, firms, and sheep breeders' associations, who generously furnished photographs. To Mr. Richard S. Cox, thanks are extended for the drawings which are reproduced.

The manuscript has been carefully edited by Mr. Edward W. France, Director of the Philadelphia Textile School, and thanks are extended for his co-operation and suggestions in its preparation.

In conclusion, it is hoped that the book may prove useful to laymen seeking knowledge of the raw materials of the woolen and worsted industries, and that it may also be of value as a reference book in educational institutions conducting textile, agricultural, commercial, industrial, and domestic art courses.

PHILADELPHIA, January, 1917.

PREFACE TO SECOND EDITION

Essentially, the second edition of Mr. Hart's highly esteemed work on "Wool" is a reprint. However, it has appeared advisable to make a rearrangement of certain chapters, more nearly to approximate actual sequence of thought and practice. It has also seemed fitting that certain paragraphs should be expanded, the better to present phases of the subject for the consideration of the layman, thus continuing to strive toward the original

goal—the making of a book of practical value. Insofar as it has been advisable and possible, tables in the appendix have been revised or replaced by others more up-to-date or more comprehensive. Grateful acknowledgment is made for the use of two illustrations from Dr. F. H. Bowman's work on "The Structure of the Wool Fiber," as well as to all those who have so freely assisted in the furnishing of the material that has made the revision possible.

E. W. F.

September, 1924.

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WOOL

WOOL

The Raw Materials of the Woolen and Worsted Industries

CHAPTER I

INTRODUCTION.—STRUCTURE, PROPERTIES AND CHARACTERISTICS OF WOOL

1. **Introduction.**—With the exception of the tropics, the world has always been wholly or partly dependent on wool for its clothing. Wool is the thick, wavy covering of the sheep. The sheep has always been one of the most valuable animals to mankind, furnishing both food and clothing. Breeding was originally directed to improve the fineness and weight of the fleece. Merinos were used for this purpose, but such types develop small carcasses and meat of poor quality. Demand for mutton, and the lack of profit in raising sheep only for their wool, has caused the cross-breeding of many types to suit environment and fancy, but with the object in view of founding the best type to give the greatest financial return to the sheep grower. These efforts have been successful, and the bulk of the sheep now bred, especially in the United States, are good mutton sheep first, with the quality of the wool produced a second consideration. With the high prices of wool since August, 1914, caused by the European War, breeding to improve the wool has received a great stimulus, especially in this country.

Aside from its other valuable properties, which will be considered directly, the chief value of wool lies in its ability to be spun into yarn. Other animals produce valuable textile fibers, a few of which are the goat, alpaca and camel, but for general purposes the fiber is not nearly so useful to mankind as the wool of the sheep. The character of fiber produced in most cases is not adapted to the many uses of wool, and furthermore, the number of animals producing such fibers is inadequate for the world's demands, and in many instances, only a small portion of the

world is adapted to the successful raising of these animals. It must be remembered that sheep are found, and in all civilized countries cultivated, in practically every inhabitable portion of the world. Nearly all animals have a coat of hair covering their bodies, and the dressed pelts with the hair or fur attached are of great value and use in the form of coats, muffs, neckpieces, gloves, robes, trimmings, etc., but these same fibers are of small value as a raw material for textiles, as they do not possess spinning properties.

It is a curious fact that the history of sheep is closely linked with that of man and the evolution of the one is involved in as deep and impenetrable mystery as the other. Whether the domestic sheep that roams our hills today has descended from the wild goat, or whether it is simply "sui generis," is a question which probably will never be decided. Naturalists are far from certain on the question, although for want of a determined theory, they have agreed that the *Ovis Ammon*, or *Mouflon* of Southern Europe and Northern Africa, were the progenitors of the *Ovis Aries*, or domestic sheep. This statement is the one generally accepted. It is a significant fact, however, that while all the varieties of domestic sheep known today present striking resemblances to each other, yet they have few if any characteristics in common with the *Ovis Ammon* or *Argali* of Asia and America, or *Ovis Musmon* or *Mouflon* of Southern Europe and Northern Africa.

As the wool of the Merino sheep has become an important element in the fabrics of the civilized world, it may be interesting and instructive to trace the history of these animals. While it is true that they are native of Spain, yet it is an historical fact that they were greatly improved by crossing with Italian sheep which were brought into Spain during the reign of the Emperor Claudius by an Italian named Columella. He removed from Tarentin in Italy to the southern part of Spain, bringing with him the first flock of these Italian sheep.

When Rome was in her glory, Pliny states that the sheep of Apulia, on the Bay of Naples, produced the best wool in the

world, while the wool of the Grecian sheep was second best, and that of the Milesians, an Asiatic race, was inferior to either of the others.

The Apulian or, as it was afterward called, the Tarentine sheep, produced a wool unequaled in its day. From birth, the sheep were given the most extravagant and finical care. To produce an exquisitely beautiful and wavy gloss to the wool, their bodies were protected by skins or other coverings. In order to examine the condition of the animal, it was frequently uncovered, the fleece drawn out, parted, and combed, to prevent matting, while it was frequently moistened with the finest oil and even with wine, and washed three or four times a year. The greatest care was bestowed on the sheep houses, constant washing and fumigation being considered imperative. When two years old, lambs were killed, it being thought that the fleece was then in its finest condition. This shows what extraordinary and painstaking care was taken to produce clothing for the wealthy and refined Roman. With the advent of cotton and silk, however, better adapted as they were for clothing in sunny Italy, we find the Italians gradually neglecting their sheep, until finally they become more valuable for food than for wool.

It was from this carefully nurtured Apulian sheep that Columella selected the animals that he carried to Spain, subsequently crossing them with the native Spanish sheep, thus establishing a new variety, known today as Spanish Merinos.

2. Early Sheep Husbandry in Spain.—In A. D. 711, the Saracens established themselves in Spain. They were a prosperous people, living in barbaric splendor and reveling in luxuries unknown to the greater part of Europe. Among the industries which their extravagant living fostered was woolen manufacturing, which increased to such an extent that in the thirteenth century there were in the small town of Seville no fewer than sixteen thousand looms. A century later we find the woolen industry fully established in the northeastern part of Spain; and the fine cloths of Barcelona and Tortosa in Spain and of Per-

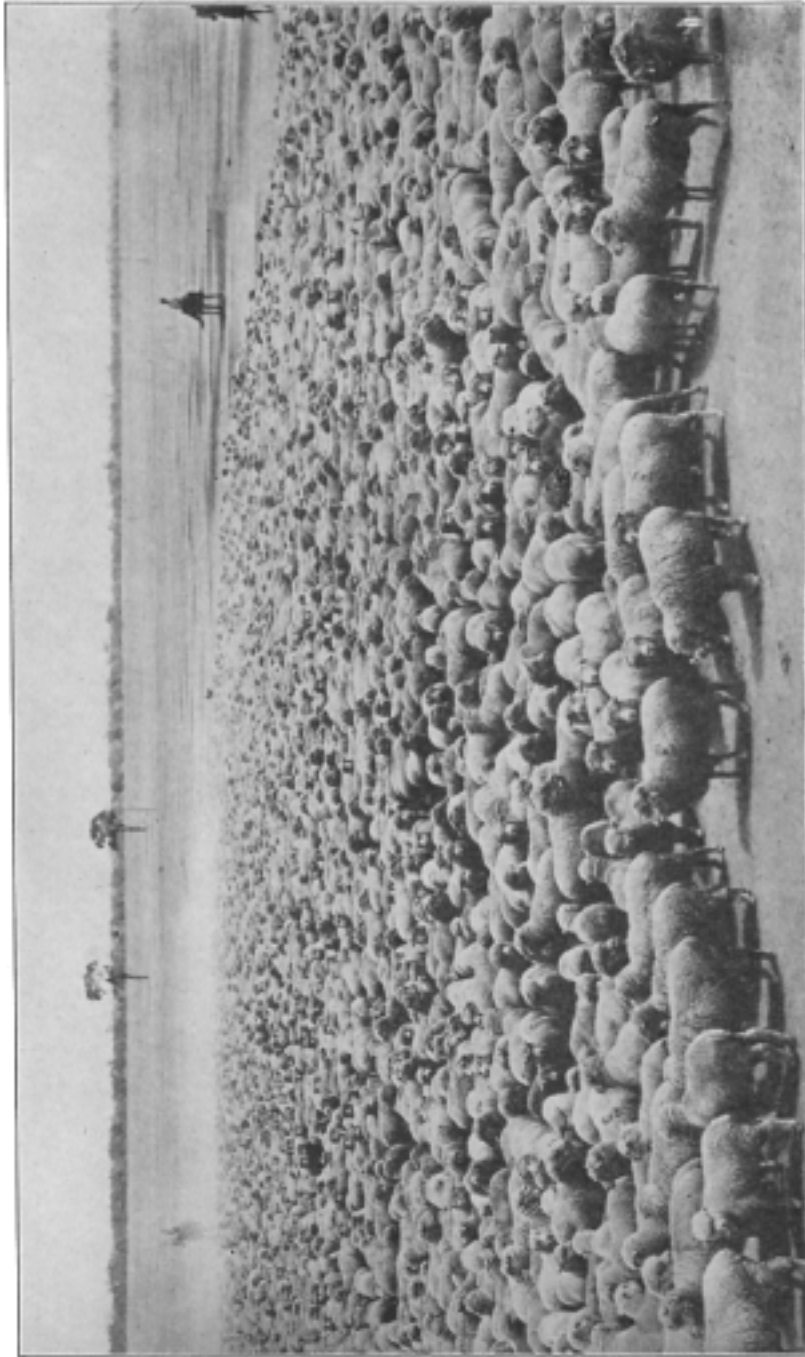


FIG. 1.—Flock of Sheep, New South Wales, Australia.

pignon in France were renowned all over Europe for their excellence. In process of time, the Saracens were driven from their Spanish strongholds, and with them vanished the industries they had so liberally supported. It is said that Ferdinand V banished one hundred thousand artisans because they were Moors, and Philip III drove out three-quarters of a million, the majority of them being weavers and their families. The busy hum of Seville's sixteen thousand looms was forever silenced. Many times since Spain has endeavored to revive the woolen industry, but without success. Its glory departed with the enterprising if voluptuous Saracens.

Naturally the sheep husbandry suffered with the woolen industry, but not sufficiently to prevent the Spanish wool from being still the most valuable fine wool then known. Notwithstanding the mutations of fortune, they illustrated then as today the omnipotence of blood.

The Spanish sheep were of two kinds, stationary and migratory, or *Estantes* and *Transhumantes*. The stationary were of two breeds, one bearing a coarse wool about eight inches long, and the other a fine, short wool. There were also mixed and intermediate breeds. The habitat of the short-wooled sheep seems to have been in *Estramadura* and *Andalusia*, in the south of Spain. The term migratory, or *Transhumantes*, as applied to sheep, arose from the fact that the Spanish shepherds, desiring to produce the finest staples, drove their sheep from southern to northern pastures in the spring, returning them in the fall. The distance traveled was at least four hundred miles, and as the number of sheep was about ten million, it may be safely presumed that forty to fifty thousand men were employed in this semi-annual migration. In the middle of the fourteenth century, laws were enacted governing the migration, and a tribunal consisting of the chief proprietors of the flocks was established. Certain rights and privileges were granted, among them being the right to graze on all open and common land that lay in the way, and also the privilege of a path ninety yards wide through all enclosed and cultivated lands between *Estramadura* and *Leon* in the north

of Spain, or Soria in the northern central part. During a migration, all persons were prohibited from traveling this road. This law remained in full force until 1836, when the proprietors of flocks were forced to keep to the ordinary road. Each herd consisted of about ten thousand sheep, divided into sections of one thousand each. Each section had an overseer, and each herd a captain. The migration began in April, and the return was made late in September, from five to six weeks being required to accomplish the tedious journey. The Leonese sheep, having passed the winter at Estramadura, crossed the Tagus River at Almarez. Shortly after this passage, the shearing took place, delaying the journey only about a day.

Their method of shearing is interesting. The building in which it was done consisted of but two rooms, one of which was the sweating room, and the other the shearing room. In the sweating room were placed one thousand sheep, while one hundred and fifty to two hundred shearers awaited them in the adjoining room. By crowding the room with such large numbers, the sheep were thrown into a profuse perspiration, causing the yolk in the wool to run freely and making the wool easy to cut. The shearing finished, the journey was resumed.

As the object of the migration was to increase the fineness of the wool by maintaining constantly good pasturage and equable temperature, it is interesting to note that authorities differ as to the value of the migration. Some claim that the stationary flocks in Spain and elsewhere produced equally good wool with the Merinos. However, it is certain that the Spanish Merino stands alone in the stability of its traits and breeding. No other breed of sheep has left so deep an imprint, and its introduction in other countries forms a most interesting and curious narrative.

3. Influence of Spanish Merinos.—In 1723 the Swedish Government imported a flock of Merino sheep. The sheep raisers viewed their advent with suspicion, and it was not until premiums for the best sheep and wool were offered by the government, that the absurd jealousy of the shepherds received a final death-blow.

Soon the flocks increased, and along with them came the manufacture of fine cloth.

France, in the seventeenth century, endeavored to introduce the pure breed of Merino. No less a personage than Colbert, the shrewd and far-seeing advisor of Louis XIV, brought several Merinos to France at his own expense. So great was the opposition, however, that he reluctantly abandoned the enterprise. In 1786 the French Government imported 376 ewes and lambs, placing them at Rambouillet, near Paris. The enterprise was an entire success, and the sheep thus introduced have exercised a commanding influence on the character of French wool. As France is separated from Spain by the Pyrenees, it is not at all surprising to find in southern France large numbers of cross-breed Merinos, and this influence has extended even to the central provinces.

Norway, about the middle of the eighteenth century, succeeded in introducing the Merino, much to the improvement of her flocks. About 1780, Denmark introduced a few Merino sheep, but mismanagement made their culture a failure. Some seventeen years later, however, the government brought in 300 Merinos, and so successful has been their culture, that the Danes now regularly export the finest quality of wool.

In 1765, the Elector of Saxony imported 300 sheep, and placed them on his own farm near Dresden. These were subsequently crossed with the Saxon sheep, much to the improvement of the Merino. Still the purity of the Merino was not obliterated, and although they became perfectly naturalized, the fleece of the Saxon sheep exceeded the Merino in fineness, so that the very word Saxony is instantly associated with the thought of super-excellent quality in wool and woolen materials.

In 1756 the Silesian sheep were introduced into Magdeburg, Prussia, and in 1768 the Saxony Merino, and 1778 pure Spanish Merino by M. Fink. The Prussian Government, after watching the experiment for a number of years, finally, in 1768, imported 300 sheep from Spain, and distributed them among the farmers, but indifference and ignorance killed them. M. Fink's enterprise,

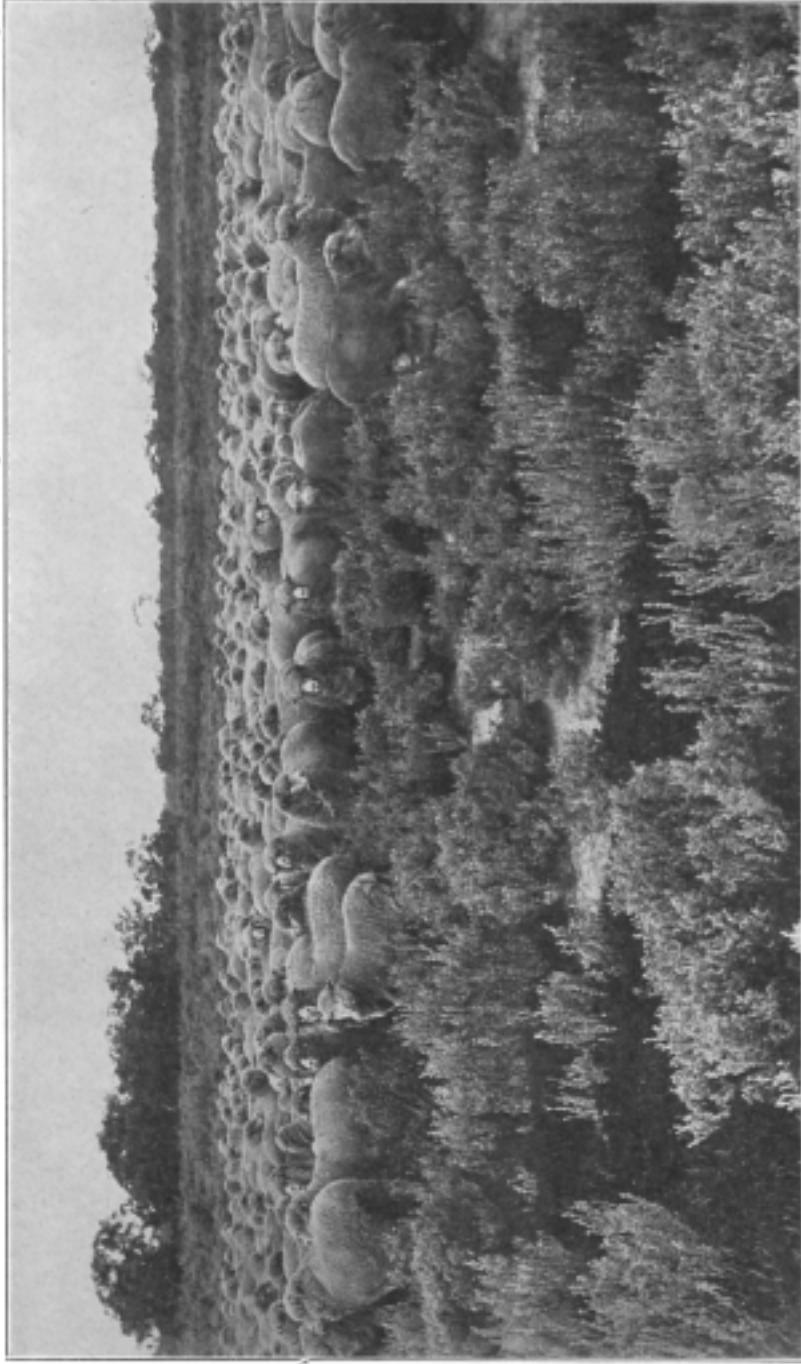


FIG. 2.—Australian Merino Ewes in Saltbush; New South Wales.

however, was successful, and soon the government employed him to buy 1000 of the choicest Merinos and establish the breed.

The Silesian sheep history is almost identical with that of Saxony. A native breed existed there which Count Von Magno improved by the introduction of the Merino, until he produced wool which today fairly rivals the Merino of Saxony in fineness.

The Empress Maria Theresa introduced the Merino into Hungary in 1775, and with such success that today the Hungarian wool is a rival to the Spanish Merino.

Hanover followed in the Merino improvement, and in every part of Germany the Spanish Merino has improved the fleece. In 1789 the Spanish Merinos were taken to Belgium and Holland.

In 1791 England imported a number of Spanish sheep, and the character of the wool seemed unchanged by the transfer. Merino sheep soon sold at enormous prices. In 1811 there was formed the Merino Society, with fifty-four vice-presidents. Premiums were offered, and, as it afterward proved, this very action sounded the death-knell of the Merino sheep in England. Not only were premiums offered for the pure Merino, but for the crossbreeds, and it was found that under the system of artificial breeding there carried on, in order to bring sheep early and profitably into the market, something more was needed than a wool producer. The Merino is undeniably great as a fleece producer, but it matures late and fattens slowly. It was proven that mutton sheep more than divided the honors with the fleece producer, and that the combination of carcass and wool which produces the greatest financial return was the best for a country like England.

The most remarkable event in the history of Merino sheep was its introduction in 1810 into Australia. For twelve years the colonists were at work improving the native breed, and had accomplished wonders. Finally they decided to try the influence of the Merino, and the cross was greatly to their advantage. In three years, the number of sheep almost doubled, and in twenty-eight years had increased almost an hundredfold. The sheep

itself improved, the climate and soil both favoring it; and soon the wool became famous throughout the world.

In 1802, Dr. David Humphreys, of Derby, Connecticut, returned from Madrid, where he had been acting as American ambassador since 1789. He brought with him a flock of Merino sheep. Prior to Humphreys' importation, a few of these sheep were imported; but only one animal became identified with our flocks, the remainder having been killed for food.

In 1809 and 1910, 4000 Merino sheep were imported into this country. Sheep were introduced at Jamestown, Va., from England in 1609, and in 1633 they were first brought to Boston; but these were the ordinary English breed, being a coarse variety of the Leicester.

South America and South Africa have both successfully introduced the Merino, and produce large quantities of Merino wools.

The Merino sheep has left its imprint upon nearly all the European countries, North and South America, Australia and South Africa. In Asia, it has made but little progress, for here the prevailing variety is quite a different animal. The fat rump and broad-tailed sheep abound, more especially the latter, and there is every reason to suppose that little change in the animal has taken place for centuries. Syria was the central point around which congregated the early flockmasters, and here the fat-tailed sheep are found in abundance. They are so termed from a great accumulation of fat in the tail, the weight of this appendage alone being about one-third the weight of the whole sheep. In some of the sheep the fat covers the haunches; others have two large lobes of fat at the side of the tail. For the most part the wools from them are coarse, and form a very considerable portion of what is called carpet wool. Usually these carpet wools are more or less a product of mountain districts or desert regions, and go hand in hand with an inferior civilization. They are the class of wools raised by the nomads of Asia, by the fellahs of Egypt, and by the northern Russians. The sheep are all susceptible of improvement to a great degree, as is shown in the Natal and Cape wools of South Africa.

4. **Ancient Breeds and Original Types of Sheep.**—It is an impossibility to give an absolutely correct list of the original breeds of sheep. Many varieties of wool sheep especially were migratory and became crossed in the course of time, while small bands of other migratory sheep became located in fresh surroundings, rapidly changed, and finally developed new types and different characteristics. In the early stages of civilization sheep were taken from one country to another by nomads and exchanged for other commodities. Different climatic conditions and changed circumstances again produced fresh types. No animal in existence has the power to adapt itself to local conditions like the sheep, and no animal is so readily influenced by environment. Under these circumstances it is impossible to get right back to the original breeds, and the very best authorities can only give us a vague idea of the different breeds of sheep existing when they were first partially domesticated by primitive civilization.

Archer, who made an exhaustive study of this subject, gives thirty-two varieties, of which four are inhabitants of Europe, fifteen of Asia, eleven of Africa and two of America. Bowman compiled a classified list of these thirty-two varieties, and it is generally regarded as the best list of its kind. Other authorities have recently made a more exhaustive study of distinct breeds and original types, and they make a wider division. These additional varieties are included in the territorially classified list given below and brings the total number up to forty-four.

Some of these ancient breeds have become quite extinct without leaving any trace of relationship behind them, while others have undergone such changes during the past century that the original type is now unrecognizable. These numerous changed types are chiefly confined to Eastern Europe, and are now recognized as distinct breeds with a separate classification. It is estimated that about twenty of the ancient breeds can still be found in Asia and Northern Africa, but the original types have undoubtedly undergone considerable change.

ANCIENT BREEDS AND ORIGINAL TYPES OF SHEEP

(Territorially classified)

I. EUROPE

1. The Spanish Merino Sheep. (*Ovis Hispaniensis*.)
2. The Common Sheep. (*Ovis Rusticus*.)
3. The Domestic Sheep. (*Ovis Aries*.)
4. The Crimean Sheep. (*Ovis Congicaudatus*.)
5. The Musmon Sheep. (*Ovis Musimon*.)
6. The Cretan Sheep. (*Ovis Strepsiceros*.)
7. The Dwarf Sheep of Scandinavia.
8. The Iceland, or "Double Fleeced" Sheep.

II. ASIA.

1. Hooniah, or Black-faced Sheep of Thibet.
2. Cago, or Tame Sheep of Cabul. (*Ovis Cagia*.)
3. Nepal Sheep. (*Ovis Selingia*.)
4. Curumbar, or Mysore Sheep.
5. Garar, or Indian Sheep.
6. Dykhum, or Deccan Sheep.
7. Morvant de la Chine, or Chinese Sheep.
8. Shaymblair, or Northern Mysore Sheep.
9. Broad-tailed Sheep. (*Ovis Laticaudatus*.)
10. Many-horned Sheep. (*Ovis Polyceratus*.)
11. Pucha, or Hindostan Dumba Sheep.
12. The Tartary Sheep.
13. The Javanese Sheep.
14. Borwall Sheep. (*Ovis Barual*.)
15. Short-tailed Sheep of Northern Russia.
16. Argali Sheep. (*Ovis Ammon*.)
17. The Pigmy Sheep of Siberia.

III. AFRICA.

1. Smooth-haired Sheep. (*Ovis Ethiopicus*.)
2. African Sheep. (*Ovis Guinensis*.)
3. Guinea Sheep. (*Ovis Ammon Guinensis*.)
4. Zeylan Sheep.
5. Fezzan Sheep.
6. Congo Sheep. (*Ovis Aries Congensis*.)
7. Angola Sheep. (*Ovis Aries Angolensis*.)
8. Zenu, or Goitred Sheep. (*Ovis Aries Steatinorius*.)
9. Madagascar Sheep.
10. Bearded Sheep of West Africa.
11. The Fat-rumped Sheep of Egypt.
12. The Fat-tailed Sheep of South Africa.
13. Morocco Sheep. (*Ovis Aries Numidæ*.)
14. The Tunis, or Pendulous-eared Sheep.
15. The Somali, or "Half-black" Sheep.
16. The Aoudad, or "Intermediate." (*Ammontragus Tragelaphus*.)

IV. AMERICA.

1. Brazilian Sheep.
2. West Indian Sheep of Jamaica.
3. The Big Horn Sheep of the Rockies. (*Ovis Montana*.)

PHYSIOLOGY AND STRUCTURE

5. **Physiology of the Wool Fiber.**—Wool, in common with all kinds of hair, is a growth originating in the skin or cuticle of the vertebrate animals, and is similar in its origin and general composition to the various other skin tissues to be found in animals, such as horn, nails, feathers, etc. Wool is an organized structure growing from the root situated in the dermis or middle layer of the skin, its ultimate physical elements being several series of animal cells of different forms and properties.

The root of the wool fiber is termed the hair follicle; it is a gland which secretes a lymph-like liquid, from which the hair is gradually developed by the process of growth.* The hair follicle also secretes an oil, which is supplied to the fiber during its growth and serves the purpose of lubricating its several parts, giving it pliability and elasticity.

