A GUIDE TO TEXTILES

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A GUIDE TO TEXTILES

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PREFACE

In this book the authors have endeavored to compile the basic facts concerning the textiles which are in common as well as constant use in the household and in clothing, so that the average consumer and student of textiles may be informed of the characteristics of the various fibers, their manufacture, and finish which render them satisfactory for certain uses, as well as the care which they require. Since specialized technical knowledge is not necessary for the intelligent selection and use of textiles the details of manufacturing technicalities are not presented here. However, in view of the lack of standardization and the enormous volume of all qualities of textiles now on the market the woman who understands something of the source, characteristics and processes involved is certainly a wiser purchaser and user of these necessities than the woman who knows nothing whatever about them except their retail cost, surface attractiveness, and the sometimes half truths stated in advertisements.

By the topical or dictionary-like arrangement of this material the student or consumer should be able to obtain the information pertinent to the fabric she has under consideration without having to read page after page of technical information in which she has no vital interest. By means of liberal cross references the student may be guided under the instruction of the teacher to obtain a further detailed and broader acquaintance with a particular article or fabric that has come up for class study. For example, if the class discussion is centered on floor coverings the student in addition to reading the section under carpets should read also those sections headed Oriental rugs, Navajo rugs, woolen and worsted yarns, and rug cushions for a more complete picture of the subject. With this arrangement, class assignments should be flexible and provide the college student, for whom this book is primarily intended, an opportunity to organize her textile subject matter in a manner most useful to her and pertinent to her purpose.

The authors gratefully acknowledge the assistance of Mr. Charles W. Dorn, technical director of the J. C. Penney Laboratories, and Mr. John V. Smeallie of the Mohawk Carpet Mills, Inc., in checking the accuracy of the subject matter contained herein.

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August 12, 1939

A GUIDE TO TEXTILES

Acetate Rayon. *See* p. 117.

Air Conditioning. *See* p. 57.

Alpaca. A sheep-like ruminant from the mountains of Peru. Its long, silky wool is combined with a cotton warp in a plain woven fabric for men's suitings and for linings. Alpaca fabric is a cool, good-wearing material and sheds dust readily. *See* Fibers, p. 159.

Angora. The Angora goat, a native of Asia, but also raised in the United States, furnishes the hair from which the fabric known as mohair is made. This fine, wavy, lustrous hair is also used for the making of velvets, upholstery, and drapery fabrics. *See* Mohair, p. 98, and Fibers, p. 156.

Angora Yarns. From the short, silky hairs of the Angora rabbit are made exceedingly soft yarns for knitting, which lack the property of felting. They are combined with wool yarns for the making of modern dress fabrics, both knitted and woven.

Animalized Cotton. *See* p. 57.

Asbestos. A fibrous mineral. The fibers are long, flexible, usually white. They are not affected by acids or gases, and will not burn. By combining with cotton, and then burning out the cotton after the weave is made, asbestos cloth is manufactured.

Aubusson Tapestry. A hand-woven tapestry for wall hangings or carpet, made in the ancient town of Aubusson, France. It is said that the first factory in Aubusson was set up in A.D. 732 by Saracenic weavers. Although the best products of its looms were made in the latter half of the eighteenth century, it is still a center for the weaving of delicately colored, exquisite carpets and wall hangings. *See* Tapestry, p. 153.

Bath Mats. These small reversible rugs are most frequently found in terry cloth, with or without Jacquard designs, and in a plain weave material employing heavy chenille yarns in the weft. Both fabrics wash easily, and are dyed in attractive, fast colors.

Batik. *See* Dyes and Dyeing, p. 48.

Bedspreads. Many varieties of fabrics are used for spreads, the purchaser making her choice on the basis of color, texture, and pattern suited to the type of decoration of the bedroom where the spread is to be used, its washability or cleanability, as well as its resistance to wrinkling, slipping, and catching, particularly when fabrics having long floats in the weave are being considered.

Candlewick and chenille spreads have as a background unbleached muslin sheeting with tuftings of colored or white cotton in simple or elaborate designs. The chenille spreads are tufted by machine, the candlewick ones by hand. Spreads of this type are eminently satisfactory, stay in place well, and do not wrinkle; the tufts are fast color if piece dyed, and the spread requires no ironing, simply a thorough shaking and brushing to restore fluffiness to the tufts. Dip dye spreads are less satisfactory as to color fastness. They are dyed in the power laundry type of machine, while the ground cloth in piece-dyed chenille spreads is vat dyed. *See* p. 46.

