CHAPTER V

STUDY OF WOOLEN MATERIALS

Wool.—Wool, the most important of the animal fibers, is the soft curly covering of the sheep and similar animals. The references to wool in history show that it has been used from the earliest times. In Genesis 4:2 we find, "And Abel was a keeper of sheep." King David, of Israel, wrote some of his psalms while tending his sheep. Homer and Virgil described the processes of wool preparation. Alexander, we are told, on expeditions to India saw woolen shawls of great beauty.

The great wool producing countries are Australia, England, South America, the United States, and South Africa. Wyoming, Montana, Idaho, and Oregon produce the largest part of the wool raised in the United States. Australia is the largest producer of the finest wool, although Ohio, Pennsylvania, and West Virginia furnish a fine quality which is a close rival. The quality of the wool depends upon the breed of the sheep, feed, care, climate, and the part of the animal from which it comes. The best wool
in soundness of fiber, softness, and evenness of length comes from the shoulders and sides of the animal. The various kinds of wool used in commerce are named either from the breed of the sheep or the locality in which the sheep is raised, as: Australian wools, New Zealand wools, Cashmere, Shropshiredew, and Merino wools.

Shearing in the United States is usually done by experts who begin work in Southern California, Texas, etc., about May and work on up through Wyoming, Montana, Idaho, Oregon, etc., and then into Canada, in this way being busy most of the year.

Most of the wool on the market comes in the form of fleece wool, the product of one year’s growth. The fleeces are rolled into bundles as they come from the mill, and are sorted according to quality and length of fiber, the wool from the shoulders and sides being, usually, the choicest part of the fleece. After sorting, the wool is washed to remove grease and dirt; dried and oiled to render it soft; burred and carbonized to remove seeds, leaves, and burs; and blended, by which means a more even yarn is produced. After the wool is blended it comes out in a soft, fleecy condition ready to be carded.

The carding machine finishes the cleaning, separates and straightens the fibers, delivering the wool in soft strands called slivers. This is
accomplished by passing the wool between cylinders and rollers revolving in opposite directions, from which project the ends of many small wires.

If the wool is to be used for worsted material it must be further straightened and have the short ends or "noils" removed by a process called combing. This leaves only the good long fibers lying practically parallel to each other. The combing process is unnecessary in the manufacture of woolen materials as the yarns are composed of short fibers which cross and are somewhat matted.

The processes of drawing and spinning draw out and twist the long soft rolls until the thread is reduced to the size required.

Before weaving, the warp yarn is sized by a starch preparation to enable the threads to withstand the friction due to constant weaving back and forth of the weft thread; it is then placed in the loom, the warp running lengthwise. The filling thread, or weft, is wound on a bobbin, which is fastened in a shuttle, allowing the thread to unwind as it is passed back and forth. As fast as the weft passes through between the warp threads, which are separated into different groups to form the pattern, it is beaten up tight against the preceding thread, thereby keeping the cloth firm and even.

Dyeing is done either in the yarn or in the
piece,—the piece-dyed materials being of a single color, while wools dyed in the yarn allow various combinations.

When cloth comes from the loom it is in an imperfect condition for use. Knots tied in the thread are carefully drawn to the surface and clipped off; threads are woven in where any have been left out; and repairs are made if necessary.

"This part of the finishing must be done very carefully for worsted materials, as the intersections will not be covered by a napped surface as in woolen materials. The beauty of woolen goods lies largely in the finish of the cloth, and of worsted goods, in the weave. If worsted materials are fulled or shrunken at all, it is only to soften the weave, and the object of fulling woolen materials is often to obliterate this entirely. The cloth is pressed over a heated roll to give it a permanent finish and luster before it goes to the retailer."

The finishing of a material such as broadcloth, where the weave is entirely covered by a napped surface, is an interesting process as it shows the severe treatment which is necessary to obtain the highly lustrous finish. This in turn throws light on the high price of good chiffon broadcloth, as a good quality of wool must be used to withstand the treatment, and the extra labor also adds to the cost.
The cloth as it comes from the loom is loosely woven and much wider than desired when finished. It is then churned in hot soap solutions to felt or shrink the material. This process is repeated until the desired result is obtained.