In conjunction with the hair follicle there also occur in the skin numerous sebaceous glands which secrete a fatty or waxy substance, commonly known as wool-fat. This substance gradually exudes from

the glands and coats the surface of the wool in rather a considerable amount. It affords a protective coating to the fiber, which serves to preserve the latter from mechanical injury during its growth, and also prevents the several fibers from becoming matted and felted together. In the preparation of wool for manufacture,

* If the form of a hair is considered, it will be noticed at the base to have an egg-shaped swelling or root, and just above this a rather contracted portion, or neck. The hair attains its greatest breadth usually in its uppermost third. The majority of hairs shows considerable differences in appearance when examined along their length (Höhnel).

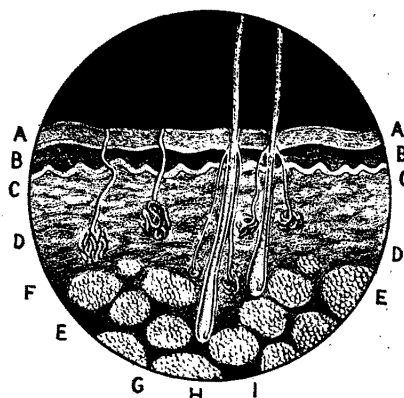


FIG. 3.
Section of Skin.
25 Diameters.

- A—Cuticle.
- B—Rete mucosum.
- C—Papillary layer.
- D—Corium.
- E—Subcutaneous adipose cells.
- F and G—Sudoriparous glands.
- H and I—Hair follicles.

this fatty covering has to be removed, the operation constituting the ordinary process of wool scouring, the object being to leave the fiber clean and free from adhering substances. There is also a wool-oil which is contained in the cells of the fiber itself, and is a true constituent of its substance. This oil should not be removed, as its removal causes the fiber to lose much of its elasticity and resiliency. The oil amounts to probably about 1 per cent. of the total weight of the fiber, whereas the external fatty matters amount on an average to about 30 per cent.

6. Structure of the Wool Fiber.—Morphologically considered, the wool fiber consists of three distinct portions:

a. The medulla; a cellular marrow, which frequently contains more or less pigment matter to which the wool owes its color.

b. The cortex; this is the name of the substance surrounding the medulla and is composed of many elongated conical tissues. This is the portion of the fiber which furnishes most of the strength and elasticity.

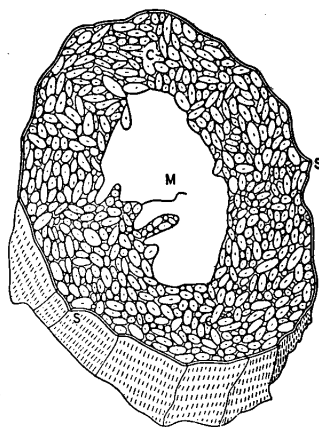


FIG. 4.
Diagram Showing Structure of
Wool Fiber.

M—Medulla or marrow.

C—Cortical cells.

S—Scales or epidermis.

c. The epidermis; this is the outside or surface of the fiber and consists of flattened cells or scales, the ends of which generally overlap each other, and project outward, causing the edge of the fiber to present a serrated appearance. This scaly covering gives the fiber its quality of rigidity and resistance, and helps to felt together on rubbing against one another by the interlocking of the projecting edges of the scales.

7. Microscopy of Wool.—The microscopic appearance of wool is sufficiently characteristic to distinguish it from all other fibers. Under moderately low power of magnification the epidermal

scale on the surface of the fiber can be readily discerned. The scales are more or less translucent in appearance and permit of the under cortical layer being seen through them. The exact nature, structure and arrangement of the scales differ considerably with different varieties of wool. In fine Merino wools, for instance, the individual scales are in the form of cylindrical cusps, one somewhat overlapping the other; that is to say, a single scale completely surrounds the entire fiber. In some varieties of wool, on the other hand, two or more scales occur in the circumference of the fiber. In

some cases the edges of the scales are smooth and straight, and this appears to be especially characteristic of fine qualities of wool; the coarser species, on the other hand, possess scales having serrated, wavy edges. Usually such scales are much broader than they are long and are very thin. The length of the free or projecting edge of the scale is also a very variable factor; in some

wools the scale is free from the body of the fiber for about one-third of the length of the former, and in consequence the scale protrudes to a considerable extent; such wool would be eminently suitable for the preparation of material which requires to be much felted. In other wools the free edge of the scale amounts to almost nothing, and the separate members fit down on one another closely, and are arranged like a series of plates. Wools of this class are more hairlike in texture, being stiffer and straighter, and not capable of being readily felted.

In some varieties of wool fiber the scales have no free edge at all, but the sides fit tightly together with apparently no over-

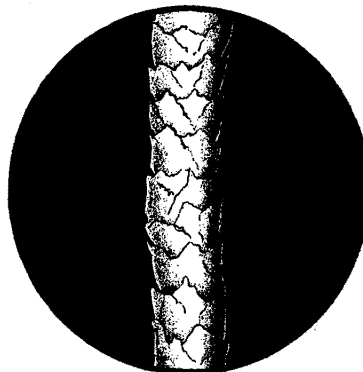


FIG. 5.

Typical Wool Fiber.

250 Diameters.

Showing the pointed and serrated edges of the epidermal scales when treated with caustic soda.

lapping; in such fibers the surfaces of the scales are also more or less concave. This structure only occurs with thick, coarse varieties of wool. Frequently at the ends of the wool fiber, where the natural point is still preserved (as in the case of lamb's wool from fleeces which have not been previously sheared), the scales are more or less rubbed off and the under cortical layer becomes exposed, this appearance is quite characteristic of certain wools. In diseased fibers the epidermal scales may also be lacking in places, causing such fibers to be very weak at these points.

In most varieties of wools the scales of the epidermis may be readily observed even under rather low powers of magnification, while under high powers the individual scales may be seen overlapping one another like shingles on a roof, and showing pointed, thickened protruberances at the edges. When the fiber becomes more hairlike in nature, such as mohair, alpaca, camel-hair, etc., it is more difficult to observe the individual scales, as these fuse together to a greater or lesser degree, until the true hair fiber is reached, which exhibits scarcely any markings of scales at all under ordinary conditions.

PROPERTIES AND CHARACTERISTICS

8. Properties and Characteristics.—To the seeker of wool for textile manufacturing purposes certain well-defined properties or characteristics must be apparent in the material, all of which go directly to increase or diminish its value and usefulness. Prominent among these properties are the following: Fineness or diameter of fiber, length of fiber, strength, elasticity, softness and pliability, color, luster, felting and shrinking, working qualities.

9. Fineness or Diameter of Fiber.—Fineness or diameter of wool fiber is a property which has always been considered of prime importance when judging the quality of wool. In fact, fineness is of such great importance in determining the value of wool, that one of the first steps in the preparation of wool for sale is to grade it according to fineness, as well as uniformity of fineness, throughout the fleece. It is well to remember, however,

when judging the fleece from any breed of sheep, that there is a degree of fineness, or diameter of fiber, that belongs to that particular breed of sheep, and that the finest wool found upon it may, in comparison, be considered coarse when compared with really fine wool. So, between the finest wools grown, with an average diameter of $1/890$ inch and the thick-haired wools with an average of $1/250$ inch, there are numerous gradations in fineness of diameter of fiber.

The really fine diametered wools always tend to be shorter in length than the coarser ones, and the extremely fine wools are very short. At the present time, however, there is an apparent scarcity of these extremely fine wools throughout the world. This condition is said to be brought about first, by the limited demand on the part of the manufacturing trade, and second, by economic reasons controlling the wool-growing industry; and in consequence, fineness, as we primarily know it, is becoming secondary, and length of fiber, with a more or less limited degree of fineness, has become of first importance.

Uniformity of Fineness.—The ideal condition as regards uniformity of fineness would be, that the wool should be equally fine in every part of the fleece. This condition is far from being realized. As a matter of fact, the diameter or fineness of fiber is quite variable even in the same fleece, and may range from .0018 to .004 inches. In the most uniform fleeces the wool on the shoulders and neck is much finer than on the hind quarters, but there should be as little variation as possible. Well-bred Merinos are noted as having least variation in this respect.

A second uniformity of fineness is that the fibers growing side by side, or the fibers in any given lock, so to speak, should be as nearly as possible of the same diameter. There is in this respect a great variation in wool. Some of the wools from the better bred sheep do not vary in diameter of fiber more than fifty per cent. from the finest to the coarsest, while from the unimproved sheep the coarsest fibers may be five or six times as thick as the fine ones. The fleece of a well-bred sheep that has an even and

distinct crimp will generally be found to be of superior uniformity of fineness in all respects, including that within the lock.

10. Length of Fiber.—In length, the wool fiber varies between large limits, depending almost wholly on the breeding and the quality of sheep. The usual market range is from one to eight inches, some coarse wools, such as braid and carpet, running over twelve inches in length. There is, however, a variation in length in different parts of the same fleece. Since the introduction and popularity of fine worsted for both men's and women's wear, length is much more important in fine wool than it was heretofore. As a matter of fact, length was of comparatively little importance when the Merino breed of sheep was first introduced into the United States, as is testified by the fact that growers of the then fine wools, in describing the wools they grew, pointed with pride to the fact that their product was not over one inch in length.

For practical purposes, the important thing for the manufacturer is the total length of the fiber, with the so-called wave or crimp it contains, taken out of it. The length of wool is measured by the length of staples; that is, of the locks of wool as they come from fleece, without stretching. The difference between the length of staple and the length of fiber is in waviness or crimp; so a short staple wool with much crimp is to be preferred to one with a longer staple in which the fibers are lacking in crimp.

Uniformity in Length.—Uniformity of length of a fiber in a fleece is quite as important as uniformity in fineness. A fleece that is uniform in length will show little variation from shoulder to britch. This ideal, however, is never fully realized, as wool from the fleece that has not been artificially trimmed is longer on the front and the middle of the fleece than on the britch and around the edges. But the fleece that is most uniform in length will have the fibers that lay together in the lock of any given area, all of the same length.

This condition is more usually found in healthy, well-bred and well-conditioned sheep than others. The main deficiencies in

this respect are (a) long-fibered fleece with an undergrowth of fine wool; (b) wool of average length and fineness with an undergrowth of shorter wool. The first is a common condition of many of the native and unimproved breeds of sheep.

11. Strength.—Wool fibers possess fairly good strength, but are inferior in this respect to nearly all other textile fibers. Wool, to be useful as a textile fiber, must have strength. That is to say, the fibers must be able to undergo a considerable stress without breaking; the stronger the wool, other properties being equal, the stronger the product out of which it is made, would naturally be.

And wool that is to be processed into a worsted yarn must be moderately strong, for in going through the various operations required the individual fibers are subjected to rather severe strains, and if the wool is weak the fibers will break up and the proportion of waste is increased in ratio. So it follows that wools selected for the making of worsted yarns, must possess good strength as well as sufficient length.

Defects of Strength.—There are two kinds of defects causing lack of strength. One is called tender wool; that is, it is weak throughout the fiber. The other is called wool with a break, or wool having a weak place; that is, when a lock is stretched, it breaks squarely across, as if during the growth of the fleece something had happened to the health of the sheep that caused the same relative part of each fiber that grew during that period to be weaker than the part that grew before and the part that grew afterward. (See illustration on page 38).

Causes of Weakness.—There are many causes which may produce a weak place in the fiber; starvation during a severe storm; overfeeding with highly concentrated food; the change from cold weather to warmer weather with succulent and green feed; sickness of any kind, especially if accompanied by fever. At times the break is so pronounced that the fleece actually drops off of its own accord or is blown off by the wind or pulled off by the

brush. It is not unusual to find in flocks that are being fed heavily with corn a few sheep that have lost their fleeces and are as pink as new-born mice.

Strongest Wool.—Wool from southern Ohio and the bordering counties of Pennsylvania and West Virginia are said to be the strongest in the world. Some territory wools, such as Wyoming and the surrounding range States, grow almost as strong a wool as Ohio, except for the weathered area on the back of the fleece and for the occasional bad break, due to severe storms or conditions that cause the sheep to be in poor health.

12. Elasticity.—This is important in wool. It is one of the properties that make wool superior to the vegetable fibers, such as cotton and linen. It may be defined as the property that causes the fiber to come back to its original shape after it has been stretched or bent or flattened under pressure. Nearly all wool from the improved breeds of sheep is sufficiently supplied with this property.

The fine wools, in particular, tend to be the most elastic. Elasticity is generally measured by the percentage of elongation that the fiber can undergo before it breaks. This is a very fair measure, but the more practical method is to measure the per cent. of elongation that the fiber would undergo without losing the power to resume its original length. Twenty-five per cent. is about the average of good live wool.

13. Softness and Pliability.—Softness and pliability are properties which vary considerably in wool, and are dependent largely upon breed and grade. Factors affecting this property are, in addition to breeding and grade of wool, care which the sheep have received, together with soil and climatic conditions. Exposure to weather seems to also have something to do with it. But, in part, it seems to be quite as much a lack of care as anything else when selecting for breeding purposes.

The amount of pliability depends fundamentally upon the arrangement of scales upon the outer surfaces of the fiber. For

a soft, pliable fiber, the scales should fit over one another loosely, and at the same time should be very numerous. These conditions are to be found in fine wools such as the Merino type. Fine Australian Merino wools are much valued on account of these properties. But the softness and downy nature of these wools seem to be attained to some extent at the expense of strength.

Soft and pliable wool can be spun into finer yarns than would be secured with wool of the same fineness that is not soft. One of the principal values of softness in wool is that products produced therefrom have a more attractive appearance and handle, and are consequently much preferred by the purchasing public.

14. Color.—Color is an important quality of wool. What is really meant by color in most cases is tint. Although wool appears to be white, it is really cream color, having a brownish or yellowish tint, and when we say a wool is white, or bright, it means that it is comparatively free from this yellowish tint. The darker colored wools, which range from gray to brown or black, are not as valuable as the white wools, but there is a small percentage of such fleeces in nearly all flocks of improved sheep. A color defect which amounts to an impurity is a mixture of black fibers through a white fleece. The fleece which has this defect, if only to a very slight extent, cannot be accepted as white fleece, because the black fibers will show in white goods and goods that are dyed a delicate shade.

The quantity of colored wools produced is, however, comparatively small, and, while they are in demand in certain fabrics, they usually are graded from 10 to 20 per cent. less than the white fleece of equal quality.

15. Luster.—Brightness is a property of fine wools, while luster is peculiarly a property of the coarser, longer wools. Wools that are lustrous make smooth and shining yarns and, in turn, lustrous cloth. The Lincolns and Leicesters are especially lustrous. Luster may be described as the property by which wool reflects light something after the manner of spun glass. It is most perfect

in good mohair. Brightness is the property by which wool reflects the light somewhat as powdered glass does.

16. Felting and Shrinking.—Felting is a most important property, and wool is the only important textile fiber which possesses this property to any great extent. However, not all wools possess the property to the same degree. This felting property in wool is dependent in a very large measure on the nature and number of scales or serrations on the surface of the fibers. The more the free edges of these scales protrude from the surface of the fiber, the more easily the wool will felt. As a rule, however, the finer and more serrated the wool, the greater its felting property. Fine Texas, Ohio, Pennsylvania, Virginia and similar Merino type wools are especially valuable on this account.

Manufacturers of woolen goods avail themselves of this property to a marked degree in finishing their fabrics by what is commonly known as the "Fulling" process. Some woolen fabrics are shrunken and reduced in length 30 to 40 per cent., and as high as 50 per cent. in width. The majority, however, are laid out to shrink from 15 to 25 per cent.

In order to take advantage of this felting property in wool, three distinct agencies are required—moisture, pressure and heat.

The moisture and pressure are supplied; the heat, however, must be generated (in case of woolen cloth) within the material itself, brought about by causing the material to friction, as it repeatedly passes through the fulling process. The degree of heat generated is a most important factor; too much heat is injurious, and too little heat defeats the object sought.

The pressure is supplied by heavily weighted revolving rolls forming a part of the so-called fulling mill. The serrated saw-like edges of the fibers having become soft and pliable, come in contact and fit into each, and lock fast under the pressure of these revolving rolls.

The moisture is supplied by means of an alkaline soap solution, with just enough alkaline content to act with the heat generated in such a manner as to cause the hardened scales (which

were originally of a gelatinous membrane nature), not only to become softened up, and pliable, but, in addition, will also loosen up and hold in suspension the fatty matter or suint, lying directly under them.

The absence of sufficient oil, due to the age of the sheep, sickness, or low vitality, oftentimes causes wool to felt on the sheep's back, particularly that portion nearest the skin. Such fleeces are known as cotted or cotty fleeces. The arrangement of all fibers in the fleece is naturally in one direction. As they grow from root to tip all the scales are pointed in the same general direction, and if the fibers are sufficiently supplied with yoke there is little chance for the scales on various fibers to become interlocked.

17. Waviness and Crimp.—This condition is caused by the uneven growth and arrangement of the cortical cells, which cause the fiber to contract and bend. Waviness is more pronounced and called crimp in fine wools. It is usually totally absent in coarse wool fibers, and if present the waves are long and irregular. The nearer the wool fiber approaches the structure of ordinary hair the more infrequent and irregular become the waves. It should be remembered that this waviness or crimp is valuable in spinning and increases the elasticity of the yarns as well as the fabric, if present to any considerable extent.

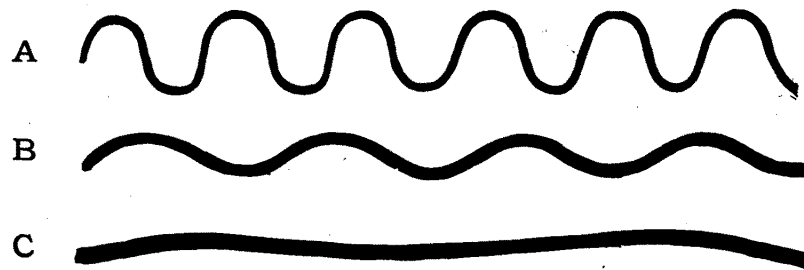


FIG. 6.—Contrast between Crimp and Waviness.
A—XX Wool; B— $\frac{1}{4}$ Blood Wool; C—Mohair.

18. Working Properties.—These are properties which are not very easily described or their presence or absence easily detected

in wool. But it will be found that wool which is superior with respect to the properties already enumerated: length, uniformity, strength, softness, etc., will be found to have good working qualities. On the other hand, wool that has been exposed to the weather until it is rough and dry and tangled by the wind will be found to be deficient. Wool that is open and free in the lock and has an even crimp will be found to have good working qualities.

19. Kempy Wool.—Frequently, through disease or other natural causes, the medulla of the wool fiber is imperfectly developed, or the scales of the epidermis are cemented together, in consequence of which the wool will not absorb solutions readily, and hence will not be dyed (or mordanted) at all, or only slightly. These fibers, which are known as kemps, will occur through the mass of the wool as undyed streaks, and will give the yarn or fabric a speckled appearance. Kempy wool is said to be due to undue exposure of the sheep and to bad feeding. It is also more noticeable in wools grown in mountainous regions. Kempy wool should not be used in fabrics intended to be dyed a solid color. For blankets, Scotch tweeds, horse-rugs, mantle cloth, and the like, the occurrence of kempy fibers in the wool is not an especial drawback. Not only may this condition, however, be brought about by natural causes, but it may at times be the result of improper manipulation during manufacturing processes. According to Bowman, kemps have a dense appearance, the cellular character being entirely obliterated, the fiber assuming the appearance of an ivory rod without any internal structure being visible. Kempy fibers are always much thicker than the rest of the wool among which they grow, and the medulla or central portion of the kemp is quite thick.

20. Chemical Composition.—The chemical composition of wool varies slightly with the different breeds of sheep, and the other factors previously mentioned as affecting the growth and character of the wool on the sheep's back. The following are average percentages: Carbon, 50 per cent.; hydrogen, 7 per cent.;

nitrogen, 18 per cent.; oxygen, 22 per cent., and sulphur, 3 per cent.

21. Action of Acids and Alkalies.—Wool is unaffected by dilute acids and has a great affinity for them. This property is utilized in the dyeing of acid colors. Being an animal fiber, wool is tendered and weakened by alkalies, and when concentrated they completely dissolve it.

22. Bleaching.—The common method of bleaching wool is to subject the scoured wool, yarn or fabric in a damp condition to the action of sulphur dioxide gas. The stock, yarn or fabric is arranged in a separate, comparatively air-tight building, so that the fumes will attack all parts equally. Sulphur is slowly burned in an iron pot giving off sulphur dioxide gas. This takes from one to two hours, according to the quantity of sulphur used. The door is then opened, and after the fumes have escaped, the wool is removed. Another method using the same agent is to pass the wool through a sulphurous acid bath. These bleaches are not permanent, and in time the natural color returns. Washing with soap quickly destroys the results obtained from the sulphur bleaching methods, and restores the original color.

The only true wool bleaches are the hydrogen peroxide and sodium peroxide bleaches. These bleaches are expensive but permanent, and are fast supplanting the "stoving" or sulphur bleach, and are used for bleaching the better grades of woolen and worsted fabrics where white is desired.

23. Dyeing.—Wool has a great affinity for dyestuffs and is readily dyed. The three most common conditions of wool for dyeing are stock or fiber, skein, and piece. The removal of all grease and oil by scouring or degreasing is necessary before dyeing.

24. Action of Heat.—Heat causes the wool fiber to expand. High temperatures tender wool, making it harsh and brittle. Ex-

cessive heat decomposes wool. Wool is completely denatured and disorganized when heated to a temperature of 130 degrees C. with water under pressure; and on drying can be rubbed into a fine powder.

25. Conductor of Heat and Electricity.—Wool is a very poor conductor of heat and electricity, but it is a good generator of electricity. These properties make wool so well adapted for clothing where warmth is desired, as the wool, being a poor conductor of heat, prevents the heat given off by the body escaping quickly.

26. Grease and Foreign Matter.—The grease present on the wool fibers serves as a protection to the fibers from felting while in the growing fleece. It is secreted by the fatty glands around the hair-follicle in the skin. The value of this natural grease to the wool is well illustrated by its absence in what are known as “cotted fleeces,” where the fibers are matted together so badly that the wool is of little value. This is caused by insufficient natural grease, due to the sheep being sick or very old. Cotted fleeces are seldom found on sheep which run the ranges of the west, as they are more hardy and possess greater vitality than housed sheep.

“Suint,” or dried-up perspiration, is also present on the wool fibers along with the natural grease or “yolk.” Suint consists of potash salts, and is soluble in water, whereas the grease is insoluble. Suint approximates 15 per cent. of the total weight of grease wool.

“Foreign matter,” such as dirt, sand, straw, burrs, twigs, manure, etc., becomes readily attached to the grease, and most of it carries along with the fleece until scoured out. The vegetable matter is removed by the burr-picker or carbonizing.

The total amount of grease, including suint and foreign matter, present in a fleece of wool depends upon the breed of the sheep, grade of wool, soil, care given the sheep, and climatic conditions. The “shrinkage” or loss in scouring will vary from 20 per cent. to

75 per cent. In other words, in scouring 100 pounds of grease wool, there would be from 20 to 75 per cent. loss. For example, if a 100-pound lot lost 60 per cent. in scouring, then only 40 pounds of clean wool were obtained.

27. Methods of Removing Grease.—The scouring bath contains soap and soda ash, and frequently ammonium or ammonium carbonate. The bath should not be heated to any higher temperature than the hand will stand, and the wool should be carefully handled while in the scouring bath or it will become felted and matted. Following the scouring bath, the wool is rinsed in a bath of cold water and then dried. This is the most common method and generally used.

Some large mills have abandoned the method just described, and have installed degreasing plants. The degreasing process is a solvent method, and reclaims the valuable grease and potash salts, both of which are a total loss in the ordinary scouring process. The wool is subjected to the action of petroleum-naphtha, which dissolves the wool fat, and then to a water bath, which removes the potash salts. By subsequently volatilizing the petroleum-naphtha, the wool fat or *degras* is reclaimed. The potash salts are recovered from the water bath. Expensive machinery and the use of dangerous materials are the objections to the degreasing process. The greater operating expense is overshadowed by the receipts from the reclaimed wool fat and potash salts.

28. Moths.—Wool in all conditions, greasy or scoured, is the prey of moths, which deposit their eggs on the wool, so that when the worms are hatched they will have tasty nourishment right at hand. One of the most common preventives is camphor.

29. Mildew.—Mildew is a fungoid growth, which readily develops in wool, where heat and excessive moisture are present, and the wool is not accessible to plenty of fresh air.

30. Moisture or Hygroscopic Quality.—Wool is the most hygroscopic textile fiber; the amount of moisture it will hold varies

with the humidity and temperature of the surrounding atmosphere. Under average conditions, wool will contain from 12 to 17 per cent. moisture, but if stored in a damp warehouse for a considerable length of time it will take on as high as 30 per cent. moisture. This feature is sometimes utilized by unscrupulous wool dealers. To ascertain the actual amount of moisture present, conditioning houses have been established for finding the true amount of fiber and moisture. A certain percentage of moisture, known as "regain," is then added to the bone-dry weight of the fiber to get the proper selling weight of the wool under consideration. The amount of regain varies with the established custom in different countries and sections of the same country; the most common allowance in the United States is 15 per cent.

CHAPTER II

CLASSES OF FLEECE WOOL.

31. Classification.—Practically all fleece wools can be classified in one of the four following divisions: 1—Merino. 2—British. 3—Crossbreds. 4—Carpet Wools.

There are about two hundred different breeds of sheep in the world, but their fleeces can all be classified under the four divisions given above. The breed of the sheep influences the character of the wool grown on it, and governs to a large extent the length and diameter of the fibers, and also the other points to be considered, such as strength, elasticity, shrinkage, color, luster and waviness.

32. Carding and Combing Wools.—In all four divisions as made above, both clothing or carding and combing wools are to be found. In fact, one mill would often use a certain wool for a woolen yarn, and another mill would use the same identical wool for a worsted yarn, and both mills might be selecting the most appropriate stock for the fabrics in view. The dividing line in the trade between carding and combing wools is from 2 to 2.5 inches. The wool classed under the British and Crossbred divisions is principally long and medium staple combing wool. Comparatively short wools are now successfully combed, and many wools which were formerly only suitable for carding are now eagerly sought for combing purposes. This change was brought about by the many improvements in the Noble or circular comb, and later the introduction of the French or Heilman comb. The original Lister or square nip comb is still necessary for coarse, long-stapled stock, and usually operates on staple ranging from 8 to 12 inches. The Noble comb is best adapted for handling fine and medium staple wools running from 2.5 to 8 inches in length. Staple under 2.5 inches is treated by the French comb, and is known as “baby combing” wool. Wools over 12 inches in length are “prepared” and not combed. The process of “pre-

paring" is to allow a coarse gill box to straighten out the tangled fibers. The "noils," or short fibers under a desired length, are not taken out in this system. The removal of the short fibers is not nearly so important a factor to a satisfactory worsted yarn

made of these very long wools, as is the case with the shorter ones, owing to such wools containing a smaller percentage of short fiber, and also to the fact that there is less contrast in length between the long and short fibers in these unusually long wools.