Chintz and cretonne, because of their firmness of weave, give satisfactory service as spreads, are easy to launder, and do not catch or wrinkle easily.

Crocheted spreads are heavy enough to stay in place well on the bed, do not wrinkle, and usually require no ironing.

Dimity spreads are made of a light-weight cotton fabric with a heavy thread stripe characteristic of dress dimity. They are attractive, inexpensive, and very easy to launder.

Jacquard fabrics in cotton are practical for hard wear if the floats are not too long. When of sufficient weight to stay in place they give a trim appearance to the bed.

Linen, either plain and heavy or decorated with lace or embroidery, forms a very handsome spread but wrinkles badly and is difficult to iron because of the size of a spread.

Mohair fabrics, without pile, are appropriate in a bedroom that requires a tailored bedspread. Because of the resiliency of the fiber, mohair fabric spreads do not wrinkle. They clean well and well repay their initial cost. Care should be taken that moths do not reach this material.

Organdie spreads are crisp, fresh looking if the organdie has had a permanent finish, easy to launder, and do not wrinkle very badly. Because of the transparency of organdie, spreads of this fabric require a sheet or other cover between them and the blanket.

Ripplette is a crêpe fabric bearing a trade name, made of cotton and rayon, with stripes of plain weave combined with stripes of crinkled effect. It is light in weight, easily laundered, and comparatively inexpensive.

Satin spreads of either all silk, silk and cotton, or rayon fiber make very luxurious spreads but are not only expensive to purchase but costly to keep up as they look better when dry cleaned than when washed. The long floats of the satin weave tend to catch on rough objects.

Taffeta of either silk or rayon makes a light-weight spread with good wearing qualities; it is most attractive when suited to the decorative scheme of the room and well fitted to the bed. It spots very readily.

Bemberg Rayon. *See* Rayon, p. 118.

Blanket Bindings. Satin ribbon binding, of silk, is the most attractive finish for the edges of bed blankets, but does not wear so well as sateen. Acetate rayon wears well and is much used. The usual width is 3 inches, folded evenly and slightly eased over the edge of the blanket, and stitched several times with large stitches by machine. The ends of the binding should be folded under and securely fastened. The lock-stitch or blanket-stitch edge finish is very satisfactory, provided that the ends are firmly secured.

Blanket Covers. For the protection of delicately colored blankets, dainty covers of crêpe de Chine, dimity, or rayon crêpe are most satisfactory. In ready-made covers the joining of the several widths of material necessary to make a cover of sufficient width is usually done with lace insertion or a silk piping or cording that matches the edge finish of the cover. A sheet placed over the top blanket of the bed offers very satisfactory protection against dust and soil.

Blankets. There are several characteristics which a good blanket should possess and which a wise shopper keeps in mind. These are warmth without undue weight, satisfactory wearing qualities, and sufficient length and width to stay in place on the bed. The first-mentioned qualities depend upon the construction of the fabric, including fiber, weave, and finish.

Fiber. In general, the two fibers used in blankets are wool and cotton, although combination silk and wool, and rayon and wool, blankets are now on the market. The warmth of the cloth depends upon its ability to hold in its mesh still air, which is a non-conductor of heat and cold, as well as upon the inherent nature of the fiber as a conductor or non-conductor. Wool feels warmer than cotton owing to its non-conducting nature and to the fact that crimpiness and the tiny serrations of the fiber tend to hold the air. A moderately loose weave, plus napping, increases the amount of still air held in the fabric. On the other hand, a well-napped cotton blanket retains the still air and consequently feels warm until wear and washing mat the nap. Cotton fiber, being non-resilient, does not spring back naturally as does wool. For this reason cotton is a better conductor of heat; a cotton blanket is not so warm as a wool blanket, *per se*. Wool and cotton are frequently combined, each adding to the desirability of the blanket, since the presence of some cotton in the fabric reduces the initial cost to the purchaser and the percentage of shrinkage, and frequently increases strength. The two fibers may be combined before the yarn is carded and spun, or a core yarn of cotton may be wrapped with all wool or cotton and wool, or the cotton yarn may be used for the warp and the wool yarn for the filling. On every blanket should be found a label stating the exact percentage of wool used.