Napping, which raises the ends of the fibers on the face of the cloth, is done by means of a wire teasel gig. The teasel is a vegetable product about the shape of a pine cone, and it is interesting to note that no mechanical contrivance has ever been invented to equal it for the purpose. The napping which has been raised by the teasel is sheared or cut to a proper length.
A WOOLEN YARN UNTWISTED
A Worsted Yarn Untwisted

67
by a machine which works like a lawn mower. The cloth is pressed and, if a higher luster is desired, it may be necessary to repeat the napping and shearing before the material is wound upon copper cylinders and steam is forced through it at a high pressure.

The difference between worsteds and woolens is principally that in worsteds the fibers of the wool lie parallel, one to another, combed wool being used, from which the short fibers have been removed, while woolens are made from yarns in which the fibers cross and are matted and intermixed. A worsted fabric when finished has a clear, bright, well-defined pattern, and seems close and firmly woven, while woolen cloths are softer, more elastic, the colors are more blended, the threads are not so easily distinguishable, and there is a duller effect in general.

*Physical characteristics.*—The scales give wool its peculiar felting property due to the interlocking of their projecting edges—the deeper the scales fit into one another, the closer becomes the structure of the material. This property is taken advantage of in the manufacture of such material as broadcloth. It is also this property which necessitates extra care in the laundering of woolen materials to prevent shrinkage, which is simply another name for the interlocking of the scales.
"The difference between hair and wool is largely in this layer of horny scales. On hair they are much less marked, and often do not

\[ a - \text{Dark-brown hair from new-born female child.} \quad b - \text{Golden hair from same child at age of four.} \quad c - \text{Dark-brown hair from adult female.} \]

project at all at the edges. The distinction is sometimes made that hair is straight and wool is curly or that hair is stiffer than wool; but here again the difference is sometimes greater between the extremes of wool or the
extremes of hairs than between a given wool and a given hair.

"The amount of luster which wool has also depends on the scales. If the edges of the scales are rough and uneven the fiber as a whole will not be so smooth and lustrous as a fiber in which the scales are more regular and reflect the light evenly. The fiber from the Angora goat, which has less prominent scales, has greater luster than the wool from most
sheep, but there is also great variation in different breeds of sheep.”

The length of the wool fiber varies from one to eight inches, depending upon the breed of sheep and the location on the animal. The wool fibers may be roughly classified as long staple wools or "tops" from which worsteds are ordinarily made, short staple wools used in the manufacture of woolens, and the miscellaneous or carpet and blanket wools. This
classification is based on the length, fineness, and felting qualities of the staples.

The hygroscopicity of wool, or the property of absorbing water without feeling wet, is greater than in any other textile fiber. It varies in different wools from eight to seventeen percent. It absorbs slowly and evaporates in the same way. A garment of wool, when dry, feels warm next to the skin; when wet, the moisture is not felt unless there is a great deal of it.

In elasticity it is next to silk. This is the
property which makes woolen materials keep their shape better than linen or cotton.

Wool is a poor conductor of both heat and electricity. It feels warm to the touch because it does not conduct the heat away from the body. Woolen shirts are worn by men working around furnaces because the wool prevents the extreme heat from reaching the body.

Because of the peculiar physical structure of the fiber a material made from wool encloses many air spaces. Dead air spaces conduct heat very slowly, which accounts for the greater warmth of a loosely woven fabric. Materials with a napped surface, as blankets and outing flannel, are also warmer for this reason. Two light-weight garments are warmer than one of heavier material because of the layer of air between.

Wool, on a dry body, as on old people or on those who do not exercise freely, feels warm and continues to do so as long as the evaporation of the skin is not in excess of the garment's power to absorb and eliminate the moisture. If, through physical exercise, this amount of moisture is increased and the wool does not absorb it as fast as it is excreted, the air about the body will be moisture laden and evaporation interfered with.