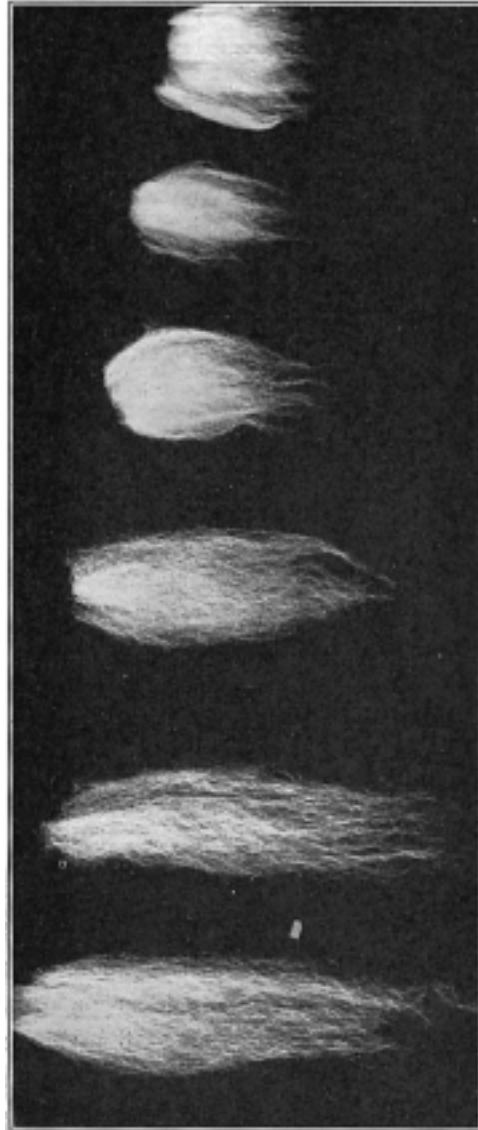


FIG. 7.—Tops of Different Lengths.

33. Old Classification.

—Some years ago, when only the square nip comb was available, all wools could easily be divided into three classes according to their availability for processing. These divisions were: First, clothing or carding; second, combing, and third, carpet. This method of dividing wools is also known as the "blood" classification. In the first class were placed all full-blooded Merino wools, and crossbred wools

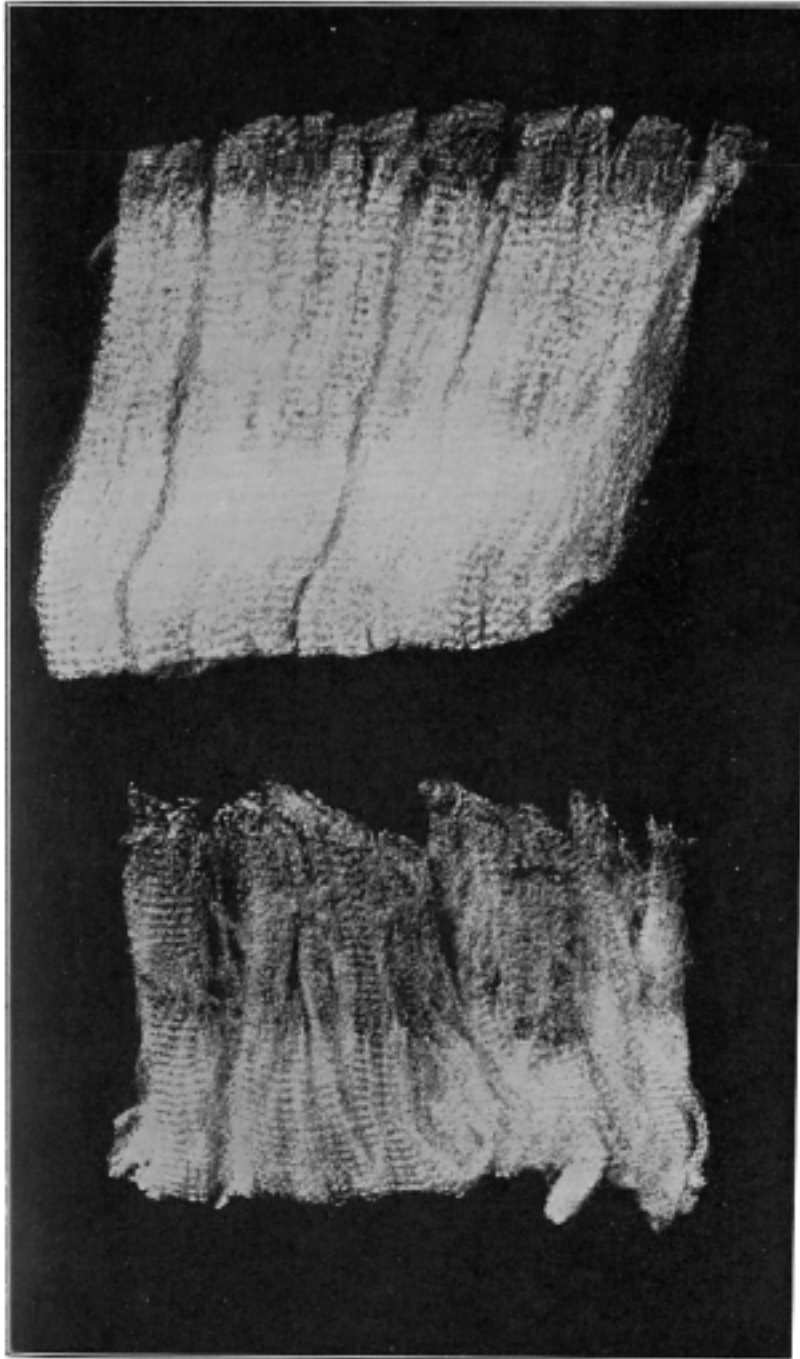


FIG. 8.—Combing and Clothing Wools.

showing a fair percentage of Merino blood. The second class included the various British breeds, such as the Southdown, Shropshire, Dorset Horn, Oxford Down, Yorkshire, Hampshire, Cheviot, Leicester, Lincoln and Cotswold. None of these wools were less than 5 or 6 inches in length. The carpet wools included all wools inferior to those placed in the first and second classes, and, as the name signifies, they were used in the manufacture of carpets. These carpet wools vary widely in fineness, length, strength, color and working properties. Most of this wool comes from native uncultivated sheep of semi-civilized parts of the world, such as China, Turkey, Persia, Arabia, Asia Minor, Turkestan, Russia, the Balkan States, India, the East Indies and Northern Africa. Another source of supply for carpet wools is the lowest sorts from the fleeces of the first two classes. Certain grades of carpet wools are also known in the trade as "colorado" wool.

34. Merino Types.—The Spanish Merino sheep was the original Merino, and the foundation of the various types of Merino sheep now found in the principal wool-growing countries of the world. Owing to changes in climate and soil, the original Merino from Spain developed into other distinctive types. These changes in type have also been brought about by breeding the full-blooded Merino sheep with British and native breeds. The principal Merino breeds of today are the Spanish, Rambouillet or French, Saxony, Silesian, Australian, American, South American and Cape of Good Hope or South African.

The American Merino has been bred from the French more than the Spanish Merino, so that the body of the sheep is larger than the latter and the mutton improved. Merino sheep are usually bred and raised for the quality and value of their wool, mutton being an after consideration. In the first part of the nineteenth century, American Merinos were bred from the Spanish stock. The type developed many folds and wrinkles of flesh on the body, which increased the fiber-bearing surface. The fleeces of such sheep often amounted to 20 per cent. of the total weight of the live sheep. With the introduction of machine shearing

and the increasing importance of mutton as a factor in sheep growing, this type became unpopular, and the breeders took up the French Merino. This new type of American Merino is comparatively free from wrinkles, and the sheep are much larger and heavier. Merino sheep are strong and hardy, and quickly adapt themselves to changing environments.



FIG. 9.—Delaine Merinos, Class C.

Merino sheep are divided into three groups, A, B and C, on the basis of the presence or lack of wrinkles and folds. Class A contains the Merinos with heavy wrinkles and folds. The extreme American type of Merino and the Spanish Merino are the leading members of this class. Class B shows only a few folds about the neck and brisket, and sometimes the thighs. The Rambouillet and improved American Merinos belong to this class. Class C shows a smooth skin, except for a suggestion of wrinkles at the neck. The Delaine Merinos belong to Class C, which also includes some of the Rambouillets.

The American Merino is now the smallest of the Merino family, which is the smallest type group of all the various breeds. American Merino rams run from 100 to 175 pounds, and ewes from 80 to 100 pounds. The sex terms for sheep are ram, a male sheep for breeding; wether, a castrated male sheep; ewe, female sheep, and lambs, young sheep. The Rambouillet is much larger, having a better mutton form, yet retaining the fine wool. Rambouillet rams average 175 pounds, and ewes run from 140 to 160 pounds. All the Merinos are completely woolled from nose to foot. The head of the American is smaller than the French. Rams of both types usually have spiral horns and the ewes have none. The fleeces are heavy shrinking, very dense and fine, the staple usually running from 2 to 3 inches. American Merino fleeces on account of the folds shear from 12 to 20 pounds, while the Rambouillet yields from 10 to 15 pounds. The Merino fleeces contain so much yolk that they soil badly on the surface. This is known as the "black-topped" effect.

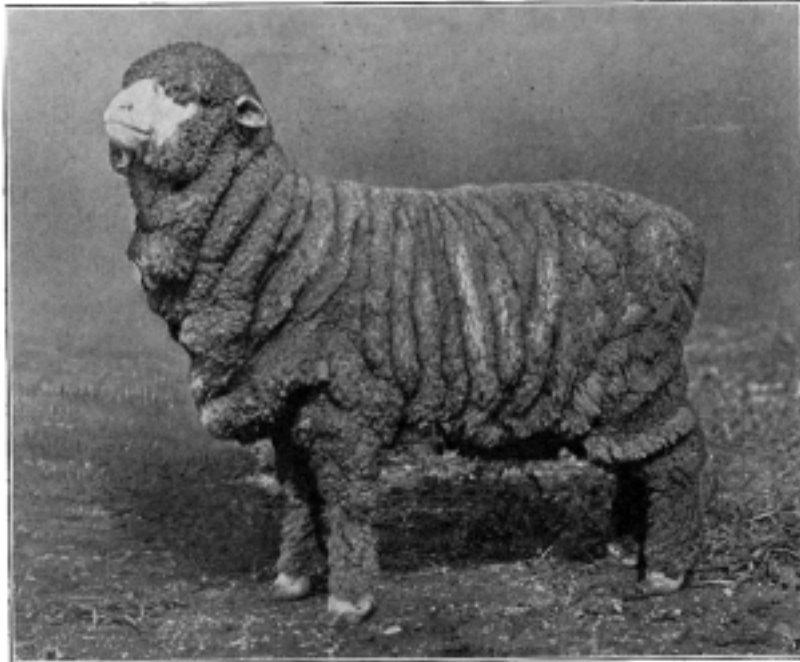


FIG. 10.—American Merino Ewe, Class A.



FIG. 11.—Rambouillet Ram, Class B.

Merino wools are the most valuable wools produced in large quantity in the world. It is estimated that the quantity of fine wools grown, coming under the Merino classification, only represents 25 per cent. of the world's wool production, and the tendency is continuous toward "mutton sheep." Merino wools are noted for their softness, fineness, strength, elasticity, and especially desired for their superior drawing, spinning and felting properties. For spinning the finest woolen and worsted yarns, Merino wools are an absolute necessity. Flannels and knit goods of high quality, suiting and dress goods of fine texture, face-finished fabrics such as broadcloths, billiard cloths, doeskins, meltons, uniform cloths, etc., are dependent on Merino stock, as no other wool would give the required appearance, handle, finish and character which distinguishes each of these fabrics, and in many cases no other wool could be spun to the required yarn sizes.

Australia now supplies the greatest quantity of Merino wool for the market. South Africa and South America follow in the order named. The River Platte district in South America is a great wool growing region, and takes in Northern Argentine and Uruguay. Australia, South America and South Africa manufacture but a fraction of the wool produced, the great bulk being shipped to European markets, the most important of which is London. The United States only grows about one-half of the wool needed for manufactures each year.

35. Complete List of Merino Breeds.

SPANISH.	RUSSIAN.
EstantantesB	DronskiB
ChunahC	SiberianC
EscorialB	
TranshumantesC	SCANDINAVIAN.
LeoneseB	SwedishC
NegrettiA	DanishC
GuadaloupeC	
PaulorC	EAST INDIAN.
InfantadoC	NepalB
	KashmirC
FRENCH.	AMERICAN.
RambouilletA	VermontA
DelaineA	Franco-AmericanA
Dishley-MerinoA	
SoissonaisB	AUSTRALIAN.
	TasmanianA
ITALIAN.	WanganellaA
SardinianB	BungareeA
SicilianC	
GERMAN.	KEY.
SaxonyA	A—Popular breeds, improved types, large flocks.
HanovarianB	B—Old breeds still kept in large flocks.
PrussianC	C—Very old breeds, almost extinct.
AUSTRIAN.	
HungarianB	
SilesianA	

POPULAR BREEDS OF MERINO SHEEP, WELL KNOWN IN THE WOOL TRADE

Tasmanian.	Spanish (Negretti).
Wanganella.	Vermont.
Bungaree.	Franco-American.
Saxony.	Hungarian.
Silesian.	Italian (Improved Sardinian).
Delaine.	Hanovarian.
French or Rambouillet.	Russian (Improved Dronski).
Dishley (French).	East Indian (Nepal).



FIG. 12.—Wanganella Merino Stud Rams, Australia.

36. Characteristics of Various Merino Wools.—Saxony, Silesian, Spanish and French Merino wools are all grown in Continental Europe, and the great bulk is manufactured into textiles in the countries where the wool is grown. Very little of this wool ever enters the open market, and none is imported by the United States. These European Merino wools are noted for their fineness, the major portion of them are worked on the woolen system. The length of fiber is usually under 2.5 inches.

Australian Merino wool is especially suited for making worsted yarns on the French or English (Bradford) systems, as it ranges from 2 inches to 5 inches in length. Another valuable feature of Australian Merino wool is the good white obtained by scouring. Cape Merino wool is also noted for its snowy whiteness when scoured, and is very deficient in felting properties. The wools grown in New Zealand and Tasmania are always included under the head of Australian wools unless a distinction is specifically made. South African and South American Merino wools average in length from 2 to 3 inches and from 2 to 4 inches, respectively. The South American imported by this country is usually spun into worsted yarn on the English system. It is considerably weaker than the other Merino wools mentioned, and has a tendency to be harsh and wiry. It is inferior to the

others in drawing, spinning and felting properties, and possesses considerable luster. One of its drawbacks is the fact that the fleeces pick up a tenacious spiral burr, which grows on the ranges, and parts of these burrs often carry through the manufacturing processes, and show up in the yarn and finished fabric. Naturally this is a detriment.

37. Merino Wools of the United States.—American Merino wools, with one small class excepted, are divided into two classes, “domestic” and “territory.” The domestic Merino wools are those grown in the Eastern and Central States. The principal States growing domestic Merino wools are Ohio, Pennsylvania, West Virginia, New York, Michigan, Vermont and Indiana. The most important section is the Ohio River Valley, and comprises Ohio, southwestern Pennsylvania and the eastern part of West Virginia. These fine wools compare favorably with any in the

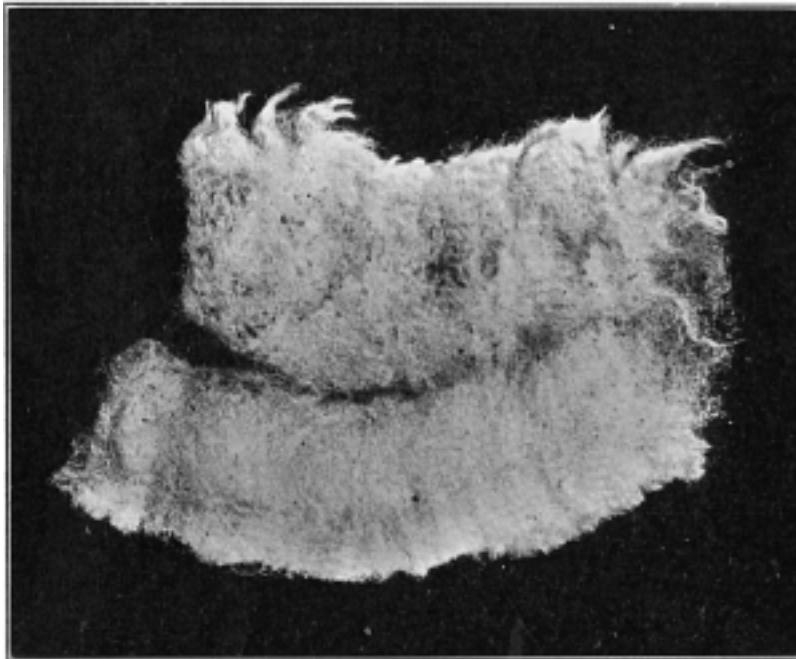


FIG. 13.—Tender Wool Showing Break.

world, and are fully equal to the finest Australian. They are unusually sound and strong, and are the most valuable American wools. The domestic wools are as a rule almost entirely free from burrs and dirt. The shrinkage represents the actual grease and suint, and is very uniform. Special attention is given to breeding, the sheep being housed and given every possible attention. In addition to the term "domestic," these wools are also known as "eastern," "fleece," "farm," and "native" wools. The length of these domestic Merino wools varies from 2 to 5 inches. Three inches and over, in Merino wools from the Ohio Valley, are known as "delaine" wools (see glossary), and are obtained by careful selection in breeding. The Delaine Merino sheep are between the American and Rambouillet for size. Rams weigh from 140 to 200 pounds, and ewes from 100 to 150 pounds. The fleece is lighter shrinking than the other two types just mentioned, and the weight runs from 9 to 18 pounds. The length of fiber in Delaine wools makes them especially adapted for worsted yarns. The term "delaine" is often applied to all "domestic" Merino combing wools grown in this country. Territory combing wools are usually known as "staple."

38. Territory Wools.—The territory wools, also known as "western" and "range" wools, are those grown in the States of Montana, Wyoming, Idaho, Nevada, Utah, Arizona, New Mexico and Colorado. Most of the wool produced in Washington, Oregon and the Dakotas is classed as territory wool. At one time all wools grown west of the Missouri River were classed as territory wools. The name "territory" was given to these wools because they were grown in the western part of the country which had not been admitted to statehood. The term "ordinary" is sometimes used for "clothing" or "carding" territory wools. It will be noticed that the States named comprise the Rocky Mountain Plateau. The sheep producing territory wools graze over the open ranges and are very hardy. They seldom receive any housing or protection from winter storms and blizzards, and are rarely furnished with fodder. The cold winters cause the sheep

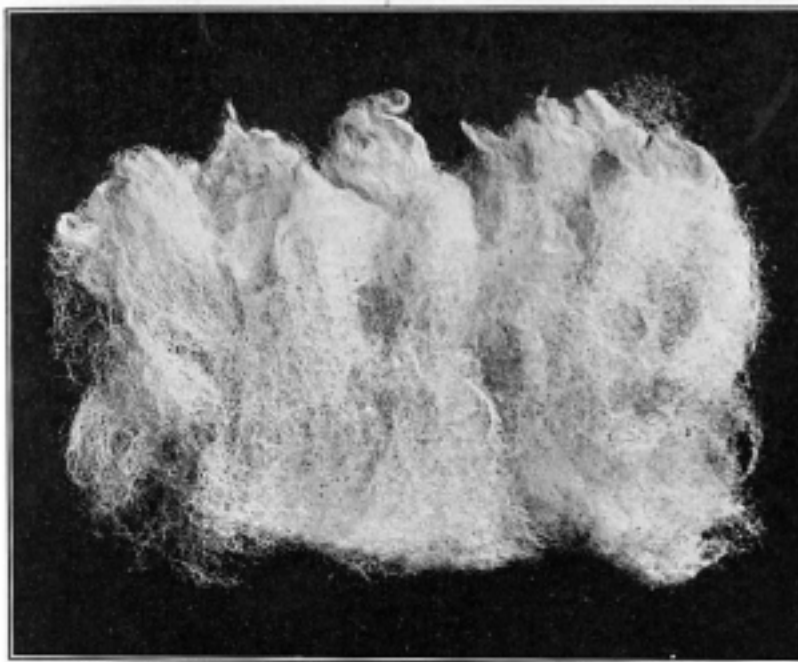


FIG. 14.—Frowsy Wool.

to grow heavy fleeces. In summer, the flocks often suffer through long droughts, causing a scarcity of water, and poor pasturage. At its best, the grass is never so plentiful or rich in this region as in other parts of the country. Tenacious burrs abound in the greater part of the ranges, and become entangled in the fleeces. The burr picking machine is frequently unable to remove these burrs from the grease wool, and this necessitates the use of the carbonizing process later, to remove the burrs.

The soil on most of these western ranges is sandy and alkaline. The nature of the soil, sickness due to insufficient nourishment at various times, and exposure, weaken the wool in the fleeces of these sheep, and at its best, territory wool never equals similar domestic wool. Most of this territory wool runs from 1.5 to 3 inches in length. The fiber is fine, but weak, tender and harsh. The territory wools have a very high shrinkage, due to the large quantity of sand, which adheres to the yolk in the fleece.

39. Influence of Farming in the West.—Territory wools are the greatest factor in the wool production of the United States, but the supply is gradually decreasing, due to the encroachment of farms, which are slowly taking over the ranges in this, the last stronghold of the old-time sheep grower. As the ranges come into demand for farming purposes, the land is too valuable to hold for sheep grazing, and with the development of irrigation and intensified cultivation of the soil, the bulk of the wool-growing industry of this section will probably become incidental to farming in the same manner as in the older parts of the country. This is an unfortunate condition, as the United States at present only grows a trifle less than half the quantity of wool consumed in its textile establishments. With the ever-increasing population of the world and the consequent decrease in the world's wool production, the time does not appear relatively far distant when there will be a real scarcity of wool, and unadulterated woolen and worsted clothing will be too expensive for many people in poor circumstances. A satisfactory artificial substitute for wool has yet to make its commercial appearance, although many chemists have endeavored to invent one. It is very unlikely that such an artificial substitute will ever be created.

40. Various Territory Wools.—The territory wools from the different producing States vary slightly in their characteristics from one State to another, and an expert wool buyer seldom errs when judging a fleece as to the State in which the wool was grown. However, they grade into one another almost imperceptibly. Differences in these wools, which can be recognized by the eye, are difficult to describe.

Montana wools, as a whole, are the best of the territory clips. The shrinkage is light compared with other territory wools. Long staple, comparative softness, good felting qualities, and attractive appearance are the features of Montana wool. In color, they have a slight creamy tinge, which shows up after scouring. This makes them unsuitable for white goods. They are weaker than most of the territory wools.

Wyoming wools are next in importance to Montana wools. The fleeces vary from gray to reddish gray in color, and the wool has a wild, harsh feel. These features are due to the alkaline soil over which the sheep graze. The shrinkage is heavy, due to the large amount of sand mechanically held in the fleeces. It is the strongest of the territory wools and of fair length. It is noted for its whiteness when scoured.

Idaho wools compare favorably with Montana wools as to shrinkage. One of the most widely known territory wools is the Triangle or Soda Springs wool. The latter term is given from the fact that the wools are grown in the section surrounding this town. Other important shipping points for wools grown in this section are Pocatello, Idaho; Granger, Wyoming, and Ogden, Utah. These three towns form the three points of a triangle, and the name "Triangle" has been applied on this account to the wools grown in the section indicated. The Triangle wools are noted for less shrinkage and longer staple than the wools grown in surrounding sections. Practically all the wools grown in the western part of Idaho are long and fine. These wools often grade 80 per cent. staple. In the eastern part of the State the wools are generally shorter.

Montana, Wyoming and *Idaho* wools are the best of the territory wools. They are of about equal value and are usually grouped together in the market quotations for wool in the trade papers.

Utah and *Nevada* wools are inferior to those grown in the previous three States. These wools are all rather short, the great bulk being classed as clothing wool. The principal reason for the Utah wools being inferior to those of Montana, Wyoming and Idaho is usually attributed to overstocking the range. Nevada wool has a very high shrinkage.

Colorado wool is greatly inferior as a whole to that grown in the five States previously mentioned. The best wool from this State comes from the northern part, and has a light shrinkage. Colorado wools in general are often called "breedless," and the average shrinkage is about 70 per cent.

Arizona and *New Mexico* wools are generally poor and uneven. They are similar to Colorado wools, and are usually grouped with them. As a rule, little care is given the flocks, and less care is taken in breeding, and as a consequence, the wool is inferior and usually kempy. This condition is largely due to the ignorance and laziness of the Mexicans, who own most of the flocks. In fact, the wool from American-owned flocks is worth several cents more a pound.

The group excepted in the domestic and territory classification of American Merino wools is "Texas and California."

Texas and *California* wools, though grown far apart, are very similar to one another, and are usually grouped together. They are often included among the territory wools, but for several reasons it is better to consider them separately. Most of the sheep run the range, and the bulk of them are sheared twice a year. For this reason the wool is known as Spring and Fall Texas or California. Another method of designating these wools is six months, eight months, and twelve months Texas or California, depending on the time the fleece was allowed to grow. California wools are also divided into northern, middle and southern counties. The northern counties wool is usually grown a year before shearing, and is the most valuable. In the middle and southern counties the wools shrink more, and the sheep are sheared twice a year. The spring wool is usually eight months' growth and the fall wool six months. April and September are the usual shearing months for Spring and Fall wools, respectively. The former is naturally longer and shrinks less than the fall wool. The length varies from $\frac{1}{2}$ inch to 1.5 inches for six and eight months' wools, and from 2 to 3.5 inches for twelve months' wools. The shrinkage averages 65 per cent. These wools are noted for their softness, fineness, strength, elasticity and excellent felting properties. They are a necessity for high-grade fabrics requiring heavy shrinkage or gigning, or both to obtain the required finish. A few of these high-grade fabrics are the choicest broadcloths, billiard cloths, chinchillas, kerseys, meltons, beavers, uniform

cloths, and bed blankets. The short fibered wools are especially desired where a napped face is desired, as they furnish more fiber ends to cover than longer wools without materially weakening the fabric or breaking the staple.

Texas and *California* short-wool fleeces are not tied, but are tightly packed in bags. *California* wools are frequently baled. The mestiza burr is common on the ranges of southern *California*, and these wools must be carbonized to remove the burrs. Such wools are known as "defective," in order to distinguish them from "free" wools. Most of the *Oklahoma* wools are included with *Texas* wools.