Commercial Standard CS39-37 of the National Bureau of Standards, United States Department of Commerce, provides standard methods of labeling wool and part-wool blankets, which in regard to the percentage of wool content are as follows:

> No finished blanket containing less than 5 per cent of wool by weight of the total fiber content shall carry the word "Wool" in any form.
>
> Blankets labeled with the word "Wool" in any form and containing:
>
> (*a*) Between 5 and 25 per cent of wool by weight of the total fiber content shall be labeled "Part Wool, Not Less Than 5 Per cent Wool."
>
> (*b*) More than 25 per cent of wool by weight of the total fiber content shall be labeled with the guaranteed (minimum) wool content, in percentage.
>
> (*c*) Above 98 per cent of wool by weight of the total fiber content shall be labeled "All Wool."

Such labels enable the housewife to judge something of the price of the article and its care while in use, a large percentage of cotton indicating that the price should be lower than one with a high percentage of wool, and that somewhat less meticulous care may be used in the washing. *See* Care of Blankets, following.

Reclaimed wool is frequently used in blankets of low grade. (*See* Reclaimed Wool, p. 122.) Blankets containing this type of fiber feel harsh, and when crushed in the hand will not spring back if the fibers have lost the natural resiliency of new or virgin wool of good quality.

Weave. Blankets are woven of plain or of twill weave; some, as the two-toned blankets, in double-cloth weave. The weave should always be close enough for firmness, but loose enough to permit of sufficient nap being given. Hold the blanket to the light to see how much light shows through, and pull the cloth between the fingers to see whether it will withstand the normal strain of use.

Finish. After weaving, the blanket is brushed vigorously on a napping machine (*see* p. 100) to raise the fine yarns to the surface and give the nap which holds the still air. This process may be overdone and so weaken the body of the fabric that it will not withstand much strain. To test for strength, grasp some of the nap firmly between the fingers and lift the blanket; a well-napped blanket should bear its weight in this test. Thin spots also indicate over-napping of the fabric.

The edge finish of the blanket is important from two standpoints: appearance, and wearing qualities. In general, silk ribbon bindings are more attractive but wear less satisfactorily than sateen bindings, or the simple blanket stitch in yarn over the ends. Acetate rayon bindings are very frequently used and give excellent service.

Sizes. Blankets are woven in single and in double length, or pairs. The double blankets are heavy to handle in washing, and cotton double blankets are difficult to manipulate when making up the bed as the two layers stick together. When selecting blankets the purchaser should know the dimensions of the bed and the thickness of the mattress on which they are to be used so that sufficient allowance may be made for tucking the blanket under the mattress. The sizes of blankets are as follows:

For single or twin beds
- 60 by 84 inches
- 60 by 90 inches

For extra-size beds
- 80 by 90 inches
- 90 by 108 inches

For double beds
- 72 by 84 inches
- 72 by 90 inches

For cribs
- 40 by 60 inches
- 48 by 66 inches

High-grade blankets are made of long-staple fleece wool, strong and resilient; they are of sufficient thread count to be strong, yet not stiff and boardlike, and they are sufficiently napped to look fluffy and to hold still air.

Cheap wool blankets, camp blankets, and some steamer rugs are made of reclaimed wools. Because of the strenuous processes to which woolen rags, clippings, etc., must be subjected to obtain the wool, the fibers may be broken and weakened, causing the blanket to be harsher and less fluffy than blankets made from fleece wool.

Care of Blankets. Wool blankets require intelligent care to keep them in condition. A sheet spread over the upper blanket on the bed protects it from dust. The bed should be stripped and the blankets aired daily, to free them from body exhalations and from the felting promoted by warmth and moisture. The strenuous washing necessary to cleanse a much-soiled blanket is more harmful to it than several washings of the same slightly soiled article. Rubbing by hand or pounding in a machine is the chief cause of felting, and a blanket so mistreated loses softness, fluffiness, and warmth as it becomes permanently felted. As a rule, blankets should not be washed in a machine.

In order to retain the desirable qualities, three points should be borne in mind: the wash and rinse waters should be at no more than blood heat; a mild soap should be used; handling should be gentle. If the water is hard, a water softener such as borax or sodium hexametaphosphate, which is on the market under brand names, should be introduced before the soap is added. Otherwise insoluble soap curds will entangle in the nap and cause a greasy, dirty condition hard to remove. After the water is softened (if necessary), add mild soap to make full suds, and during the washing keep up the suds. Let the blanket soak a few minutes, then gently squeeze the suds through the meshes, without rubbing. If a special dirt spot needs attention, use the tips of the fingers to massage in some extra soap. Avoid hard wringing; better, lift the blanket into a succession of rinse waters until free from soap, and hang wet to dry. Do not dry in a hot place or in direct sunlight. When dry, shake, and fluff up the nap with a soft brush.