The tensile strength varies so greatly that no definite statement can be made.
Of all the textile fibers, wool is the most reactive to coloring matter. Consequently, it may be dyed very easily and the colors are usually "fast."

Owing to the rapidly changing fashions today, dress materials are frequently cast aside when only partially worn. Naturally this greatly increases the demand for new fabrics and, therefore, for raw wool.

Statistics from 1909 give approximately 220,000,000 pounds as the amount of new wool, freed from grease, used in the United States. Later figures show that about 250,000,000 pounds are used per year at the present time. Estimating the present population at about 90,000,000 the amount of raw wool per capita is less than three pounds. Considering the waste in manufacture (one hundred pounds of raw wool being required for eighty-five pounds of cloth) and also the proportion which must be used for blankets, carpets, rugs, felts, and upholstery, it is very apparent that the supply of new wool is not equal to the demand. To make up for this shortage, shoddy and cotton have come into general use as substitutes.

Shoddy is the term which has come to be applied to all reclaimed wool which has already served one or more periods of usefulness. The term is unfortunate as it suggests only deception, sham, and fraud. No objection is raised
to the use of other waste products, so why should there be in this case? The only just cause for complaint is found in the abuse rather than the use of the so-called shoddy.

The wool is reclaimed from wool rags, tailors' clippings, and scraps of various kinds. These are dusted, cleaned, and then torn apart by machines especially designed for that purpose. If any cotton is present the mass is treated with dilute acid to decompose the vegetable matter, leaving only the wool. This is washed, dried, and carded, preparing it for spinning a second time. The quality of the shoddy depends upon the quality and value of the material from which it is made. The best quality is obtained from knitted goods and worsted materials if a good quality of fiber was used in the first place. To be sure it is not so strong as it was originally. The strain undergone in the various processes through which it has passed has weakened the fibers to a greater or less degree. Yet in many cases it is not "worn out" by any means. The much felted woolen materials give the very short inferior fibers. It has been said that, "Anything with two ends may be spun." When we find fibers not more than a fourth of an inch in length we realize the truth of that statement and wish the manufacturers were a little less clever. These short fibers soon become loosened or wear
Poor Quality Shoddy

Better Quality Shoddy
off, leaving the garment "threadbare" as we say.

The better quality may contain fairly long fibers ready to do good service again. The processes undergone thoroughly sterilize the material, so there is no possible danger of contamination. The existing prejudice is not justified, as the use of these reclaimed materials has clothed many people much more cheaply and warmly than would otherwise have been possible. In fact, it is the only way in which the insufficient supply of new wool may be pieced out and made to go around. Should this material be wasted, many persons would be unable to afford proper clothing and it is difficult to estimate what the price of wool would be. To quote from an article in a trade journal: "This is no excuse for dishonesty, false labeling, or misrepresentation. Good, honest, sound, and well wearing cloths can be made, are made, and sold on their merits at prices 'within the reach of all' and all that is needed is that they be represented for what they are in the name of common honesty."

Because there will always be unscrupulous manufacturers who will misrepresent their goods, there should be pure textile laws requiring proper labeling of all materials. Until that is accomplished some knowledge of materials, on the part of the shopper, is necessary if full
value is to be received for the dollars expended.

“All wool and a yard wide” has come to be synonymous with good quality in the minds of many. This is a misconception, as a material may be “all wool and a yard and a half wide” and a poor material at the same time. The quality of the wool and the weave of the material are fully as important as the fact of its being all wool.

To judge of the firmness of the weave hold the material up to the light. If the light shines through, it indicates a loose and open weave unable to withstand strain. The tensile strength test given below should also be used in this connection. The “feel” of the wool, to be acquired by practice, tells much in regard to quality. Notice carefully the difference in the “feel” of the wool in a series of blue serges. Threads should be unraveled and the length of the separate fibers noted. Long fibers usually indicate a good quality of wool, and very short ones indicate shoddy.