Louisiana "lake" and some *Georgia* wools are, in a general way, similar to the short wools of *Texas* and *California*, but come under the domestic classification. They are unimportant, as the relative amount produced is very small. These wools are also clipped in the spring and fall, and usually run very kempy. Little attention is given to breeding the sheep, and as a consequence the wool is inferior to that of *Texas* and *California* for fineness and evenness.

41. **British Types of Sheep.**—The British breeds of sheep have always been bred from a mutton viewpoint, the quality and character of the wool being a second consideration. The block standard is the aim of all breeders of mutton sheep. The British breeds are subdivided according to the character of their wool into the long wool and medium wool breeds. The medium wools are divided into two distinct classes—namely, the "down" and "mountain." The down class is far more popular than the mountain, as the latter are much smaller sheep. The block standard requires the sheep to be low-set, deep, wide and symmetrical. These requirements furnish the carcass with the highest percentage of desirable parts for meat, and enable the butcher to cut to the best advantage with little waste. Such types furnish about 50 pounds of dressed carcass per 100 pounds live weight.

42. **Conformation of Mutton Sheep.**—The following excellent description of the characteristics and distinguishing features of the mutton type of sheep is taken from Dr. Carl W. Gay's work, "The Principles and Practice of Judging Live Stock," published by The Macmillan Company:

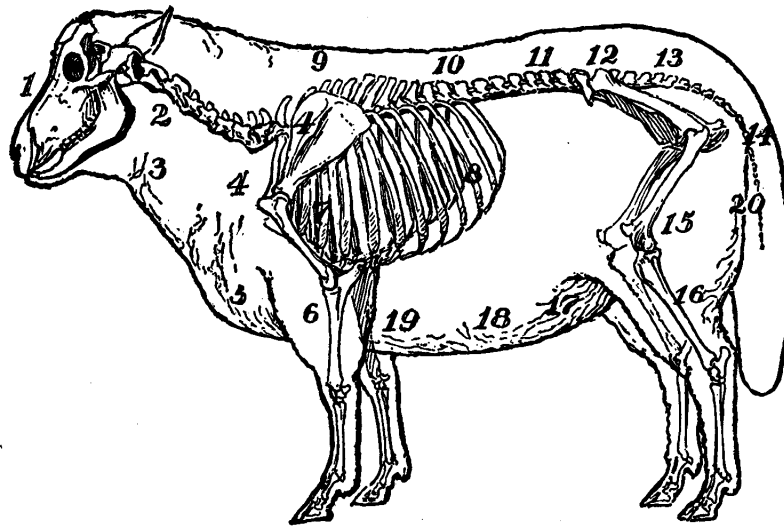


FIG. 15.—Points of Sheep: 1, head; 2, neck; 3, shoulder vein; 4, shoulder; 5, brisket; 6, foreleg; 7, chest; 8, ribs; 9, top of shoulder; 10, back; 11, loin; 12, hip; 13, rump; 14, tail; 15, giggot or leg of mutton; 16, hind leg; 17, flank; 18, belly; 19, foreflank; 20, twist.

“Head short, broad and deep; a large, full, clear eye; broad muzzle, large nostrils; fine, well-shaped ears, nicely poised and carried. The size and shape of the head, also whether covered with wool or hair, and the carriage of the ears is a matter which involves the breed, as does also the presence or absence of horns. The horns of the horned breeds should be strong, or fine, depending upon sex, of good texture and symmetrical in size and shape. The neck desired is short, thick just back of the poll and begins there to swell into the width of the shoulders, being especially full in the neck vein. Typical shoulders are broad, not prominent, but closely laid in, and well covered with flesh, both at the side, where they are apt to be bare, and over the top, where they are often too open; that is, having too much space between the

tips of the shoulder blades and the spine; the back straight, strong, broad and especially thickly covered with flesh; the ribs well arched and deep, especially the forerib; the crops so well filled as to be even with the sides of the shoulders; the chest deep, full, broad on the floor, and square at the brisket; the loin broad, and thickly fleshed, this region being most frequently bare; the hips broad, level, smooth and not too prominent; the rump long, level, broad and smooth, especially at the dock, where there may be an accumulation of blubbery tallow; the leg of mutton broad, deep and thick; the twist full and well let down in the seam; the legs short, straight; pasterns and hocks strong; the sheep standing well up on its toes, and having straight hind legs."

43. Mutton Qualities Influenced by Breed.—It must be borne in mind that the quality of the meat is dependent on the quality of the sheep, and in turn the quality is determined principally by the breeding. The breed influences the quality of the meat as much as it affects the character and quality of the fleece. Sheep, yielding a choice meat, show a refined head and ears, smooth shoulders, and hips, clean-boned joints and cannons, fine hair on the face, ears and legs, fine fleece, and a trim under line. The flesh should be firm, but slightly yielding.

The improvement of the fleeces of sheep by selection and breeding has been practiced for centuries, but the development of the mutton breeds was started less than two hundred years ago.

The production of mutton has become very largely a business of furnishing lambs to the market. As in beef and pork, the demands of the market call for young meat and comparatively light weights of carcasses. The premium paid for baby beef and bacon hogs applies with even greater force to sheep. Thick, fleshy, but rather light joints are demanded by the cook, whether for the home table or the restaurant. The tastes of the consumer have been cultivated to discriminate in favor of the tasty, tender lamb, until we find that from 70 to 80 per cent. of the sheep which reach the market are less than one year old. The age of

heavy mutton seems to have passed. This is a condition which is most favorable to the sheep raiser, who is thus enabled to secure quick return from his flock. In the very nature of things there will always be mature sheep sold as mutton, as the breeding stock must sooner or later reach the block. The increasing demand for lamb mutton indicates a good future for the industry, provided care is taken to keep up and improve the grade of the product. Careful attention is needed not only to the production of the rapidly growing lamb, but that it possesses the qualities called for by the high-class trade. A prime lamb is in demand and will always command a high price, while the skinny, bare-backed sheep is not wanted at all. The market wants flesh in any case, and when it comes from the back, the loin, or the leg so much the more it is prized.

The raising of lambs for the market requires, first of all, a strong uniform flock of ewes which are active foragers, uniform and regular breeders, and copious milkers. It is also important to pay some attention to the shearing qualities of any flock of sheep.

44. Classification of Wool from Mutton Breeds.—The wools grown by these mutton sheep are known as down (medium) and long, depending on the breed. The long wools include coarse, semi-luster and luster wools. According to the following list, which was prepared by W. T. Ritch, an Australian wool expert (who for several years past, has been engaged in introducing the Australian methods in the West), there are thirty-eight distinct breeds of sheep in Great Britain, all of which belong to the mutton class. It is only natural that the most popular of these breeds should have found favor in British colonies, which have found sheep-growing profitable. Nearly all the sheep of Canada and New Zealand belong to the mutton type, and while the Merino is still dominant in Australia and South Africa, nevertheless the well-known British breeds are continually gaining ground. Merino sheep have been introduced in Great Britain, but they do not

prosper, as the climate is unfavorable, and the heavier breeds are desired for their mutton.

45. Complete Classified List of British Breeds.

MOUNTAIN.

Name of Breed	Native District
Highland Blackface—C	Scotland
Herdwick—C	Cumberland
Welsh Mountain—C	Wales
Ronaldshay—D	Orkney Islands
Hebridean—D	St. Kilda
Manx—D	Isle-of-Man

HILL.

Cheviot—A	Scotland
Kerry Hill—C	Wales
Gritstone—C	Derbyshire
Shetland—C	Shetland Islands
Radnor—C	Wales

DALE.

Wensleydale, Blueface—C	Yorkshire
Wensleydale, Longwool—C-B	Yorkshire
Cotswold—A-B	Gloucestershire
Swaledale, "Marsham"—C	Yorkshire

HEATH.

Clun Forest—D	Flint and Salop
Penistone—D	Yorkshire
Limestone—D	Westmoreland
Norfolk Horn—D	Norfolkshire

MOORLAND AND UPLAND.

Loik—C	Lancashire
Dartmoor—C	Devonshire
Exmoor Horn—C	Devonshire
Dorset Horn—A	Dorsetshire

LOWLAND.

Lincoln—A-B	Lincolnshire
Devon Longwool—C-B	Somerset and Devon
Leicester, "English"—A-B	Leicestershire
Romney—A-B	Kent
Roscommon—C-B	Ireland
Border-Leicester—A-B	South of Scotland
South Devon—C	Cornwall and Devon

DOWN.

Name of Breed	Native District
Shropshire—A	Salop
Ryeland—C	Herefordshire
Oxford—A	Oxon
Hampshire—A	Hants
Suffolk—C	Norfolk and Suffolk
Southdown—A	Sussex
Dorset-Down—C	Dorsetshire

KEY.

- A—Popular and important breeds.
 B—Longwool breeds suitable for crossing with Merinos.
 C—Breeds seldom found outside of Great Britain.
 D—Very old breeds, likely to become extinct in a few years.

46. British Breeds Classified According to Character of Wool.

(Important Breeds in Large Type)

LONGWOOLS (Coarse Wool Character)

LINCOLN.	Herdwick.
COTSWOLD.	Wensleydale, Bluefaced.
LEICESTER "ENGLISH."	Wensleydale, Longwool.
LEICESTER "BORDER."	Swaledale.
ROMNEY.	South Devon.
ROSCOMMON.	Dartmoor.
Highland Blackface.	Devon Longwool.

MEDIUM WOOLS (Mountain Character)

CHEVIOT.	Penistone.
Shetland.	Lonk.
Radnor.	Hebridean.
Ronaldshay.	Manx.
Gritstone.	Limestone.

MEDIUM WOOLS (Down Character)

SOUTHDOWN.	Ryeland.
HAMPSHIRE.	Exmoor Horn.
OXFORD.	Norfolk Horn.
SHROPSHIRE.	Kerry Hill.
DORSET HORN.	Clun Forest.
Suffolk.	Welsh Mountain.
Dorset-Down.	

This classification furnishes a relative comparison of the length of staple in the fleeces of the various British breeds. In addition to the average length of staple, there is considerable variation

in the character of the wool produced by the different breeds within the same group. In the long-wool breeds there is considerable similarity with the exception of the Herdwick and Scotch Blackface, and these are unimportant. The medium wools of down character as produced by the various down breeds are very similar to one another in character and length. The medium wools of mountain character usually show wide variation in every feature except length, which is about half way between the staple length of the long wools and the medium wools of down character.

All British breeds are named after the county or district in which they originated and in which they are still located. Any stranger traveling through Great Britain by rail can easily tell which county he is passing through by observing the sheep through the car windows as they are grazing. Livestock specialization and intensive farming have proved that the various breeds give the most profitable results in their own localities. In Australia and New Zealand, the various breeds are also located in certain districts for the same reason. In South Africa, South America, and even in Canada, efforts are being made to have each breed located in the most suitable district, and the results so far are very encouraging. In the United States alone, this natural law of the most suitable locality and environment is ignored, as every farmer merely buys the sheep he fancies.

These two lists of British breeds of sheep, one classified according to the original home or territory of the breed, and the other divided into three groups, according to the length and similarity of the wool, have nothing to do with the rules of classing wool, yet they show that the descriptive terms used in the wool trade sometimes differ from those used by breeders. In crossbreeds the International wool terms fortunately fit in very well with those used in Animal Husbandry.

47. Description of Important Long-wool Breeds.—With a few exceptions, all the important British breeds, which are shown in large type in the preceding list, have found favor in the United

States. These wools are better known in the trade as luster and semi- or demi-luster wools, and do not possess good felting properties. They are distinctively combing wools, and are spun on the Bradford system for lustrous dress goods, linings, braids, etc. These luster wools are not raised on an extensive scale in this country, but a small quantity is produced in nearly every State, with Kentucky and Indiana the most important.

48. Lincoln.—This breed is the largest and heaviest of domesticated sheep. It grows about the heaviest fleece of any breed, and averages from 14 to 18 pounds. The Lincoln is a very old breed.

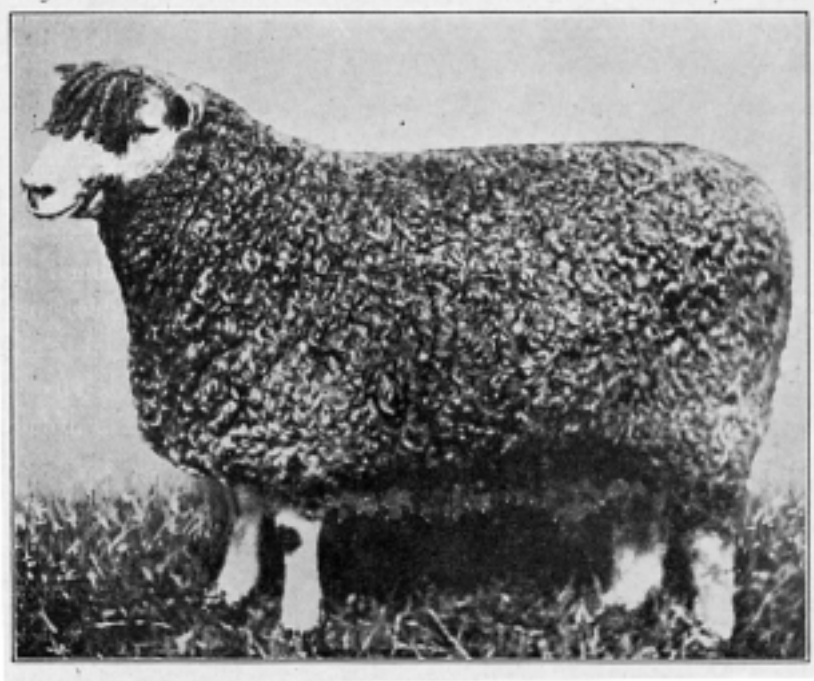


FIG. 16.—Lincoln Shearling Ram.

which originated in Lincolnshire. The original Lincoln was improved by a cross of Leicester blood, which brought refinement to the breed, and improved the quality of the meat, which is of a coarse texture. Lincoln rams vary in weight from 200 to 250 pounds. It grows a very long wool, from 8 up to 15

inches. The wool is noted for its luster, strength, whiteness and soundness. Lincoln sheep can be distinguished by their huge, massive block form. A tuft of wool grows on the forehead. The face, ears and legs below the knees and hocks are covered with white hair. Large numbers of Lincoln sheep are found in Canada, New Zealand and South America.

49. **Leicester.**—This breed was improved by Bakewell, and was the first breed to receive attention. Naturally it was largely used for improving the other British breeds of sheep. Leicester sheep are natives of Leicestershire, Yorkshire, and the South of Scotland. They are very hardy, and thrive especially well in cold, bleak climates. Leicester rams average 225 pounds, and ewes run from 175 to 200 pounds. They have a square outline, with a comparatively high stand. The rump is very prominent and well rounded. They have a broad head, prominent between the eyes, and tapering toward the muzzle with the nose inclined to

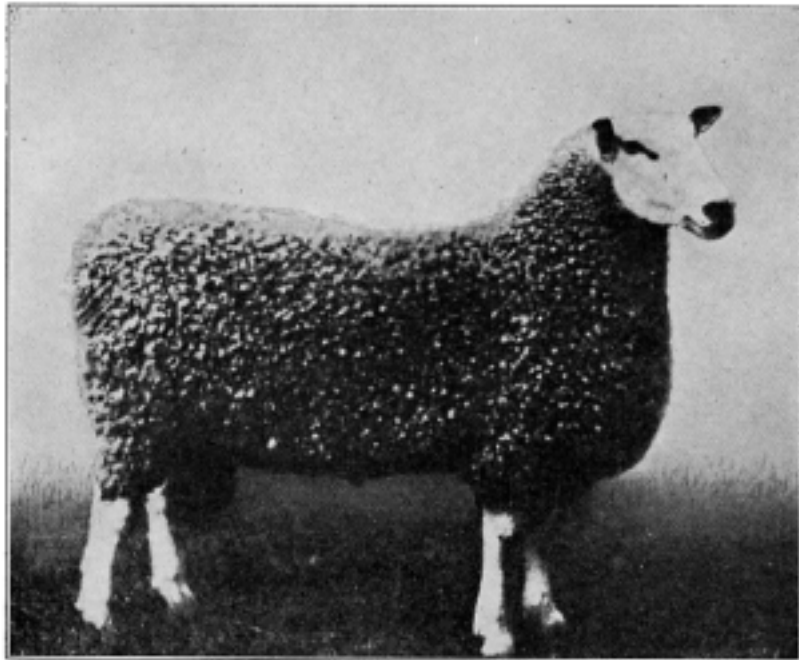


FIG. 17.—Border Leicester Shearling Ram.

be Roman. The ears are fine and well poised. Both ears and face are covered with short white hair with an occasional black spot. The expression of the Leicester countenance is very "sheepy," giving a mild, sleepy and timid effect. Leicester sheep have black hoofs and lips. This breed is conceded to possess the best back of any breed of sheep. The wool runs from 5 to 8 inches in length, color a good white, and the wool falls in ringlets. Leicester wool is much finer than that from the Lincoln sheep. The fleeces weigh from 9 to 11 pounds, and are often bare on the under side of the body.

Between the two types of Leicesters there is a slight immaterial distinction. The Border Leicester has a white face, free from wool, a more rugged appearance, and is the more numerous of the two. The English Leicester, also known as Bakewell Leicester, is the other type, and can be distinguished by its bluish face, and the tuft of wool on its head. Leicester sheep are seldom found in the United States; but find favor in England and Canada.

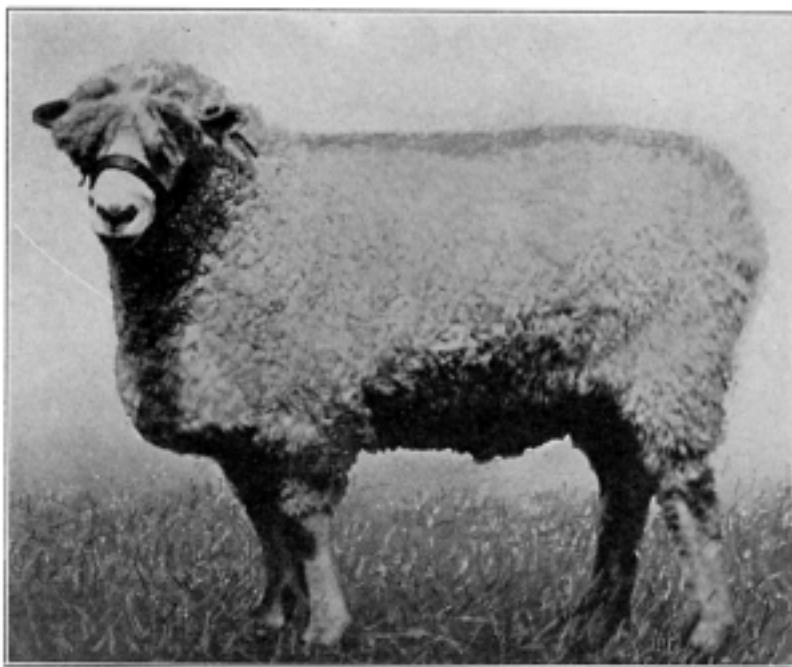


FIG. 18.—Cotswold Ram.

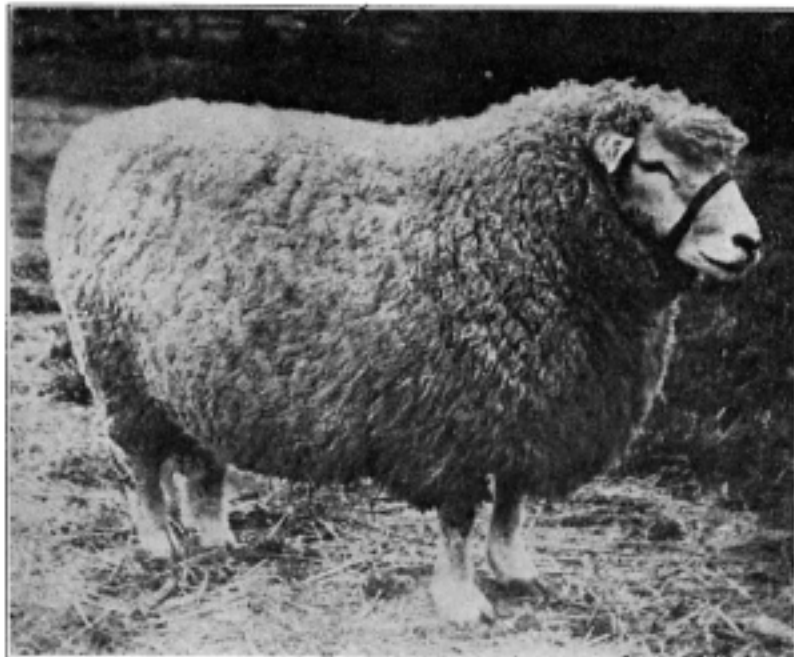


FIG. 19.—Romney Marsh Ram.

50. Cotswold.—This breed takes its name from the Cotswold Hills in Gloucestershire, England. Cotswold sheep closely resemble the Lincoln in many ways. The head is carried high, and grows a heavy forelock, which falls over the face and eyes. The ears and face are covered with white or grayish white hair. The weight ranges from 200 pounds to 250. The fleece, evenly distributed all over the body, is divided into locks, and is open and wavy. The weight of the fleeces is from 15 to 18 pounds. From 10 to 15 inches in length is the average range of Cotswold wool. The Cotswold is much more numerous in the United States than the Lincoln and Leicester breeds, but its principal use outside of England is for crossbreeding purposes.

51. Romney.—There are two divisions of the Romney breed, Romney Marsh and Romney Upland. The Marsh is the most popular. This breed is native to Kent County, England, and as the city of London is right at hand, it is easy to account for this

breed being sought particularly for its mutton qualities. The conformation and wool closely resemble the Lincoln, although the wool is usually finer. Outside of England, the Romney sheep are popular in New Zealand and Argentina for crossbreeding.

52. Roscommon.—This breed is confined to Ireland, and the bulk of the sheep of the Emerald Isle belong to it. The breed is more widely known as “Irish,” and is a good mutton sheep, growing a long, strong, coarse, luster wool.

53. Description of Important Medium Wool Breeds.—The “down” breeds furnish the bulk of the British medium wools. The most important are the Southdown, Shropshire, Hampshire, Oxford and Dorset Horn. The Southdown is named from a range of low, chalky hills, where grass is always green and luscious, known as the “Southdowns” in Southern England. The others are named from the counties in which the breeds were developed.

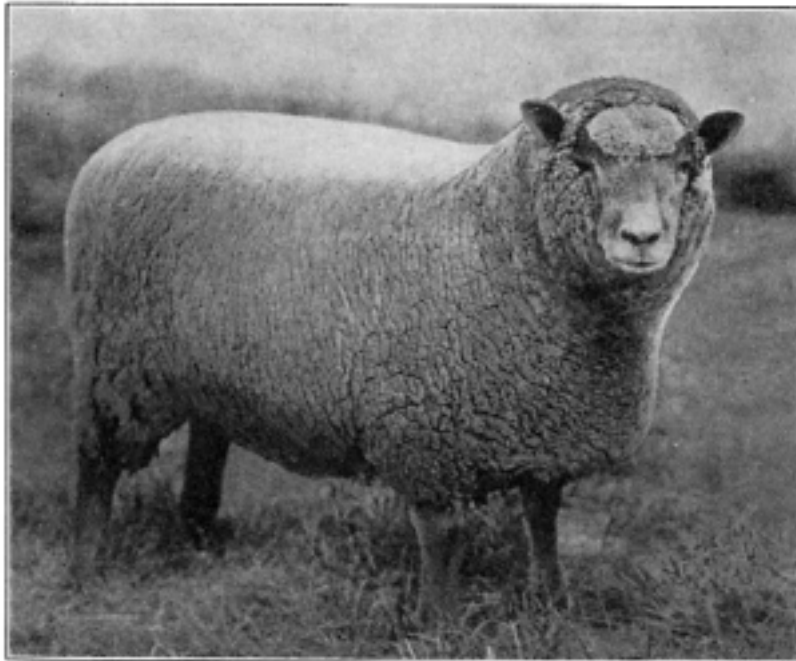


FIG. 20.—Southdown Ewe.



FIG. 21.—Southdowns at Pasturage.

These down breeds are noted for their mutton qualities, and there are no great distinctions in type. The wool is much finer than that of the long wool breeds previously described. It is also much softer, with good crimp, strength and elasticity. At one time down wools were only used on the woolen system, but the improved combing machinery has made them all available for worsteds. The down breeds are the most popular in England, and have found favor in all the important wool-growing countries. Down wools grade from $\frac{1}{4}$ to $\frac{1}{2}$ blood. The usual length ranges from 3 to 5 inches. In the United States, the Shropshire, Oxford and Hampshire are the favored British breeds.

54. Southdown.—This is the smallest of the down breeds, rams averaging 175 pounds and ewes 135 pounds. The Southdown is the oldest, best known and purest breed of this type, the other down breeds being developed from it by improving with such larger breeds as the Leicester, Lincoln and Cotswold. It possesses the most compact, broadest, deepest, lowest down and most thickly fleshed form of any sheep. The head is unusually short, wide between the eyes, and rather fine. The ears are short, small,

pointed, and covered on the outside with little tufts of wool. Below the eyes, the face is without wool, and is covered with brownish, gray hair. The cheeks and forehead are well covered with wool. The legs are covered with brownish gray hair like the face. The Southern fleece is very dense and light shrinking, grading $\frac{1}{2}$ and $\frac{3}{8}$ blood. The fleeces weigh from 6 to 8 pounds. The wool is short and evenly distributed.