Even better than soap for blanket washing are the new soapless cleansers on the market which are sulphated or sulphonated alcohols. *See* p. 19. These are entirely neutral in water; therefore, they do not have the effect on wool which the alkali of even a mild soap may have; they cleanse in hard water as well as in soft, making full suds in either, so that no alkaline water softener is necessary; being neutral, they do no harm to wool if not entirely rinsed out; they have a decided affinity for greasy dirt in wool and cause the blanket to become clean with the minimum of handling, and without loss of softness and fluffiness.

Dry cleaning is also advisable for the very fine blankets, since it prevents shrinkage and keeps ribbon bindings fresher in appearance.

Before putting blankets away for the summer, wash them, shake and air thoroughly, then sprinkle lightly with paradichlorobenzene, and wrap in heavy paper, sealing the ends so that no moths can enter.

Bellman-Brook Finish. *See* p. 57.

Bleaches. *See* Stain Removal, p. 147.

Bluings. *See* p. 20.

Carbonizing. The destruction of vegetable fibers, either as impurities in the wool fleece or as fibers in wool-cotton mixtures which are to be used as a source of reworked wool. In loose wool, a soaking for about 1 hour in a 4 to 6 per cent solution of sulphuric acid is followed by drying at moderate heat, then baking at 90° to 105° C. The vegetable impurities are reduced to charred particles which dust out. A similar treatment is given wool-cotton rags; the charred cotton fibers are dusted out by willowing, and the excess acid is removed by treating with soda ash and washing.

Carding. Carding is the operation of completing the cleaning, opening, and disentangling of wool and cotton fibers, arranging them in more or less parallel order, reducing them from a heavy lap or sheet into a thin web and finally into a thin rope or sliver suitable for the combing or the drawing machines.

The carding of woolen, worsted, and cotton is essentially the same in principle, but machines are specially designed for each type of yarn. All are elaborations of the old-time hand cards which consisted of flat pieces of wood covered on one side with leather closely studded with bent wires. (The modern adaptation of this device is called card clothing.) The mass of washed fibers was placed on one of the cards and the other was drawn over the first one, the teeth of the card apron opening and cleaning the cotton or the wool between. The fluffy fibers were next rubbed between the backs of the two cards into a soft roll and considered ready for spinning.

The cotton carding machine of today has one enormous cylinder 40 inches by 50 inches in diameter covered with card clothing, i.e., several hundred steel wire teeth, ¼ of an inch in length, to the square inch. In the cotton card above the cylinder is a series of narrow iron bars also covered with card clothing, formed into an endless chain the same width as the large cylinder. The cotton lap is fed to the large cylinder, and as this revolves the cotton is caught by the wire teeth of the flats moving against those of the cylinder and combed. Short fibers are carried off by the flats in one direction, the cleansed cotton on the cylinder being carried in the opposite direction, removed from it as a soft, fleecy web, and finally reduced by means of a funnel arrangement to a soft, loose rope known as a sliver. The cotton sliver is then ready for the comb if extremely fine yarn is desired, or for the drawing frames where it is drawn out to a smaller diameter suitable for the spinning frames. The waste cotton resulting from carding is used for inferior grades of cloth as well as for many other purposes.

Woolen yarn is carded in a set of two or more main cylinders. Small cylinders above the large ones replace the flats of the cotton card. The teeth of the card clothing covering the cylinders become finer in each succeeding unit or "breaker" of the machine. In order to eliminate any uneveness in the stock the wool is fed diagonally into the third and last breaker.

For worsted yarns the long wool is carded on one of three types of special machines, the process having as its objective not only the cleaning and blending of the wool but the parallelizing of the fibers in preparation for the gilling and combing machines. The worsted card consists of one rather than three machines as characteristic of the woolen card.

Carding is a process very hard on fibers as it tears them materially and reduces their strength unless it is very carefully carried on.

Modern carding owes much to the inventions of the English textile workers of the eighteenth century. It was Lewis Paul who in 1748 first used a revolving cylinder covered with fine wire teeth. James Hargreaves in 1762 improved on this invention by rotating more than one cylinder against the cotton, and in 1772 John Leigh invented an apron arrangement at the front of the card for feeding the cotton to the cylinders. Arkwright is credited with the invention of the funnel for reducing the web to a sliver and of a doffer for removing the sliver from the machine. Evan Leigh originated the "revolving flat" used in the carding of cotton today.