Tensile strength.—The warp yarn in a material is always more tightly twisted and stronger than the weft or filling yarn. This is necessary because of the greater strain on the warp in weaving. In cheap materials, frequently, there is more difference than is necessary between the strength of the warp and weft yarns. This may be detected by exposing the
warp and weft threads separately. When considerable difference is found, it is an indication of poor wearing quality as the weft threads will not be able to stand the strain of the warp.

To test the tensile strength place the thumbs together and press them down hard on the material, holding the cloth tight underneath. Do the threads separate or break more easily in one direction than the other?

If the threads can be separated by the thumbs in this way the material will not give good service if subjected to hard wear.

It will usually be found to be economy in the end to buy good material. The extra expenditure of $.25 to $.50 per yard will amount to very little in the cost of a garment, and yet it may double or treble its value. In the case of a garment which will be worn only a few times, because of the rapidly changing styles, a cheaper material may serve the purpose fully as well. The use to which the garment is to be put should always be considered when purchasing the material. If service is an important item, remember that pennies saved may mean dollars lost.

Appearance and feeling can no longer be trusted absolutely, but the trained hand and eye may do much in judging of the quality of materials. Woven fabrics made of wool should be soft when gathered up in the hand and
should spring back when the hold is loosened. Wool should feel warm and springy. There is a great difference in the "feel" of different qualities of wool. The difference is hard to describe, but can easily be acquired with practice.

Take a small piece of the material and expose the warp and weft threads separately. After some practice the cotton can be quite readily detected unless it is covered with wool, as is very often the case. Wool threads are more curly and elastic than cotton. White wool usually has a creamy tint, while cotton is dead white.

_Burning to detect cotton._—This is most useful in determining whether threads are part
wool or all cotton. If cotton and wool have been spun together, this test is not reliable, although something may be learned if the yarn is unraveled so that the fibers may be burned separately. Cotton burns quickly, leaving a small amount of ash and no perceptible odor. Wool burns slowly, leaving a black ash in the form of a ball at the edge of the flame. The odor of burning wool is that characteristic of burning bones or feathers.

Chemical Test for Any Mixed Cotton and Wool Fabric

Boil a sample for five minutes in a solution of $\frac{1}{2}$ teaspoon of household lye in a pint of water. If all wool the entire piece will be destroyed, if mixed with cotton, the cotton will be left and the wool destroyed. Should there be a residue it must be thoroughly washed. This residue represents the cotton in the cloth. If mixed with wool in spinning, an open material will be left, if the warp is made of cotton, it alone will remain. The weft will be destroyed. A small sample of the cloth to be tested should be placed in a granite dish, well covered with the solution and allowed to boil gently to prevent rapid evaporation and consequent strengthening of the solution. The use of a granite dish is emphasized as the alkali will
Original
36 inches wide—50 cents per yard

Cotton Residue

Original
44 inches wide—65 cents per yard

Cotton Residue

MATERIALS BEFORE AND AFTER BOILING IN THE LYE SOLUTION
act on some metals, especially on aluminum. Several pieces of imported Viyella flannel,

Original  
36 inches wide—50 cents per yard

Original  
54 inches wide—$2.50 per yard

MATERIALS BEFORE AND AFTER BOILING IN THE LYE SOLUTION

sold as all wool and nonshrinkable, when tested were found to contain 50 per cent of cotton.
Original
54 inches wide—$1.25 per yard

Original
36 inches wide—50 cents per yard

MATERIALS BEFORE AND AFTER BOILING IN THE LYE SOLUTION

84
The cotton made it fairly nonshrinking, as advertised, and increased its value for men’s shirts and ladies’ shirt waists, but it was deceptive and $.75 per yard was too much to pay for a material 30 inches wide, containing so much cotton. The same could be said of the only piece of so-called “all wool” white flannel, suitable for infants’ clothes, which was to be had in a high class store. We are not objecting, however, to the use of cotton but to paying wool prices for cotton and to being sold half cotton as all wool.