55. Shropshire.—This has only been recognized as a distinct breed since about 1860, but it has come into strong favor. It was evolved by using Southdown rams on native ewes of Shropshire and Staffordshire. The Shropshire is a very popular breed in this country, and thrives well in nearly all sections. It is considerably larger than the Southdown, being intermediate in size, rams weighing 225 pounds and ewes from 150 to 160 pounds. The fleece is evenly distributed, weighing from 8 to 12 pounds. The fleeces are liable to grow black or brown spots of wool, espe-

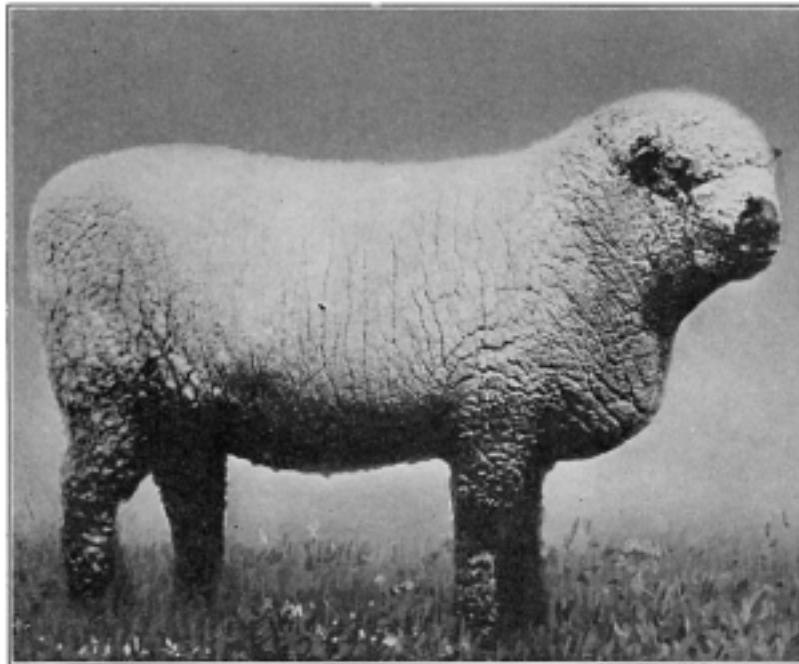


FIG. 22.—Shropshire Ram.



FIG. 23.—Hampshire Ewe.

cially around the head. The head is carried high and very alert. The general carriage and appearance of the sheep are best described as stylish. An unusual feature found in this breed is the covering of the legs with wool. The head is completely covered with wool, except the tip of the nose, which is covered with heavy dark brown hair. The ears are stubby, yet pointed, and covered with fine tufts of wool.

56. Hampshire.—The Hampshire is one of the oldest and largest of the mutton breeds, and is found in large numbers in the United States. Rams weigh 250 pounds and ewes 185 to 195 pounds. This breed is noted for the quick growth of its lambs. Hampshire sheep are characterized by a large head, Roman nose, large ears extending straight out, dark brown or black hair on face and ears, and woolled on the forehead and cheeks. They are big boned, especially in the head and legs. The fleece is one of

the poorest of the down wools, running light, open, uneven and short. The wool grades with Southdown for fineness.

57. **Oxford.**—About 1830 the Oxford breed was established, and it is the result of a Hampshire-Cotswold cross. The Oxford is the extreme mutton type, the back and hind quarters are unusually heavy. It is the heaviest of the down breeds, rams weighing from 250 to 350 pounds and ewes from 180 to 275 pounds. The Oxford resembles the Shropshire to a considerable extent. The head is woolled only to the line between the eyes, and is longer than the Shropshire wool. The face is covered with grayish brown hair. One of the most noticeable differences is the covering of the ears and legs with brown hair instead of wool. The ears are also longer and finer than those of the Shropshire, but are carried in the same alert manner. The fleeces are the heaviest, longest and coarsest of the down breeds, weighing from

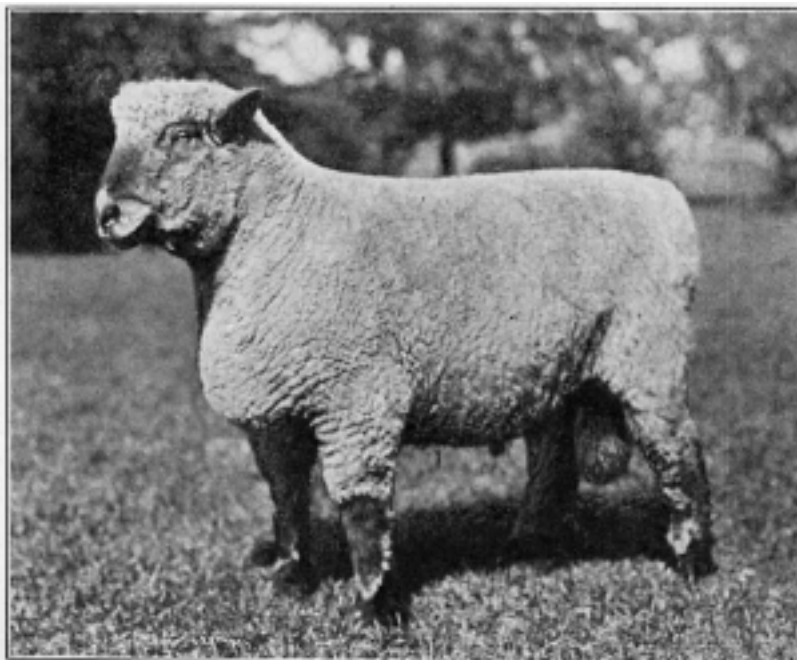


FIG. 24.—Oxford Ram.

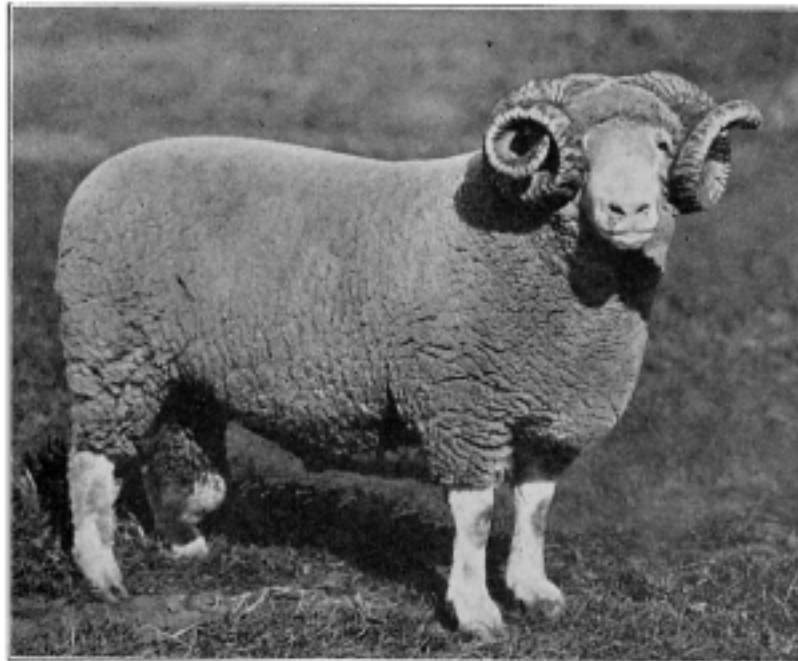


FIG. 25.—Dorset Horn Ram.

9 to 13 pounds. The Oxford is continually gaining favor in this country.

58. Dorset Horn.—This breed has received much prominence in recent years, owing to its adaptability for breeding so-called “hot house” or winter lambs. The breed has proven its ability to readily change its lambing season to suit the desires of the sheep breeder, and for this reason they are in good demand for breeding lambs ready for the market in the late winter from Christmas to spring. They are also very prolific. Naturally it is most profitable to keep these sheep in fair proximity to good-sized cities, both for shipping convenience and opportunity for the owner to keep in close touch with the demands of the market for his lambs. The Dorset Horn is intermediate in size, rams averaging 250 pounds and ewes 160 pounds. As the name signifies, the breed has prominent horns, which are formed in a close spiral curving forward. The head grows a wool foretop, with

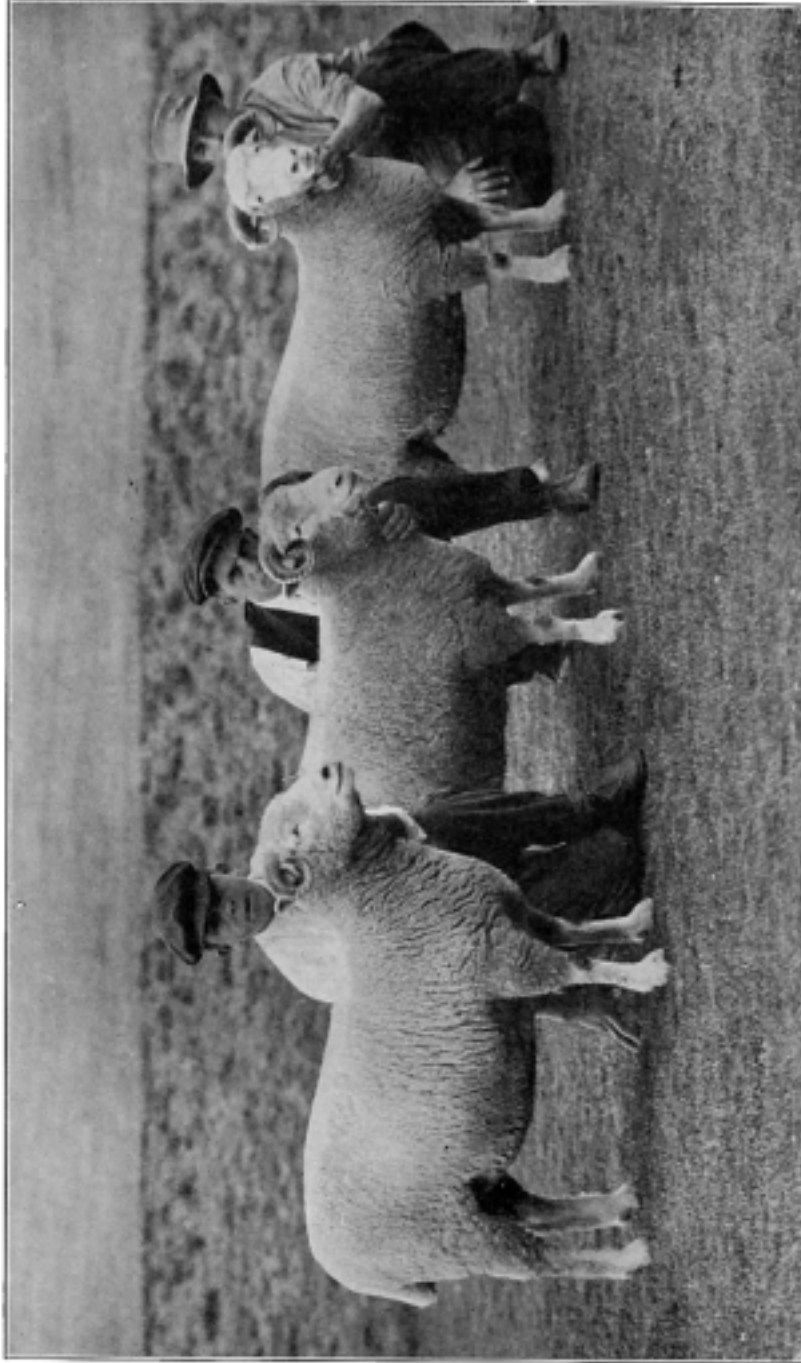


FIG. 26.—Dorset Horn Yearling Lambs.

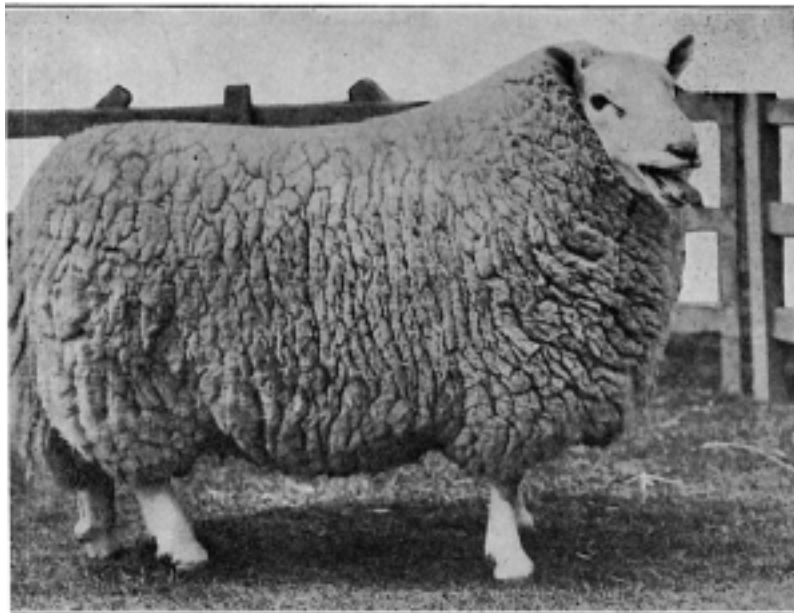


FIG. 27.—Cheviot Ram.

the face and ears covered with fine white hair. The wool is short and light shrinking, grading in fineness about halfway between the Southdown and the Oxford. The fleeces are light, averaging from 6 to 7 pounds. The fleeces also run uneven and are bare on the belly.

59. **Cheviot.**—The Cheviot sheep are natives of the Cheviot Hills of southern Scotland. They are of medium size, rams average 200 pounds and ewes 150 pounds. They furnish high-grade mutton. The wool grown has a harsh, wiry feel, which gives the distinguishing character to the best grades of Scotch and English “cheviot” suitings and overcoatings. The fleece is lighter and more open than the average fleeces of the down breeds, yielding about 5 pounds of washed wool. The Cheviot fleece runs even, the wool is pure white, averaging about 8 inches, thus exceeding the down wools in length. Owing to their light fleeces and medium weight, Cheviot sheep have never been extensively raised outside of Scotland. The distinguishing features are a

broad head between the eyes. The eyes are very bright and alert. The ears are carried erect, and the head, ears and legs are covered with fine white hair. The fleece ends abruptly with a "ruff" just back of the ears and about the throat.

60. Crossbreds.—This class of sheep is becoming a greater factor every year in the world's wool production. A crossbred, in the general meaning, is the offspring which results from mating a ram and ewe of two distinct breeds. The term "crossbred" is specifically applied to sheep in South America, South Africa, New Zealand and Australia, which have been produced by breeding Merino sheep with one of the mutton breeds of sheep, either of the long-wool or medium-wool breeds. In most cases, the long-wool breeds are used, as the resulting crossbreds are much heavier than those bred from the down breeds. The most popular long-wool breeds for crossbreeding are the Lincoln, Cotswold, Romney Marsh and Leicester. The usual method is to breed long-wool rams with Merino ewes.

Crossbred wools are divided into coarse, medium and fine wools. Coarse crossbreds are below $\frac{1}{4}$ blood and range from 12 inches down in length. They are lustrous, harsh, possess indifferent felting properties and are fairly strong. Medium crossbred wools include those grading $\frac{1}{4}$ and $\frac{3}{8}$ blood. The length is 10 inches and downward. These wools are very strong, lustrous, soft and possess fair felting properties. Fine crossbreds include those of $\frac{1}{2}$ and $\frac{3}{4}$ blood qualities. The length is 6 inches and downward. They are very strong, with fair luster, good color, soft handle and good felting properties.

Pure bred mutton rams to be used for crossing with Merino range ewes in this country are mostly secured from breeders in the Northern Central States, the Province of Ontario, Canada, and certain districts in the Pacific Coast States. Some of the valleys in the Coast States are favored with a climate similar to England. In these districts old-country methods are possible. The most important of these districts is the Willamette Valley in Oregon. It contains about 5,000,000 acres, mostly devoted

to raising Cotswold, Lincoln and Leicester rams for the range. Some of the down breeds are also found here for the same trade.

61. Purpose of Crossbreeding.—The object of crossbreeding is to obtain a dual-purpose sheep, one which possesses the strong points of each breed to a considerable extent. The Merino is used to give a comparatively fine fleece, and one of the British breeds to improve the weight and form of the sheep and the quality of the mutton. The result gives the sheep owner a high return for both his mutton and wool. The practice has been carried out systematically in New Zealand, South America, Australia and South Africa. Great care and judgment must be exercised in selecting the best adapted breed, and types from the selected breed, to cross with the ewes. The breeder aims to constantly improve his flocks by selecting rams possessing features which will improve any present deficiencies in his flock. A knowledge of the original conditions in the home of the breed rams, such as climate, pasturage, profligacy and disposition, is of great value in determining their usefulness for crossing. The conditions, in the country where the crossbreds are to be raised, should be as near to the home conditions of the breeding ram as possible. The climate, pasturage, soil, etc., vary considerably in different parts of the same country, and what might be the best breed for one section could be a failure in another section. Before breeding season, the ewes should be divided according to the grade of their fleeces, and the rams should be classified in the same manner. By proper selection, the breeder is then able to mate his sheep to produce a fairly uniform crop of lambs, all of the same general form and size, and the fleeces will all grade together.

Unfortunately, there has been little systematic crossbreeding in this country, but recently interest has been aroused. In the past, crossbreeding was conducted in a very haphazard manner in the West, no record being kept of the results obtained, and little attention given to selection. The most popular British breeds used for crossbreeding in the United States are the Cotswold, Hampshire, Oxford, Shropshire and Lincoln. Australia

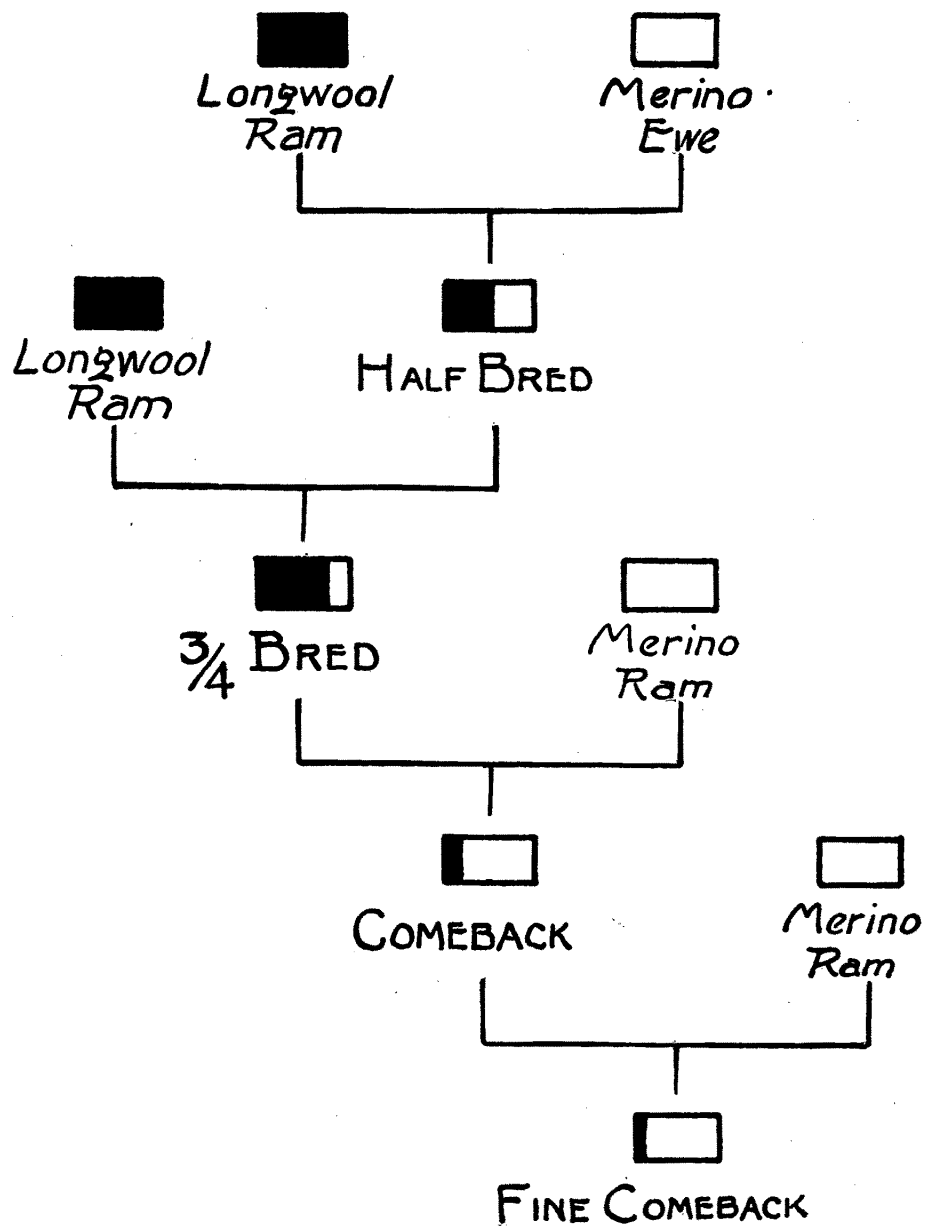
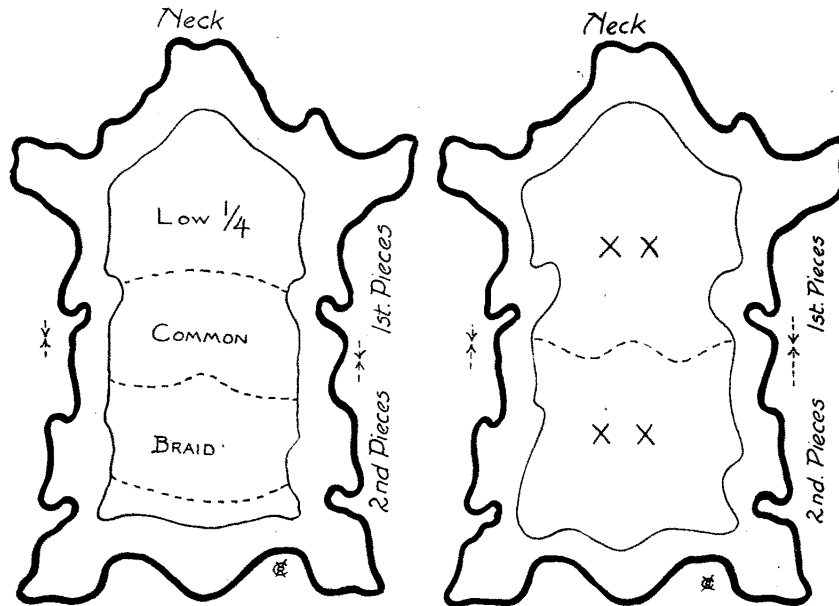


FIG. 28.—Graphic Chart Illustrating Systematic Crossbreeding.

and South Africa are the only important wool-growing countries where the Merinos outnumber the mutton types. About 15 per cent. of the wool grown in Australia is crossbred, and the remainder is Merino wool.

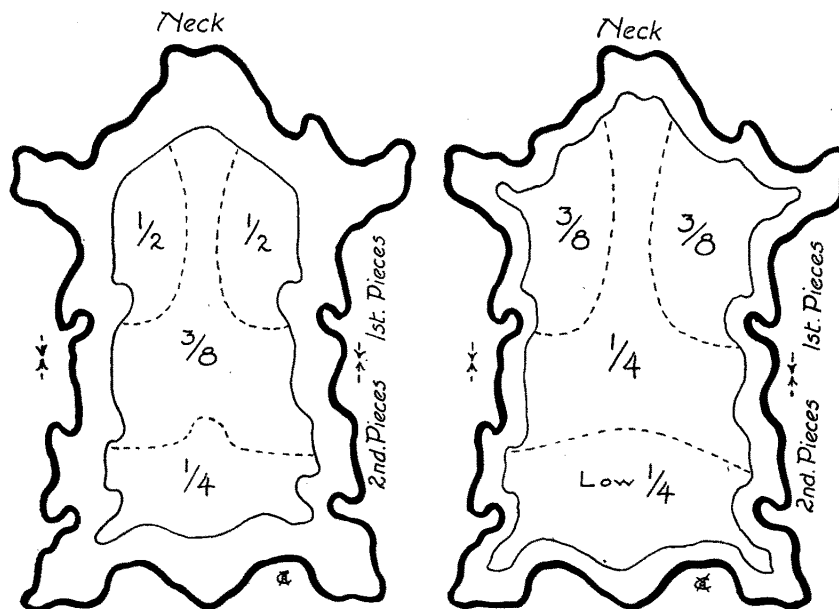
62. Results of Crossbreeding.—The following description shows the possibilities and results of scientific crossbreeding, and is illustrated in the drawings of fleeces showing the grades of wool produced by each cross. Consider the crossing of a pure-bred Merino ewe and a pure-bred Lincoln ram, bearing in mind the distinguishing features of each, such as size, form, and the grade and character of the fleece. The result of the cross is a "halfbred." The halfbred ewe is crossed with a pure-bred Lincoln ram, resulting in a "three-quarter bred," which would possess three-fourths Lincoln or long wool, mutton-type blood, and one-fourth Merino or fine wool blood. The terms used do not signify the grade of the wool produced. Breeding any farther than this point toward the coarse wool is seldom practiced. The next breeding step is to breed the three-quarter-bred ewe with a pure-bred Merino ram. The offspring is known as the "comeback," as it loses a considerable part of the Lincoln features and approaches the Merino. The wool produced by this cross is often known in the trade as "comeback." The final cross is produced by mating the "comeback" ewe with a pure-bred Merino ram, and the offspring is called "fine comeback." The halfbred and comeback are very similar; the latter favors the Merino a trifle more than the halfbred and has a slightly finer fleece.

The natural supposition would be that the cycle would repeat itself by crossing the fine comeback with a Lincoln ram; but unfortunately this cross brings poor results, the offspring being irregular and of a nondescript character. Large numbers of these irregular crossbreds are raised in the West with poor returns to the sheep grower, as the fleeces are light, uneven and often weak. The proper method is to cross the halfbreds and comebacks with Corriedale rams, which will hold them as halfbreds year after year with care and proper selection. The other alter-



British LINCOLN

British MERINO



British HALFBRED

British 3/4 BRED

(Continued on next page)

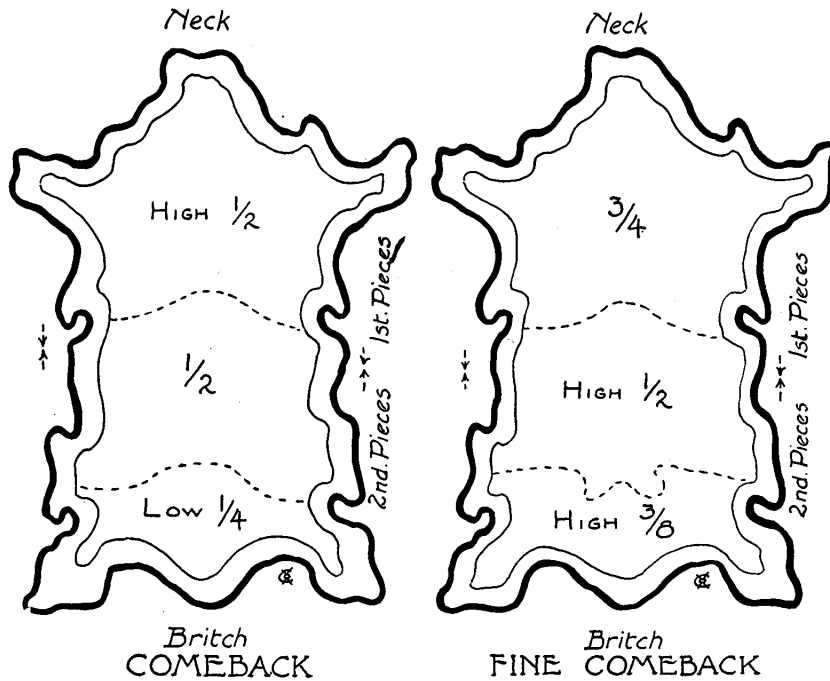


FIG. 29.—Diagrams Illustrating Fleeces Produced by Crossbreeding.

native is to send all the fine comebacks to the butcher and start over again. Romney and Leicester rams on Merino ewes will produce finer wool on the resulting crossbred sheep than the coarser long-wool breeds, such as Lincoln and Cotswold. Crossbred sheep, developed from Merinos and any of the down breeds, naturally produce finer wool than the long-wool crosses, but the down breeds are not used for crossbreeding to the same extent as the long-wool breeds. The contrast between the Merino and down breeds is not so marked as that between the Merino and long-wool breeds. The resulting crossbred sheep from the latter cross are much heavier than those produced by the Merino-down breed cross, and furthermore the wool produced by the crossbred sheep of the long-wool-Merino type is much longer in staple. All the crossbred wools are suitable for worsted manufacture.