Carpets and Rugs. Woven and tufted floor coverings were probably first developed and perfected in the Orient (*see* Oriental Rugs, p. 102) thousands of years before Christ and were, of course, entirely the work of hand labor. The Saracens are credited with introducing this handicraft into Europe sometime before the fourteenth century, but Europeans, impatient with the slowness of hand methods, soon developed looms on which rugs could be quickly woven. Under the patronage of Henry IV and Louis XIV carpet weaving was encouraged in France and developed rapidly. After the revocation of the Edict of Nantes, 1685, many Protestant weavers fled either to Belgium or to England where they were welcomed and encouraged to ply their trade. England soon became a large producer of woven carpets, the names of several of her towns being given to types of weaving carried out in their environs: Wilton, where cut-pile fabrics were first made in 1745; Kidderminster, where the first Brussels-type loom was introduced, also in 1745; Axminster, where in 1755 reproductions of Oriental carpets were first made.

In the United States the first carpet mill was set up in Philadelphia in 1791, and the young industry was given tremendous impetus in 1839, when power was applied to the hand loom by Erastus B. Bigelow.

Early woven carpet, in Europe and the United States, was of the type known as ingrain, woven like plain cloth of yarn-dyed wools, the warp threads so manipulated that the ground color of the design became the figure on the other side. This was reversible, good wearing, and comparatively inexpensive, but it is seldom seen in the modern market. It has been supplanted by the following machine-made carpets: Brussels, which in its turn is losing popular favor, Wilton, Axminster, tapestry, and chenille.

The purchaser of modern floor coverings has a great variety from which to make a selection and should judge a given carpet or rug by the quality of the materials in it, its weight, the type of its construction, and especially the firmness of its weave.

Materials. In the usual machine-made carpet, wool yarns are used for the pile, cotton for the warp, and either cotton, linen, or jute for the weft or filling. Cotton, jute, paper, or hemp are employed for the fillers or stuffers—extra threads which add bulk, stiffness, or weight to the carpet. Coarse, long wools, from 1 to 13 inches in length, technically known as carpet wools, are imported duty free from Scotland, Asia Minor, China, Thibet, Iceland, and the Argentine, the quality of the fiber playing an important part in the wearing quality of the rug. Rayon is used to some extent for the pile of carpets.

In 1939, the members of the Institute of Carpet Manufacturers adopted the policy of "designating by means of stamping, tagging, labeling or other means of identification" the composition of the pile or face in the floor coverings manufactured by them. If the tag or label states that wool is present in the pile it means that the "wool or hair of the sheep, goat, or other like animals" and not wool "reclaimed from any woven, knitted, felted or otherwise manufactured fabric" has been employed. When the pile is of more than one fiber, "each constituent fiber thereof, in the order of its predominance by weight, if its percentage of weight is 5 per cent or more of the total fiber weight in the face or pile, beginning with the largest constituent fiber," is designated.

After a thorough washing in soap and caustic soda solutions the short wools are carded and rather loosely spun into woolen yarn. The finer and longer wools are carded, combed, and tightly spun into worsted yarns. Worsted is more lustrous and more enduring than the woolen yarn because the longer fibers do not shed so quickly as the shorter ones. The purchaser may learn of the type of wool yarn used in the pile of the rug under consideration by rubbing the surface briskly with thumb and first finger; the woolen fibers being short, rub out rather easily, indicating that the rug has a pile of woolen yarns.

Each single spun yarn is known as a "ply" and for different constructions is twisted together with one, two, or more single-ply yarns. As many as six-ply yarns are used in the weaving of some floor coverings.

Designing of Carpets. The design for a carpet is first made in colors by an artist skilled in this field and when accepted is enlarged on squared paper, each tiny square or "point" of which represents a tuft in the carpet and must be painted in the proper square for that tuft. This design is a guide for the workers who select the yarns of designated color from the spools and thread up the loom. Color is applied to the wool in the raw stock or to the yarn, or it is printed on the warp before the warp is set up in the loom, as is customary in tapestry carpets. Aniline dyestuffs are generally used in the dyeing of carpet wools.

Weight. Generally speaking, the heavier the rug the more desirable it is as a floor covering, as a heavy rug will stay in place better than a light-weight one; the greater the weight, the closer the construction or compactness and the greater the amount of wool used, with the resultant increased resiliency, warmth, and softness of the fabric.