For a garment which must be laundered frequently the addition of some cotton will help to prevent shrinkage and perhaps add usefulness to the garment. If represented as being part cotton and sold for a reasonable price, no objection can be raised.

Test the following and note results of tests:
2 pieces of white flannel.
2 pieces of serge.
2 pieces of shepherd check (black and white).
2 pieces of gray or tan mixed novelty goods.
1 piece of broadcloth or a similar material.
2 pieces of any materials you are especially interested in.

It will be found helpful to study the sample, before using the alkali test, and see whether you can form some opinion as to the composition of the material.
Original
54 inches wide—$1.25 per yard

Residue

Original
54 inches wide—$5 per yard

Residue

MATERIALS BEFORE AND AFTER BOILING IN THE LYE SOLUTION
Test one at a time, but the same solution may be used. Add water to replace what evaporates and if testing many at one time add some fresh solution.

The relation of cotton to wool is often plainly shown by the form in which the cotton is left. If a piece of woven fabric remains we know that either wool was mixed with the cotton in the yarn before weaving or that wool was blown into the cloth mechanically during the felting process and finished over to give the appearance of woolen material. Cheap eiderdowns are often made in this way. Sometimes the warp is cotton and the weft wool. (A sample of shepherd check showed a cotton warp with every other check filled in by cotton weft. It was therefore practically one-fourth wool.)

Tests for fastness to dyes, crocking, and fading.—A very simple and practical test for crocking is to rub the material with a soft white cloth which has been slightly moistened. If any color comes off on the white cloth, the material will crock.

Fastness to light.—The sample to be treated is placed in a suitable frame in such a manner that only a part is exposed. The frame is then placed in such a position that it receives as strong sunlight as possible. A window with southern exposure is a good location in which to hang the frame containing the samples. At the
end of one week's exposure the samples are examined and note made of those which show any appreciable fading; these are to be classified as not fast. At the end of the second week another examination is made and those samples noted which show an appreciable fading; these are to be classified as fairly fast. At the end of four weeks the samples are once more examined and the colors fading in this period are noted and classified as fast. The samples which show no fading at the end of four weeks are classified as very fast.

The samples may be partly covered with black paper, fastened securely to a piece of wood and exposed to the light as suggested above.

Test eight samples, varying in color and price, for crocking and fastness to light.

Tests for Shoddy

The following indicate the presence of shoddy:

Very short fibers.
Fibers of various colors.
Lack of uniformity in size and general character of the scale structure.
Ends broken and uneven.
Scales missing on parts of the fiber.
A high power microscope is necessary for these determinations. The adulteration of a worsted cloth is more easily detected than of a woolen as the entire thread is usually replaced by a similar one of cotton. There are pure wool cloths made of "Virgin wool" and nothing else. The great family of serges, worsted cheviots, and certain white flannels contain only fleece wool. This must be understood to refer to good quality materials demanding a fair price. It still remains a fact, however, that many fabrics used for clothing contain other materials than wool fresh from the sheep shearer and in many cases without detriment and in some cases with positive advantage. If the shoddy is of fairly good quality and especially if mixed with some good new wool, the resulting fabric may look very well and give good service.

**Suggestive Review**


2. Distinguish between woolen and worsted materials—differences in kinds of fibers used,
in appearance of spun yarn, in the finishing, and in the appearance of finished cloth.


Shoddy—reclaimed wool, use a necessity because the demand for wool exceeds the supply of new wool. Quality varies greatly. Should be sold for a fair price and not misrepresented.

4. Materials which may be classified as worsteds and woolens with samples of the materials. Note prices, considering width, uses, and wearing qualities.

5. Judging materials. Important to consider quality of fiber and firmness or looseness of weave. Tests.

6. Use of cotton as an adulterant. Different tests for detection, as: appearance, "feel," burning, and boiling in dilute alkali solution.