An excellent example showing the difference in staple length on medium-wool Merino and long-wool Merino crossbred sheep re-

sulted from breeding experiments by the Agricultural Experiment Station of the University of Wyoming at Laramie. The wool was passed upon by Prof. J. A. Hill, Station Wool Specialist. Two lots of Merino-range ewes were mated respectively with Southdown and Cotswold rams of good type and breeding. The resulting lambs were dropped in the latter part of March and shorn on the second of the following January, the fleeces representing a little over nine months' growth. The fleeces from the Southdown grades, graded as $\frac{1}{2}$ blood, averaged 2.75 inches in staple growth, and the average shrinkage was estimated at 51 per cent. Sixty per cent. of the fleeces from the Cotswold grades were graded as $\frac{3}{8}$ blood and the remainder as $\frac{1}{4}$ blood. The average staple length was 4.1 inches and the average shrinkage was estimated at 43 per cent.

63. Carpet Wools.—As the name indicates, these wools are principally used in the manufacture of carpets and rugs. They



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FIG. 30.—Native Sheep of Egypt.

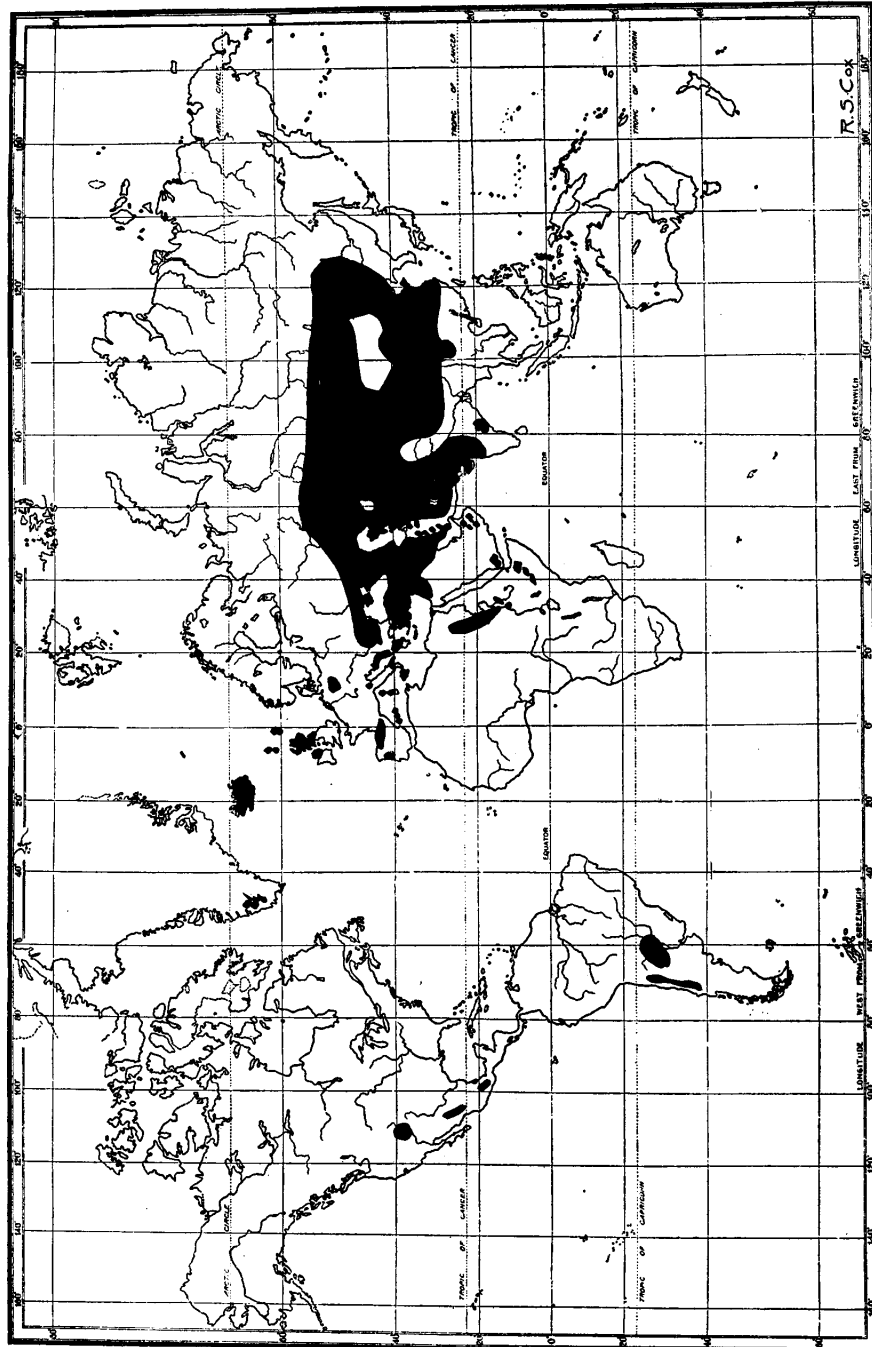


FIG. 31.—Map of World Showing Source of Carpet Wools.

are mostly produced in Asia and Southeastern Europe by unimproved native sheep, most of which are the fat-tailed sheep which are valued more for the oil and fat obtained from the carcass than the wool grown. Most of these sheep are sheared twice a year. Large quantities of carpet wools are "pulled" or "skin" wools, obtained from the pelts of slaughtered sheep. The great bulk of these wools is produced in Asia, Russia and Asia Minor, although practically all parts of the world contribute a limited amount. The fleeces are very light, uneven, coarse and kempy. These carpet wools are inferior to those previously described in the other three classes. Most of the carpet wools are only suitable for wool-spun yarns for use in low-grade Axminsters and Smyrna rugs, art squares and ingrains. Some of the better varieties are of good length and quality, and make good combing wools for Wilton, Brussels and Tapestry carpets and rugs.

At times when wools of the other classes are high in price, cloth manufacturers turn to the better of the carpet wools for relief, but these wools do not give the same results as those they replace. Some of the better grades of carpet wools are mixed with other wools in the manufacture of coarse fabrics, such as the cheaper grades of cloakings, overcoatings, coarse tweeds and cheviots. Some grades are also used for felt boots, horse blankets, coarse upholstery goods, robes, paper makers' felts and wadding for gun cartridges. A large source of supply for carpet wools other than those produced by unimproved native sheep, are the skirtings, britch, badly cotted fleeces, tags and pieces from braid and coarse domestic and crossbred wools. Carpet wools are comparatively coarse, and are usually graded as coarse, common, medium and good. The following table contains most of the important varieties of carpet wools, together with the country of production, and character and usual grade of the wool. Many of the wools included in this table come on the market as pulled, skin or tanners' wool.

64. List of Important Carpet Wools.

Variety of Wool	Producing Country	Character	Grade
Scotch black-faced or highland wool.	Great Britain	Long staple, strong combing	Common to med.
Oporto	Portugal	Good staple, luster combing	Medium
Sardinian	Italy	Long staple, straight fibered	Coarse
Iceland	Iceland	Straight fibered combing	Medium
Turkish	European Turkey and Balkans	Long, strong combing	Coarse
Donskoi	Russia	Long, straight fibered combing	Medium
Crimean	Russia	Long, straight fibered combing	Medium
Bessarabian	Russia	Long, strong combing	Coarse
Georgian Toucha	Russia-in-Asia	Short to medium staple	Good
Georgian Nouka	Russia-in-Asia	Short to medium staple	Medium
Turkestan	Russia-in-Asia	Short to medium staple	Medium
Bokhara	Russia-in-Asia	Mostly colored medium staple	Medium
Camel Hair	Russia-in-Asia	Varies	Varies
Afghan	Afghanistan	Medium to long staple combing	Medium
Mongolian	Mongolia	Very kempy, medium staple	Common
Angora	Asia Minor	Good sound staple	Good
Smyrna	Asia Minor	Good sound staple	Good
Aleppo	Syria	Good sound staple comb- ing	Good
Bagdad	Mesopotamia	Mostly brown and black, good sound staple	Good
Avassi	Mesopotamia	Good sound staple comb- ing	Good
Karadi	Mesopotamia	Good sound staple comb- ing	Good
Kandahar	India	Both short and long staple	Medium
Joria	India	Short staple	Varies
Marwar	India	Short hairy staple	Coarse
Thibet	India	Medium to long staple combing	Medium
Woosie	China	Short staple	Common to med.
Kinchow, etc.	China	Very kempy, short to medium staple	Coarse to med.
Egyptian	Egypt	Long, lustrous combing	Medium
Soudan	Egypt	Short staple	Common
Valparaiso	W.Coast, S. Amer.	Long, sound staple	Good
Cordova	Argentina	Long, sound staple	Good
Mexican	Mexico	Mostly short staple	Coarse to med.

65. Miscellaneous Breeds.—The Corriedale, Iceland and Tunis sheep have not been included among the British types, as they had their origin outside of Great Britain. They are long-wool sheep and good mutton types. Peculiar and special breeds of sheep, which do not come under the classification of the breeds of sheep as described in this chapter, are also considered a part of the miscellaneous group.

66. Corriedale.—Authorities disagree as to the breeder originating this breed, which has been established during the past twenty-five years. The difference of opinion is probably due to several breeders working along the same lines and reaching identical results about the same time. One fact is certain, that the home of this breed is the Province of Canterbury, South Island, New Zealand. The type was evolved by crossing the Merino with coarse-wooled Lincoln and Leicester sheep, and then breeding in again by recrossing their progeny until the desired ideal was



FIG. 32.—Corriedale Sheep.

obtained. The Corriedale is an excellent dual-purpose sheep, both its wool and mutton commanding top prices. Selected breeding stock has been sent from New Zealand to Australia, Patagonia and the United States. The Corriedale has retained the block or mutton form of the Lincoln or Leicester from which it was bred, and also grows a very fine wool for such a type, noted for length and sharp regular crimp. The breed retains the herding and grazing properties of the Merino, and possesses a very vigorous constitution. It is especially efficient in hilly districts and snow ranges. The average weight of Corriedale fleeces is 20 pounds for rams, 14 pounds for wethers, and 12 pounds for ewes.

67. *Iceland.*—The sheep of Iceland are the old Norse breed, and there has been practically no mixture with other breeds, as the government has forbidden the importation of sheep for fear of the introduction of disease among the flocks. Little attention is given to the breeding and care of the sheep and wool. The sheep are of medium size, possess a fair mutton carcass, and usually show prominent horns curved downward in both sexes. The fleece is similar to Lincoln wool for quality, but shows a far superior luster, which is its distinguishing characteristic.

Iceland sheep produce an unusually heavy undergrowth of wool in the fleece, and on this account are known as "double-decked" sheep. A peculiar feature of Iceland wool is that the noil is more valuable than the top. When buyers are inspecting this wool more serious thought is given to the percentage of noil which it will yield than the yield after scouring. It is unusually soft and lustrous, and is very desirable for certain knitted and woven fabrics where a high luster is necessary. Unfortunately the supply is very limited, as the flocks of Iceland only number about 900,000 head. Practically all of the wool is shipped to Copenhagen and Liverpool in July and August, and only a small amount finds its way to this country.

In winter the flocks are kept in stables and fed with hay. By the end of April they are turned into the field to graze. The

lambing season begins about the middle of May, and the weaning season begins at the middle of June. Before weaning, the ears of the lambs are branded to indicate the owner. Each farm has its own earmark, which is officially registered. After the weaning season the mother sheep are kept in a movable sheep pen near the farmhouse, and milked every morning and evening. The lambs and dry sheep are driven into the mountains to graze without the care of a shepherd. In September, men are sent out to round up the sheep and drive them down to the farms.

The farmers in the northern part of the island have given more attention to the care of their sheep and the preparation of the wool for the market. These farmers shear the wool from the sheep, but in the southern and western parts of Iceland the wool is usually pulled from the sheep. The wool is sheared or pulled from the sheep in May and June, and then washed by the farmer in his home.

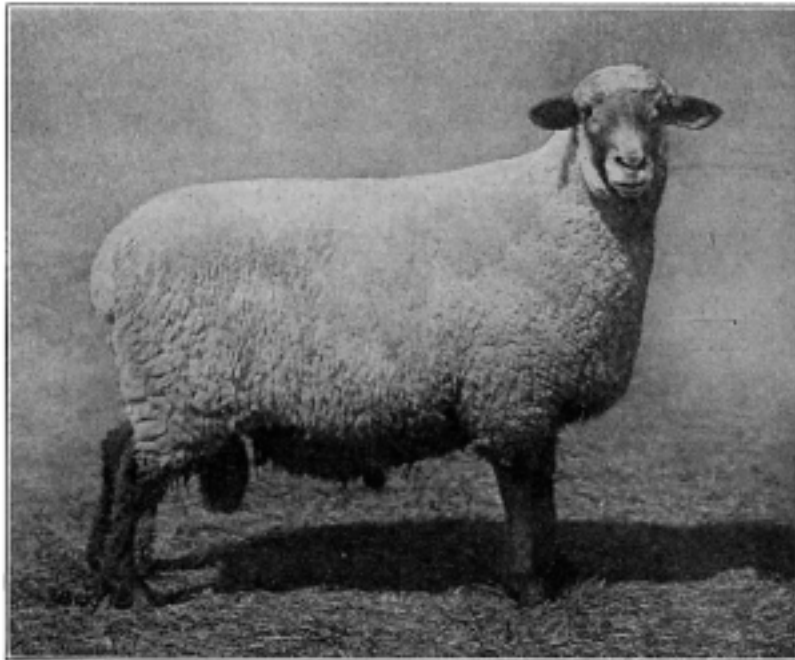


FIG. 33.—Tunis Ram.



FIG. 34.—Winter Lambs with Ewes.

68. Tunis.—This breed is a native of Tunis, in Northern Africa, and was first brought to this country in 1800. It has never become important, but recently has received considerable attention from breeders on account of its mutton qualities and its ability to produce winter lambs. The Tunis is of excellent mutton form, is intermediate in size, with the head and legs covered with reddish-brown hair. The breed is without horns. Tunis sheep grow a very long and coarse fleece resembling Cheviot wool in character. The fleeces weigh from 6 to 12 pounds.

69. Karakul*.—The Karakul sheep are natives of Bokhara, a principality under Russian protection in Central Asia. Bokhara is bordered by Turkestan on the north and Afghanistan on the south. A few Karakul sheep are kept in the territory adjoining Bokhara, and some Karakuls are found in Persia, but the stock

* From United States Government pamphlet "Karakul Sheep," by F. R. Marshall, L. L. Heller and V. O. McWhorter, Animal Husbandry Division, Bureau of Animal Industry.

common to that country and known in the United States as Persians are not valuable as fur producers. The number of sheep in this territory is estimated at from 3,000,000 to 4,000,000. The value of these sheep lies in the fur obtained from the lambs. The common practice is to kill the lambs when but a few days old, as the character of the curls deteriorates with greater age. The skins of prematurely born lambs have value as furs, but ewes are not sacrificed to secure them. The furs obtained from the young Karakul lambs are known as Persian lamb, Astrakhan and Broadtail. These skins are all black in color, but vary in the character of curl. Persians have the most pronounced, most uniform, and tightest curls and the greatest value. Astrakhans have longer hair, the curl is much more open, and usually has less luster or gloss than the Persian lamb. Broadtail skins are taken from lambs prematurely born. Their hair is shorter than on Persian skins, and instead of being tightly curled it is swirled and exhibits a very attractive wavy pattern. In each of these classes of lambskins there are varying grades. The annual exportation of lambskins from Bokhara averages about 1,500,000. The skins are collected by dealers and traders, most of them to be resold at the annual summer fair at Nijni Novgorod, in Russia, 272 miles by rail east of Moscow. About 166 skins are packed into a bale and ordinarily not assorted for export to various countries until after becoming the property of the dealers, largely Germans from Leipzig, who purchase them at Nijni Novgorod. In Leipzig the skins are sorted into uniform lots for export to various parts and a few are also dyed, though as a rule the dyeing is not done until the skins reach the firm by which they are to be made up for wearing apparel.

The Karakul is a sheep of medium size, with black face and legs, and a long, coarse fleece of some shade of gray ranging in length from 6 to 10 inches. It is classed as carpet wool. The conformation of the Karakul does not commend it as a mutton producer. The breed is described as "broad-tailed." It has the narrow back and flat sides common to sheep not bred for meat



FIG. 35.—Karakul Ewe and Lamb.

production. A depression back of the shoulders and a high loin are usually present. The face is narrow and decidedly Roman-nosed. The ears are small, pendulous, and set somewhat low.

Karakul sheep were first introduced in the United States in 1909. The production of these furs in this country appears to be feasible and to present commercial possibilities. The importations have consisted chiefly of rams, which have been mated with ewes of other breeds to determine what class of the readily available ewes are most valuable for mating with Karakul rams to produce lambs having good skins. Flocks owned in Texas, Kansas and New York now comprise over 1000 head of sheep having one-half or three-quarter Karakul blood. Besides these grades, there are 60 rams and ewes that are either imported or descended from imported stock. The imported rams have been largely used upon long-wool ewes, with Cotswold and Lincoln ewes having the preference.

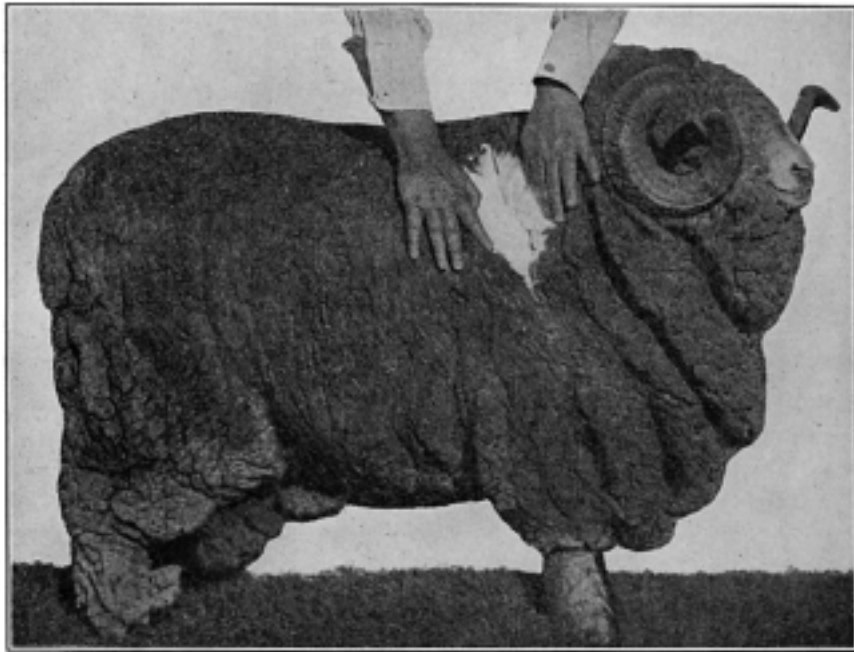


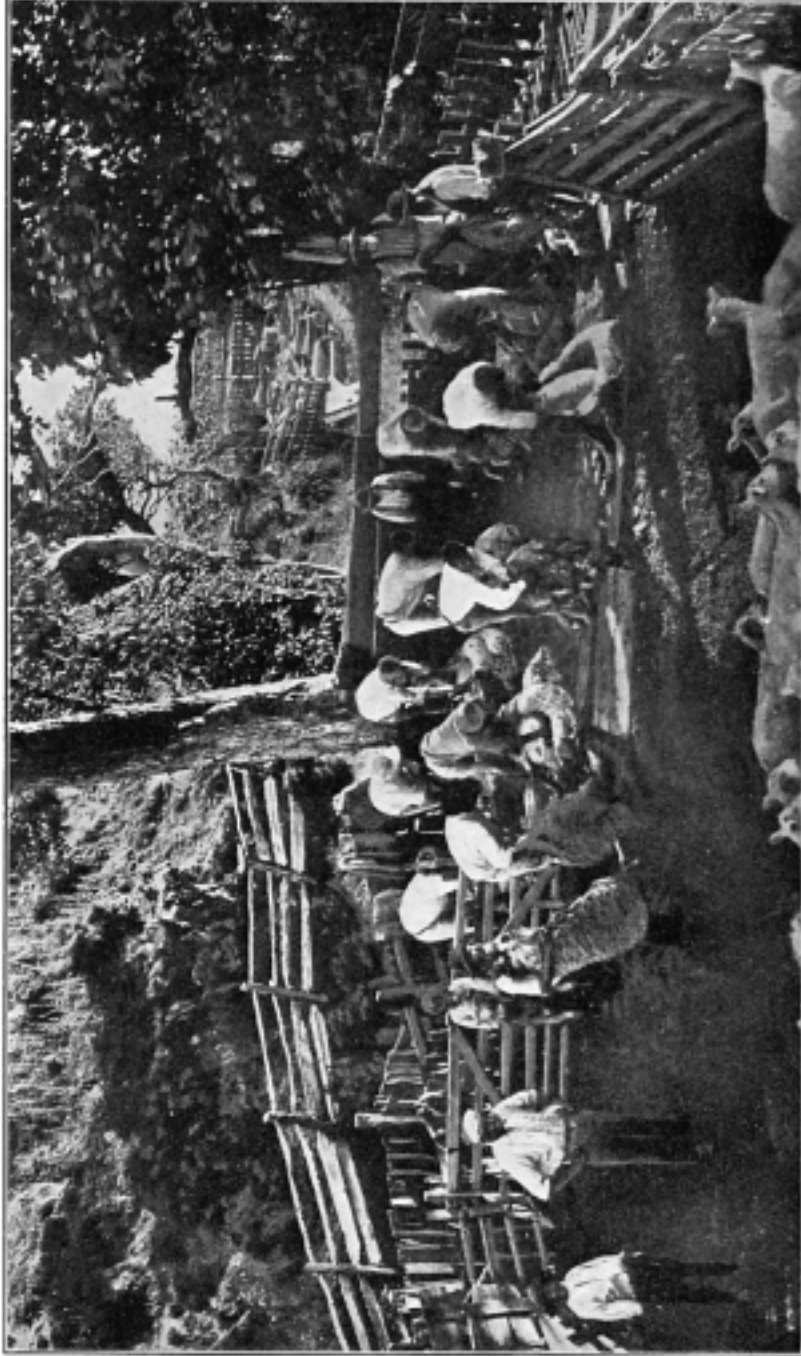
FIG. 36.—Australian Merino Ram, Showing Method of Examining Fleece on Sheep's Back.

CHAPTER III

SHEARING, PREPARING AND MARKETING WOOL

70. Method of Shearing.—The great bulk of our sheep are now sheared by power clippers, although hand clippers are still used in the East and Middle West where the flocks are small. The invention of the machine shear only dates back about twenty-five years, but only about one-fourth of the world's sheep are now sheared by hand. Sheep shearing requires considerable skill, and experienced shearers average between 175 and 200 head per day, as against 100 head as a high figure for expert hand shearers on our Western ranges. The individual Australian shearing record for one day of eight hours is 316 head. The machine shears clip the wool evenly, leaving a uniform stubble of about a quarter of an inch on the sheep's back, whereas with the hand shearing the stubble is often uneven. The yield of wool per head is naturally increased by the close shearing, and the increased weight gained in this manner is estimated at about 5 per cent. The fleece is also in better condition after machine shearing, as there is less danger of cutting the fibers and tearing the fleece apart. The machine shears frequently leave a slight scratch or two on the sheep's skin, and occasionally through carelessness the shearer cuts under small pieces of flesh, and these adhere to the wool growing from them and often carry through to the card. Owing to their numerous folds, American Merino sheep cannot be sheared advantageously with machine shears.

The cost of shearing in this country averages 10 cents per head. This figure includes rolling and tying the fleeces and packing them in bags, but does not include the cost of the bags. The Australian cost is about 8 cents per head, and this price includes the cost of skirting and classing, which amounts to about 1 cent per head.



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FIG. 37.—Shearing Sheep with Hand Clippers near Auckland, New Zealand.

71. **Shearing Season.**—The spring of the year is the season for shearing. Some sections of the country, where the climate is favorable, such as California, New Mexico, Arizona, and Texas, start shearing in late March or early April. The bulk of the shearing in this country is performed in May and June. Some wools are clipped semi-annually in the spring and fall; the most important of these wools are Texas and California.

In the southern hemisphere the seasons are reversed; the spring season comes at the same time as our fall season. The shearing



FIG. 38.—Machine Shearing in Wyoming.

months for Australia, New Zealand, South Africa and South America are October and November.

72. **Weight of Fleeces.**—Fleeces vary in weight according to the breed and sex of the sheep. In the previous descriptions of the various breeds the average fleece weights of each breed are given. Male sheep, rams and wethers (castrated male sheep) are larger and heavier than ewes and lambs, and naturally yield heavier fleeces. The combined average weight of Australian Merino fleeces is about 8 pounds. Australian Merino rams aver-

age 17 pounds; wethers, 13 pounds; ewes, 10 pounds, and lambs, 2½ pounds. Specially selected stud rams have yielded fleeces weighing 30 pounds.

73. Method of Machine Shearing.—Shearing plants have been installed at various convenient locations on the sheep ranges. The buildings consist of long sheds, with shafting driven by a gasoline engine, extending the full length of the shed on both sides of the shearing space. Shearing machines are placed at convenient intervals and receive their power from the shafts. One shearer operates each shearing machine. The sheep are driven to the shearing sheds from the range in large flocks of 2000 or more, and are placed in large corrals next to the shearing sheds. Suitably fenced inclines lead from the corrals to each shearer's stand. When the shearer is ready to start a number of sheep are driven into each chute. The shearer reaches into the chute and pulls out a sheep. The sheep is forced into a sitting position between the shearer's knees by skillful manipulation on the part of the shearer. The shearer now proceeds to shear the fleece, guiding the clipper with the right hand. When the entire fleece is removed the sheep is driven into another chute, which leads into the count-



FIG. 39.—New Shearing Sheds and Range, Bitter Creek, Wyoming.

ing pen. On the way to the counting pen the sheep are branded. As the wool grows it carries the brand mark with it so that it is always easy to distinguish. Helpers fold the fleeces with the dirty side of the fleece inside, and tie them tightly as fast as the shearers throw them on the floor. Each fleece is folded and tied separately, and then placed in a long burlap bag. These bags are hung from a suitable framework, and a man tramps the fleeces down as closely as possible as they are thrown in. From 300 to 400 pounds of wool are placed in each sack.

74. Australian Method.—In Australia, each ranch possesses its own shearing plant, or a small number of ranches combine and establish a co-operative shearing shed conveniently located. One important feature practiced in Australia and usually omitted in this country is sweating the sheep prior to shearing. The sheep are transferred from the gathering pens to the sweating pens, which in turn are next to the catching pens from which the shearer takes the sheep. The temperature of the sweating pens is usually 10 degrees or more greater than the normal temperature. The sheep are closely herded together in the sweating pen for two hours during the day or eight hours during the night. Sweating causes the yolk to flow more freely, thereby putting the wool in the best possible condition for shearing. The sheep shear much easier when sweated. The actual shearing is performed in the same general manner as the shearing in this country, except that the shearers handle the sheep more skillfully and gently, and the belly wool is usually shorn separate from the rest of the fleece. Great care is taken to protect the fleece from contact with foreign substances. After the fleece has been removed from the sheep the Australian method of preparing it for the market is widely different from ours.

The fleece, usually $9\frac{1}{2}$ x $4\frac{1}{2}$ feet, is taken to the skirting table and is skilfully thrown on it in such a way as to spread out evenly over it. The skirting table is usually about 10 x 15 feet in size and the top of it is a grid composed of wooden

slats placed five-eighths of an inch apart. Two skirter usually work together at each table; one skirter operates on the fore parts of the fleece and the other man skirts the hind parts. Skirt-



FIG. 40.—Sheep Entering the Sweating Pens, Bitter Creek, Wyoming.

ing separates from the main portion of the fleece inferior and heavy shrinking parts, such as tags, leg pieces, neck pieces, bellies, locks and stained parts. The various skirtings just enumerated are separated by the skirter as follows: The small fragments of wool skirted from the forequarters of the fleece are much finer and lighter shrinking than the inferior pluckings of the britch end. They are known respectively as First Pieces and Second Pieces.

The first and second pieces are carefully gone over, together with the bellies and sweepings from the shearing floor, at the piece picker's table. The tags, stained parts and locks are assigned to individual bins. The piece picker's table is 8 x 3½ feet, and sloped like a desk. The top is made from pyramid slats one-half inch apart to allow dust, sand and twice-cut wool to fall through.

After skirting, the fleece is rolled with the cut side out, and secured by twisting in one end. The proper method of rolling

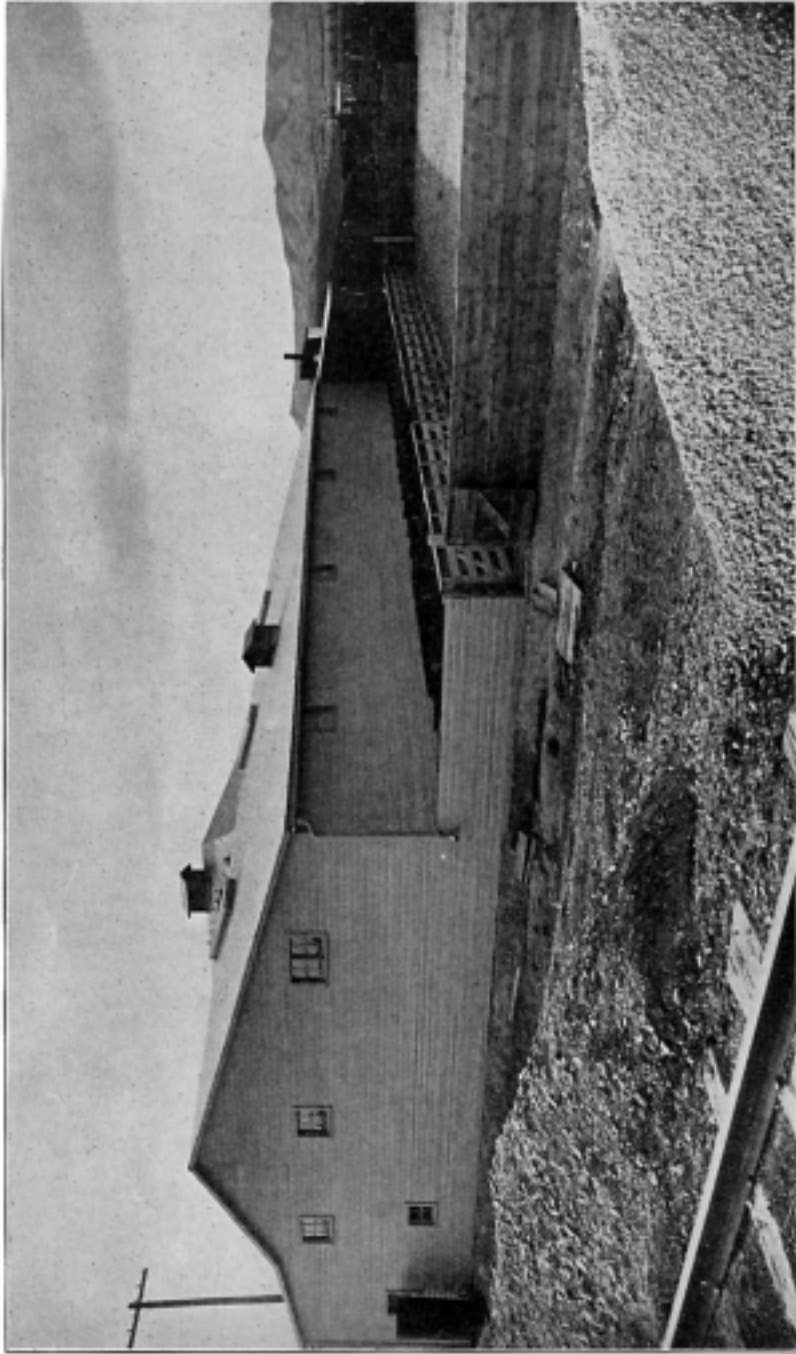


FIG. 41.—Model "Australian" Shearing Plant, Walcott, Wyoming.

the fleece is to have the flesh side of the fleece down on the table, then turn in a little of the britch end and a little of the neck portion of the fleece. The side of the fleece furthest away is then drawn toward the roller, making two folds. The fleece is now ready to be rolled up from britch to neck. This method places the best portions of the fleece on the outside. The fleeces are seldom tied. When string is used for tying the fleeces a light glazed twine is selected similar to a stout fishing line. The grade is next determined by the wool classer as 44s, 56s combing, or whatever grade it may be, and the fleece is ready to be placed in the bale assigned for that grade. Great care is taken in packing, and the bales are reduced in size by the use of hydraulic presses. The bales usually contain about 40 fleeces and average 330 pounds in weight. Usually heavy jute bagging is used in baling, and is either singed on the inside or lined with paper to prevent loose jute fibers becoming mixed with the wool. Frequently tar-lined paper is used for lining as a preventive against insects and dampness. Each bale is plainly marked with the grower's name or brand and the grade of the wool contained. By this method the grower's identity is maintained until the wool is unpacked at the mill.

The Australian method of handling wools is closely followed in New Zealand and South Africa. In South America, the wool growers are fast adopting the Australian method, and the better wools are usually skirted and baled without tying the fleeces.

75. Introduction of Australian Method in West.—In 1915, an "Australian" shearing shed was erected at Bitter Creek, Wyo., and the wool from 80,000 sheep shorn in three weeks was skirted, classed and prepared according to the Australian system. The wool was sold direct to several large mills in the East at prices which more than repaid the sheep owner for the additional trouble. The success of this experiment has attracted widespread attention, and several other similar plants were erected in Wyoming. About 270,000 sheep were shorn in these sheds in 1916, yielding over 2,000,000 pounds of wool. Numerous

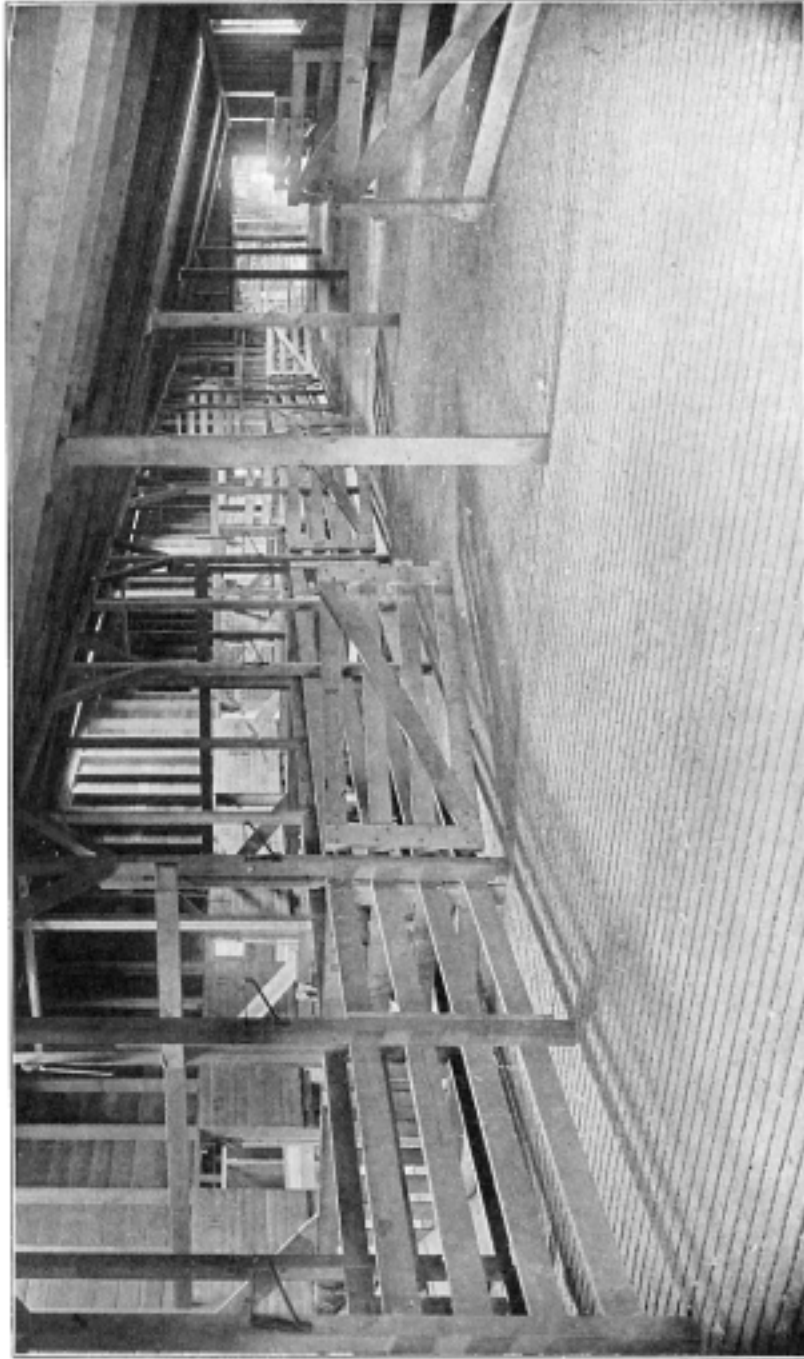


FIG. 42.—Shed, Stalls and Pens Leading into Shearing Room, Walcott, Wyoming.



FIG. 48.—Baling Room, Showing Skirting Tables and Shearing Board, Walcott, Wyoming.

additional sheds adapted for the Australian method were erected in Wyoming for the 1917 season. It is expected that the improved method will soon spread through the other Intermountain States. Should this method be adopted too rapidly its success is liable to receive a temporary setback, due to the lack of sufficient skilled wool classers, skirters and piece pickers. Quite a number of green hands, recruited from the student body of several agricultural colleges in Wyoming, have been developed into first-class skirters and piece pickers in these new sheds, and this co-operation on the part of the agricultural colleges will probably prove an important factor in the future development of the movement. The introduction of the Australian method in the West is being supervised by W. T. Ritch, an Australian wool expert, whose services were secured by several large sheep owners of Wyoming.

76. Poor Preparation of United States Wools.—A frequent source of trouble to the manufacturer arises from the sisal and other rough vegetable fibered strings used in tying the fleeces. When any of the fibers become mixed with the wool they are carried through to the finished cloth, and as they will not take the dyes used on wool they show up conspicuously. Burling is necessary to remove them, adding an unexpected expense to the cost of the cloth. The use of paper string in tying the fleeces avoids trouble of this kind.

Tags and damp stained pieces are usually folded in the fleece, and will discolor the parts of the fleece in contact with them. When black wool is packed with white, locks from the black fleeces often become mixed with the white and are often missed during sorting. Where the wool is to be used for manufacturing white or light-colored fabrics the presence of black fibers causes great trouble and considerable loss. Fraud is sometimes practiced by unscrupulous growers placing balls of hard manure, stones and other heavy materials inside the tied fleeces to increase the weight. Several years ago an Ohio fleece was found to be tied with 121 feet of stout, rough jute twine.



FIG. 44.—Defective Cloth, Due to Presence of Sisal.



FIG. 45.—American Wool Packed in Old Sacks and Poorly Sewed.

A good marking compound soluble in scouring is badly needed. The use of paint in marking is preferred to tar. The paint has to be clipped by the sorter from the locks, and the small amount of wool imbedded in the paint is of no use to the textile manufacturer.

77. Wool Marketing in United States.—Our wool growers avail themselves of numerous ways of disposing of their wool. The factors influencing the selection of a selling method are the quantity of wool offered for sale, distance from large wool market, opportunity for co-operation among neighboring wool growers, knowledge of grades and quality of wool, general market conditions, and the ability of the wool grower to make a shrewd deal.

All things being equal, a large quantity of wool will bring higher proportionate return than small lots. The general price level of wool like every other universal commodity is governed primarily by the two great factors, "supply and demand." The wool grower depends on reports in the newspapers, trade and agricultural papers for information as to the value of his clip. These market reports are based on such facts as can be gathered from buyers and sellers in the main wool-selling centers—Boston, Philadelphia, Chicago, New York and St. Louis. In many cases the grower does not really know the quality of wool his sheep have yielded and is unable to understand the true meaning of the various grades quoted in the market reports. Where a number of buyers are competing for a lot of wool, good prices are obtained, but when the buyers combine to stifle competition the wool grower invariably receives a low price for his wool.

Six methods are used by wool growers in selling their wool—namely, (1) to buyers representing wool merchants or large mills, (2) local dealers, (3) consignment sales through commission houses, (4) direct to mills located in the vicinity, (5) auction and (6) farmers' co-operative sales agencies.

78. Wool Merchants.—The bulk of our wool is sold by the grower to buyers representing wool merchants. These buyers

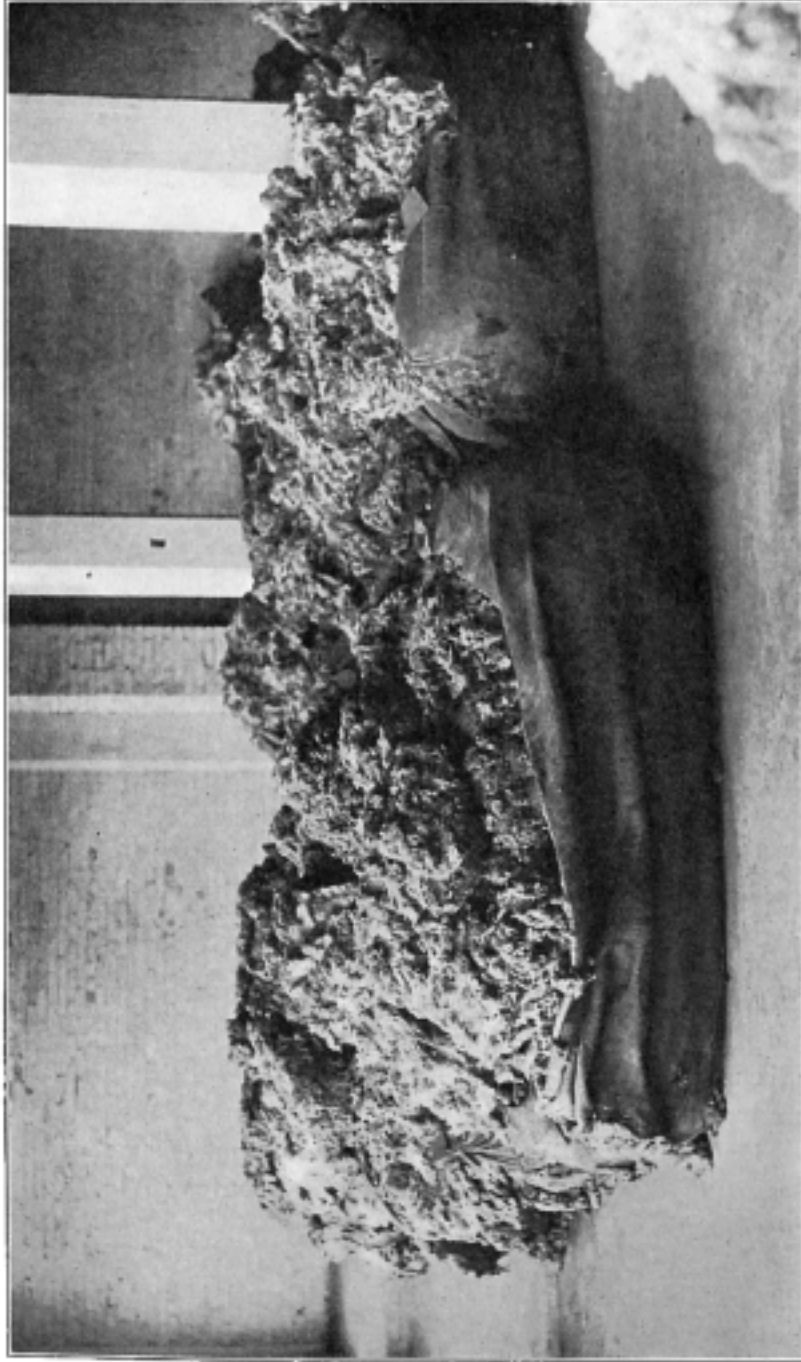


FIG. 46.—American Wool on Display in the Original Bag.

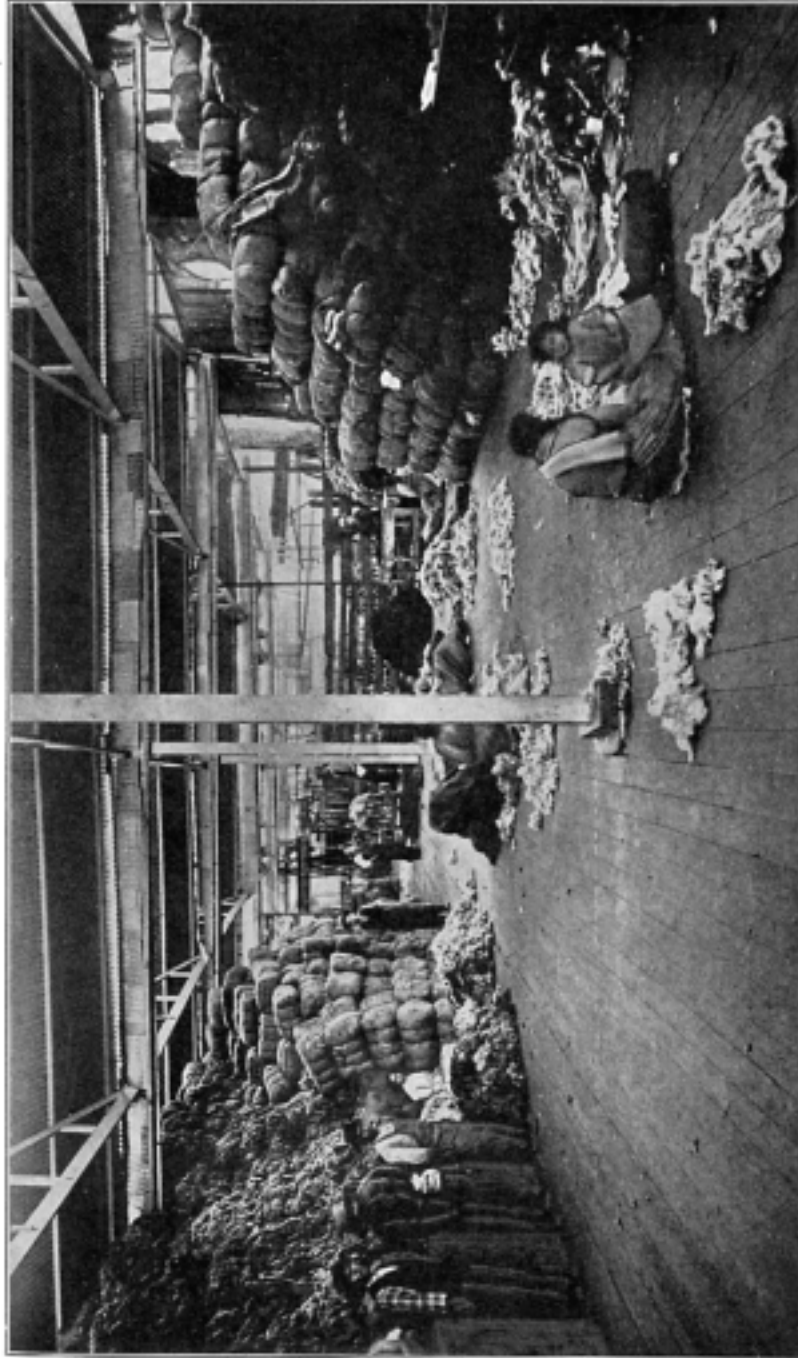


FIG. 47.—Wool Warehouse, Lima, Peru.
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visit the various ranches and shearing sheds in the West during the shearing season, making the owner offers for his wool. The buying charge against the wool averages the wool merchant about $\frac{3}{4}$ cent per pound. Some years, when the merchant anticipates high wool prices, the buyer is sent to the ranges to buy the wool on the sheeps' back, the owner contracting to deliver the wool when sheared at the agreed price. If the merchant's judgment as to higher values proves correct he frequently saves several cents a pound by this method of buying. As a rule, however, selling wool on the sheeps' back is usually regretted by the grower. Boston is the most important wool market in the country, and is followed by Philadelphia, Chicago, New York, St. Louis and Louisville. These cities contain large warehouses where the wool is graded and stored awaiting sale to the mills. Boston has a warehouse capable of holding 100,000,000 pounds of wool, all of which is easily accessible.

The wool merchant is an important factor in our system of marketing wool, and really performs services for the profits secured, in addition to being the middleman between the grower and the manufacturer.

79. Services Rendered by Wool Merchants.—The merchant grades the purchased wool in such a manner as to best suit the various mill requirements. Storage facilities are at his command which the grower does not possess. The merchant carries a large assortment of wools, which enables the manufacturer to select the grade which best suits his requirements, and secure immediate delivery, as the principal markets are located near the important manufacturing districts. Furthermore, while the grower receives cash from the merchant for his wool, the merchant often extends the manufacturer considerable credit. The merchant must have a large amount of capital at his command, as the bulk of the wool to be sold for a whole year is bought for cash and received within a period of three months. It sometimes happens that the wool merchant advances money to the wool grower when the latter is short of funds, taking a lien on

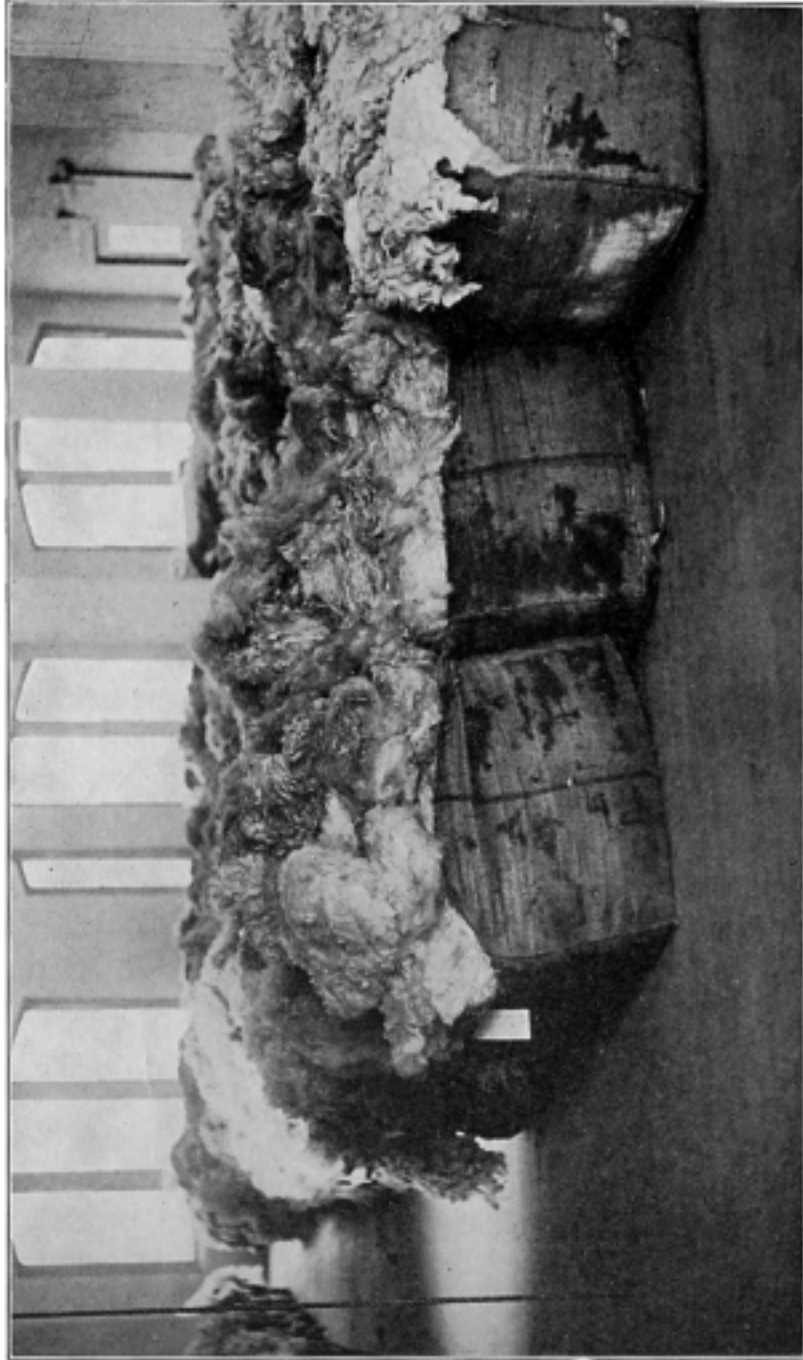


FIG. 48.—Australian Wool, Skirted, Classed and Baled on Display at Boston.

the unshorn wool and of course charging interest on the amount loaned. Many wool merchants also sell wool on commission.

In addition to handling domestic wools, many of the larger wool merchants send buyers to the great foreign wool markets, such as London, Liverpool, Sydney, Melbourne, Adelaide, Buenos Aires and Cape Town. The larger wool merchants import large quantities of foreign wools.

Various systems have been suggested for eliminating the wool merchant and establishing direct dealings between the wool grower and the manufacturer. The most prominent systems proposed are wool growers' co-operative associations and large manufacturers' associations to buy wool direct from the growers for the mills holding membership. It is extremely doubtful if any method will become successful enough to entirely eliminate the wool merchant.

80. Mills Buying Direct.—Buyers representing large manufacturing units consisting of a number of mills under the same ownership, operate in a similar manner as the buyers representing the wool merchants. If the buyer is capable the mill saves the profit made by the merchant, and on the large amounts of wool required for these mills this saving is a great advantage to the manufacturer.

On the other hand, it would not be profitable for the average mill to send out a buyer to purchase direct from the grower. In many cases the buying expense involved would be greater than the saving secured, and furthermore, few individual mills can command enough capital to pay cash for a year's supply of wool in advance.

81. Sales to Local Dealers.—The farmers in the Eastern and Mississippi Valley States usually sell their wool to local dealers in nearby towns. These local dealers usually conduct their wool buying in addition to some other business, usually storekeeping or grain buying. The local dealer is seldom proficient in judging wool and usually pays the same price for all wools offered, irre-

spective of grade and shrinkage. As the farmer seldom knows the quality of the wool produced by his sheep, he is at the mercy of the local dealer, as the quantity grown by the individual farmer is too small to attract the attention of the wool merchant. When the shearing is over in the district the local dealer has usually secured a wide variety of wools. Buyers representing the wool merchant then travel from town to town buying the accumulated wools from the local dealers. In most cases these local dealers turn a handsome profit at the expense of the farmer.

Where wool buying is done in conjunction with storekeeping the local dealer frequently has the farmer at a disadvantage when he sells his wool by having extended considerable credit to the farmer on merchandise, groceries, etc., from the store. It frequently happens that the local dealer is simply the buying agent for some wool merchant who supplies him with buying funds.

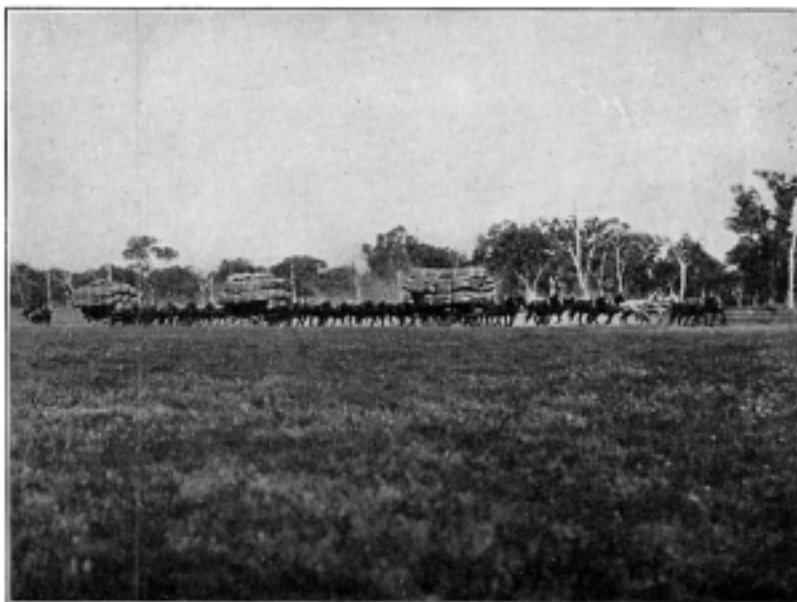
82. Consignment Sales.—Large wool growers in the West frequently consign their wool to wool commission houses when they are not satisfied with the offers of visiting wool buyers. This enables the grower to hold the wool for a rise in price. The owner places a minimum selling price on his wool. The commission house deducts from the amount received from the sale of the wool all carrying charges, such as storage, grading, freight, hauling, insurance, selling commission, loans to the grower and interest on the same. Many of the wool merchants also handle wools on a commission basis.

83. Direct Sales to Local Mills.—The custom in certain sections of the Middle West is to haul the wool grown direct to local mills, or the mills send a representative through the district to buy the wool from the farmers. In many cases, whole or part payment for the wool is made with the products of the mill. This method is to the advantage of both grower and mill, as the farmer secures a slightly higher price from the mill than from the local wool dealer, and the mill is buying cheaper than it can from the wool merchant or local dealer. Such mills buy as much

wool as possible direct from the nearby farmers. Most of the woolen mills buying wool in this manner are scattered through Ohio, Tennessee, Indiana, Michigan, Iowa, Wisconsin and Minnesota. The manufactured products include bed blankets, horse blankets, cassimeres, mackinaws, socks and sweaters.

84. Sales by Auction.—Selling wool by auction is sometimes practiced in the sheep-range country. After shearing time all the wool is hauled to town and arranged in various lots to be auctioned off on an advertised date. Buyers representing merchants, commission houses and large mills have been notified in advance of the coming sale, and if interested in the wool offered attend the sale. The auction system, which is the prevailing method of selling wool in London, Liverpool, Australia, New Zealand, South Africa and Continental Europe, has never been popular in the United States.

The New York Wool Exchange was established in 1894 to conduct the sale of our wools in the same manner as cotton is



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FIG. 49.—Wool Teams on the Road, New South Wales, Australia.

marketed. Our American wools were divided into 200 grades by the New York Wool Exchange, but this number proved entirely too small. The Exchange announced auctions, but sellers and buyers failed to appear, and the project was abandoned in less than four years.

The Wyoming Wool Growers' Association built a wool warehouse at Omaha in 1908, and established an auction system, which was abandoned within a year. In 1909 another attempt was made to establish an auction system. The National Wool Warehouse and Storage Company was organized with aid from the National Wool Growers' Association, and built a large warehouse at Chicago. The auctions again failed to attract buyers, but the company changed its plans and has become a successful commission house.

85. Reasons for Failure of Auctions in United States.—The reasons for the failure of the auction system in the United States is largely due to the following: The wide variation in American wools; the business habits of our people; sheep raising is not standardized in this country; breeders shift their favor from one breed to another; the lack of grading at the shearing shed; the desire of the American grower and dealer to do their own bargaining with the willingness to "take a chance" and make a large profit. In other words, the trading instinct is prevalent, and our traders lack the conservatism shown by foreign traders, who operate on more secure lines, and are satisfied with a surer and smaller profit.

86. Farmers' Co-operative Sales Agencies.—Organizations of this kind have, with varying degree of success, been instituted in upwards of twenty States, but several years must elapse before judgment should be passed as to the success of the movement. The object of such organizations is to take charge of the wool grown by their members, and to sell it in quantities sufficiently large to interest the wool merchant. Inefficient management and members' lack of confidence in the management are the principal

handicaps of this selling method. If up to the present it has accomplished nothing else, it has done a good work along the line of educating wool growers in matters of improving their flocks, giving closer attention to them, sending their clips to market in better condition, and the elimination of the use of sisal twine. They have learned that better returns come from better prepared clips from better sheep.

87. Comparative Prices (in Cents per Pound) of United States Wool in Boston, 1906-1923.

OHIO (Unwashed)	1906	1907	1908	1909	1910	1911	1912	1913	1914
XX and X.....	26	27	23	28	22	20	23	20	24
Half blood	33	33	26	36	28	25	30	23	27
TERRITORY (Scoured)									
Staple, fine.....	71	73	60	78	65	60	67	54	60
Staple, medium....	66	68	52	70	57	52	60	47	53
Clothing, fine.....	68	65	53	70	58	50	60	48	55
Clothing, medium...	63	60	45	65	50	45	56	43	50
OHIO (Unwashed)	1915	1916	1917	1918	1919	1920	1921	1922	1923
XX and X.....	27	34	58	65	62	57	31	42	55
Half blood	36	40	67	78	75	62	33	50	52
TERRITORY (Scoured)									
Staple, fine.....	72	91	160	180	185	155	85	128	130
Staple, medium....	67	87	155	172	180	150	78	124	125
Clothing, fine.....	68	81	145	170	170	130	70	115	110
Clothing, medium...	69	79	138	165	165	123	64	110	104

88. Rail and Ocean Freights on Raw Wools.—As the bulk of our wool is produced in the West, and the great manufacturing districts are located in the East, the freight charges form an item of cost that cannot be slighted; \$2.75 per 100 pounds is a fair estimate for the average transportation of greasy wool from the West to Boston. A special rate of 90 cents for bags, 75 cents for bales and \$1 per 100 pounds applies on all wools shipped to Boston from the Pacific Coast terminals, such as Seattle, Tacoma, Portland, Astoria, San Francisco, Los Angeles and Sacramento. Shipments from Liverpool to Boston range from 30 to 33 cents per 100 pounds, and these prices include dock and shipping charges amounting to about 12 cents per 100. The rates to Bos-

ton from ports in Australia, South Africa and South America are \$3, \$1.90 and \$1.50, respectively. But to these rates must be added the railroad charges in the above-mentioned countries from the ranch to the shipping port. The average railroad charge for hauling wool from interior points to the Australian seaboard is from 65 to 70 cents per 100 pounds.

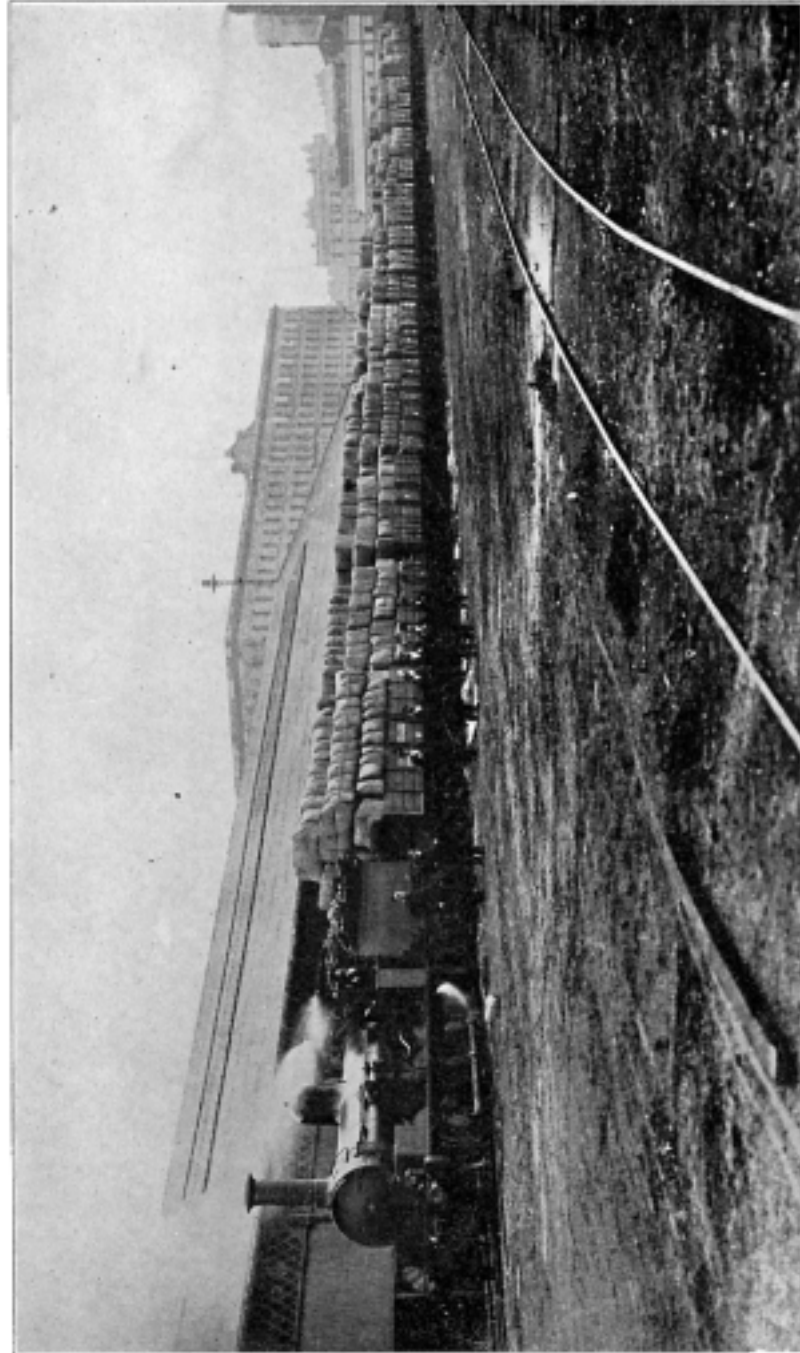
In South America the average freight rate for grease wool from interior points of Argentina and Uruguay to Buenos Aires is 50 cents. In the southern parts of Argentina the rates are variable, as the wool must be hauled to the coast by ox teams and costs from \$3 to \$7 per 100 pounds.

As a matter of fact, only a small portion of foreign wool is shipped directly from the producing country to the United States; nearly all such wool is first sent to Liverpool and then transhipped to Boston, New York or Philadelphia. Since the opening of the Panama Canal there has been an increase in direct shipments from Australia to our Atlantic seaboard ports.

DISTANCES BY WATER ROUTES FROM IMPORTANT WOOL PORTS TO
BOSTON AND LONDON

	Boston	London		Boston	London
Bombay	7,962	6,260	Hong Kong	11,390	9,688
Boston	...	3,088	Liverpool	2,854	638
Bremen	3,377	409	London	3,088	...
Buenos Aires	5,804	6,294	Melbourne	10,200	11,055
Cape Town	6,776	6,117	San Francisco	5,450	8,039
Constantinople	4,820	3,118			

89. Foreign Wool Auctions.—The London wool sales are held six times a year, every two months. During the progress of the London sales, the entire quantity of every lot of wool to be sold each day is accessible for examination by the buyers in well-lighted warehouses. Colonial wools are featured at the London sales. Printed catalogues are provided, which give the clip marks and other descriptions marked on the bales. Later in the day the auction sale begins in the salesroom on Coleman Street. It is not unusual to find 100 lots, each averaging 18,000 pounds, sold in fifteen minutes. Every lot is promptly sold to the highest bidder, except such lots as may be withdrawn and the "star



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FIG. 50.—Arrival of Wool Train, Sydney, New South Wales, Australia.

lots." These star lots are composed of one, two or three bales, and are auctioned off after all the larger lots have been disposed of. After the sales, printed catalogues are distributed by the brokers to consigners and purchasers of wools, and a permanent record is thus obtained of every lot sold at auction. London prices practically govern the wool markets of the world.

The Liverpool auctions are conducted and catalogued in the same manner as the London sales. The India wools are featured at the Liverpool sales, but lesser quantities of other foreign wools are also handled. Sales are also conducted in a similar manner in important continental centers such as Antwerp, Hamburg, Bremen, Havre and Marseilles. River Platte wools are featured at Antwerp, while the others auction wools which have been purchased by dealers in the country of origin.

Large quantities of wool known as "off sorts," obtained by skirting, are exceedingly heavy-shrinking. The bulk of such wool is graded and scoured in the country of origin and sold at the European auctions. By forwarding the wool in the scoured condition, a saving is made on transportation charges, and the off sorts are presented for sale in a more attractive condition than would be the case if they were offered in the original greasy condition.

Australia's position as the greatest fine wool-producing country, both for quantity and quality, remains unchallenged. While the natural advantages, such as cheap extensive ranges furnishing green pasturage through the entire year, are very favorable to the wool-growing industry, except when visited by exceptional droughts, nevertheless due credit must be given to the efficient breeding, management and above everything else, the practical and attractive manner in which the wools are prepared for the market. However, the amount of suitable grazing land is limited, as more than half of Australia is dry and barren, without any water supply and practically no rain.

90. Wool Auctions in Australia.—In recent years the Australian wool growers have been selling large quantities of their

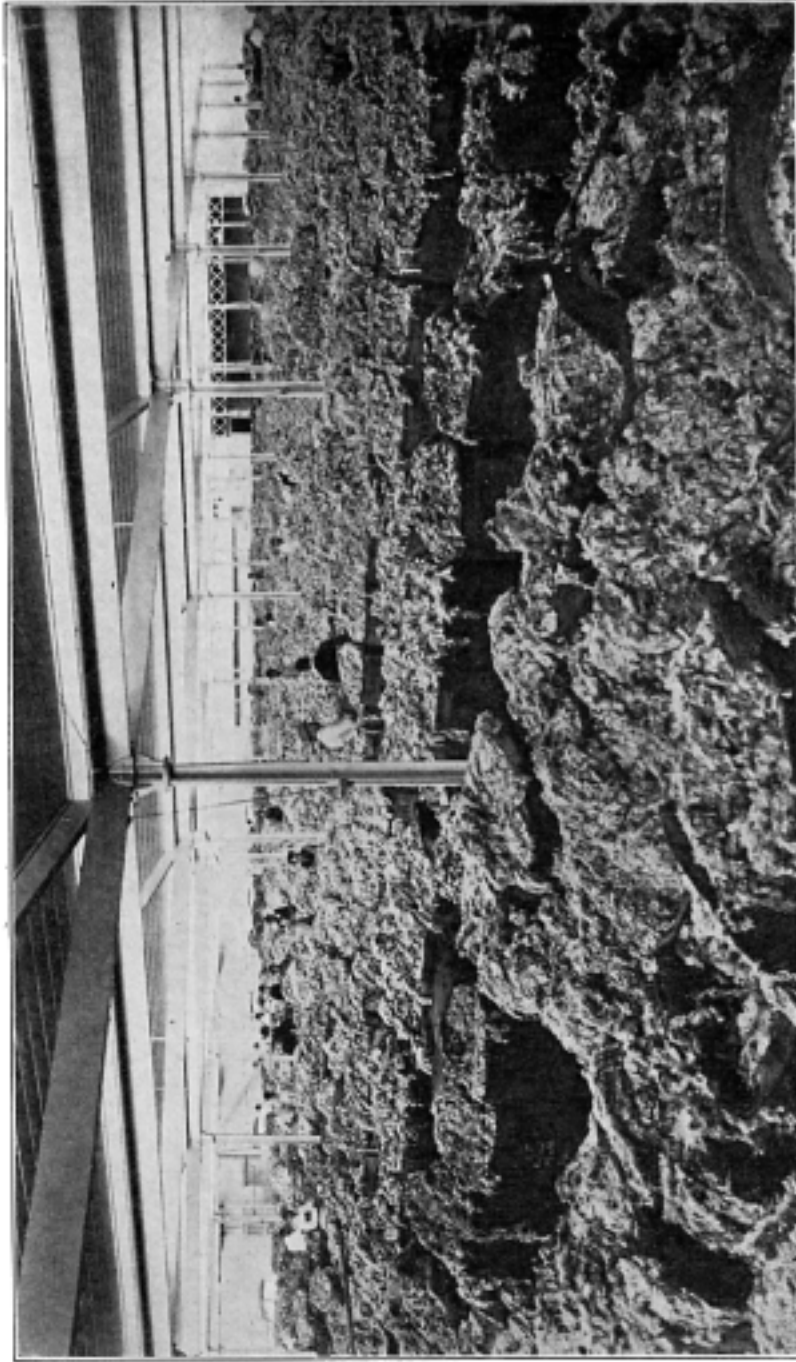


FIG. 51.—Dalgety's Show Sales Room, Melbourne, Australia.

wools at auction sales conducted in numerous cities throughout the country. These sales are similar to the London sales, with the exception that only ten bales of a lot are opened for examination by prospective bidders. Every year more foreign wool buyers visit Australia to attend these sales. American buyers purchase about 100,000 bales of wool in Australia annually. The chief criticism of the Australian system is that there are too many selling centers. A good plan has been suggested to hold one series of sales in the capital city of each of the six States. The most important Australian wool auctions are conducted at Sydney, Melbourne, Brisbane, Adelaide and Geelong.

When selling in the English market, freight, insurance, storage, dock fees and other charges add from \$5.00 to \$6.00 per bale to the cost of selling. The amount of these charges varies with changes in freight rates, money exchange and the weight of the bales. Another objection is the long delay in receiving the money after the wool has been sold. When selling wool in Australia the wool grower is paid within two weeks after the sale. Although a higher price is obtained at the London sales, the net return to the grower is usually greater and always quicker when the wool is sold in the home markets. It frequently happens that the shipment to London misses the sale for which it was intended. The lot must then wait two months for the next sale. In the meantime storage and insurance charges accumulate, and five or six months may elapse between the shearing of the wool in Australia and the receipt of the returns from London.

In New Zealand six sales are held during November and December, which is the regular selling season. These auction sales are held in Wellington, Napier, Christchurch, Nelson, Timaru and Ivercargill.

91. Marketing Wools of the British Isles.—In Scotland wool is seldom sold at annual fairs, but is sent to wool brokers, who usually sell it by auction, and charge a commission of 2½ per cent. The brokers supply farmers with wool sheets, warehouse the wool, insure it against loss by fire, and issue printed cata-



Fig. 52.—Display for Wool Sale, Brisbane, Queensland, Australia.
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logues to buyers, besides advertising and organizing the sale. These sales take place at certain seasons, and the exact dates are published at the beginning of each year. When necessary, special sales are frequently held between these fixed dates.

In order to obtain the best possible prices for small lots, brokers often grade or class together two or three lots of exactly the same description, and in this way make up a suitable quantity of uniform quality as an extra inducement to big buyers. This practice invariably secures the owners of these small lots a higher price than they would realize if their lots were sold individually. Brokers often effect sales privately, both in their offices and by mailing samples to manufacturers. The system of selling through brokers seems to answer very well where the varieties of wool are not numerous.

Many large wool growers sell direct to wool merchants, and also to American agents. In some districts the tendency toward private sales between farmers and agents seems to be increasing.

The system of selling by auction at a broker's warehouse differs in many ways from selling by auction at a wool fair. A wool merchant must not be confused with a general merchant dealing in wool. General merchants or village shopkeepers in England and Scotland do not now deal in wool. Many years ago they bought wool from local farmers, but the practice was very unsatisfactory and strongly condemned. When the "Truck Act" was passed it almost made it impossible for shopkeepers to buy wool on the old lines, and small farmers have been able to sell their wool at a profit ever since. The difficulties of the small woolen mills in Scotland ceased at the same time.

Originally, all the wool sold at English wool fairs was done by "private bargain," but selling by auction has gradually replaced the old method. There are still some small but important fairs where auction sales have not been adopted, and many buyers would not favor a change. However, it is only a question of time before the auction system becomes general. From a buyer's standpoint there is much to be said in favor of private sales.

When the wool is indifferently classified, or the fleeces irregular, a buyer has a better chance to make an examination and purchase small, odd lots under the price ruling for that day. Brokers also favor the private sales, because unsold lots are handed over to them for disposal. The bulk of the annual clip in England is sold at the wool fairs. Brokers and buying-agents handle but a comparatively small portion.

About two days before the fair the wool is sent or brought to the sale room, placed in order and catalogued. Printed catalogues are generally mailed to buyers who bought at previous sales, but sometimes this is found inconvenient, and they are presented to intending buyers the afternoon preceding the sale day, when the wool is exposed for inspection. For the convenience of buyers who arrive late, the wool is again open for inspection from 6 A. M. until 9 A. M. on the day of sale. Sales usually commence at 10 A. M., but in some cases not until 1 P. M.

The buyers at these sales consist of wool merchants, foreign agents and manufacturers; brokers of course do not buy. The buyers are skilled wool men, well informed on market conditions, and they also possess a thorough knowledge of the requirements of the woolen and worsted industries. While inspecting the wool they mark suitable lots in their catalogues with the price they are disposed to pay, and when these lots are knocked down they enter the selling prices. In this way they feel the pulse of the market soon after the sale begins.

Selling often takes place where the wool is exposed, and you seldom hear several men shouting the same price at the same time. Smaller lots, greater variety and more variations in quality no doubt prevent the "Coleman Street Style" from being duplicated. The auctions in a broker's salesroom closely resemble Coleman Street, because imported as well as home-grown wools are sold there.

In Ireland the system of handling and marketing wool differs considerably from those of either England or Scotland. The country produces a large quantity of wool and a somewhat mixed

variety from every point of view. The leading sheep is the Roscommon, and this breed is not only crossed with down breeds, but is also used for "grading up" several smaller breeds. Farmers also cross other long-wool sheep with downs and hill sheep with long-wool sheep. From a mutton standpoint the Irish crosses are often criticised, because they produce big, fat carcasses, but they usually produce excellent wool. The quantity of wool produced in Ireland increases annually, and the quality has earned a high reputation.

Unfortunately, their auction sales are not numerous, therefore most of the Irish wool is sold privately at the annual fairs. Large growers often sell their wool to agents and merchants before the fairs commence, while others send their whole clip to brokers. Such transactions, however, only represent a small portion of the wool grown in Ireland. English wool merchants are represented at these Irish fairs in large numbers, as are also a few manufacturers. All these buyers have stands in the market, await the arrival of the farmers, and, after the wool is examined and the price agreed upon, it is weighed and the amount immediately paid over in cash.

The fine, soft texture and clean condition of Irish crossbred long wool has created a market of its own, which the manufacturer cannot overlook; therefore the wool merchant can afford to spend a little extra time in matching up and classing. Irish wools yield 5 per cent. more than English, and a considerable portion of the annual clip is exported to the United States.

92. South American Wool Sales.—Although direct shipments are made by some large stations to Liverpool and elsewhere, the bulk of the South American wools is sold in Buenos Aires, Bahia Blanco and Montevideo.

The method of handling wool at Buenos Aires differs in some respects from that in other centers; however, the Australian method is supplanting this system. The wool is first exposed for sale in the large market hall, where it is inspected by buyers and speculators, and bought as there shown. Next it is taken to the