Firmness of Weave. The pile weave in most carpeting is made by looping the extra or pile warp threads over wires inserted parallel to the weft or filling threads. The greater the number of these wires and the greater the number of pile tufts to the inch, the firmer is the construction of the carpet and the better its wearing quality. The firmness with which the loops are bound in place is controlled by the number of times the weft is shot across the carpet between the loops. If the weft is shot twice across between every two rows of pile loops it is spoken of as a "two-shot" fabric; if the weft is thrown three times, as a "three-shot" fabric. In order to determine the shot of a carpet, bend it back across the width and count the number of weft threads showing. If two are visible the carpet is a three-shot one with the third weft buried in the body of the carpet and not visible. To count and determine the pitch or the number of pile tufts per inch crosswise of the fabric, bend the carpet along the filling, as above, and place a ruler close to the weft threads. Another quick method of determining the closeness of the weave is to examine the back of the carpet. The greater the number of tiny squares per square inch into which the surface is divided by warp and filling yarns, the closer is the weave. In comparing two carpets in this manner the size of the pile yarn must be considered.

Height of Pile. In general the carpet with a dense, short pile gives the longest wear and is easy to care for, while the long pile gives the feeling of greater luxury and comfort.

Width of Carpeting. Carpets vary in width from 27 inches, the old "ell" of Flanders, where mechanical looms were first used, to several feet, depending on the construction of the carpet and the width of the loom used. Broadloom is a term indicating the width of the carpet and not its construction. Some broadloom carpets are now as wide as 18 feet; chenille carpet is made in any width up to 30 feet. Narrow strips may be sewn together and the ends finished to form rugs of any desired dimension.

Types of Pile Carpeting

The pile of carpets such as velvet consists of short tufts of yarn held by the ground warp and filling of the body and at right angles to them. Various methods and machines are employed in securing the pile, particularly the cut pile which is in such great demand for floor coverings.

Wilton. For this type of carpet, worsted or woolen yarns are used. Worsted yarns give a pile that is erect and resilient, and details of design that are fine and clear; woolen yarn gives a softer pile and slightly coarser details. In its finest grades the Wilton carpet is generally considered the best of all floor coverings made by machine.

Wilton carpet, irrespective of the type of yarn used, is woven upon the Jacquard loom (*see* p. 199) and contains a rather more restricted range of colors than other weaves, unless the system of "planting" other colors is employed. This method consists of placing spools carrying extra colors in one or more frames. The figures having these colors will be visible in a direct line through the fabric.

Three types of warp thread are required for the Wilton construction: the ground warp known as "chain" warp, which is intertwined with the weft threads during the process of weaving; the filler or stuffer warp, which is cotton or jute and adds bulk and stiffening to the fabric and together with weft stuffers forms the backing; and the third, designated as the pile warp, which forms the face of the fabric. The chain and stuffer warps are wound on two separate beams; the pile warps are on spools held in racks known as "frames." The pile warp during weaving is looped over flat strips of metal, or wires, that are inserted parallel to the weft after the weft has been shot through. The depth of the wire regulates to a large degree the height of the pile. As these wires are removed from the loom during the weaving, a knife on the end of the wire cuts the loops of yarn, giving a velvetlike and tufted appearance to the surface. In fine Wilton rugs as many as 13 wires to the inch of carpet are inserted, and in order to secure the tufts in place high-grade worsted Wilton fabrics have at least three shots to each row of pile.

In this type of weave, when a certain color yarn is not needed to show in tufts on the surface as called for in the design, it is not looped over the wires but carried along in the body of the rug and may be seen on the wrong side among the backing threads.

Saxony. This type of rug is made of the Wilton construction but of coarser and more loosely spun woolen or Saxony yarns.

Brussels. This is an example of machine-made floor covering with splendid wearing qualities, but because of the vagaries of fashion it is little used in modern homes. The pile in this type of weave is uncut, with rows of looped yarns forming the surface of the fabric. The weaving of Brussels carpet is based on the same principles as the making of Wilton carpets, except that the pile loops are not cut as the wires are removed from the loom.

Velvet. This cut-pile carpet is known as a "single-frame" product; that is, instead of having separate colored warps for each of the colors called for in the design, as Wilton has, only one series of pile warps form the tufts, the various colors having been printed on the yarn while on huge drums preparatory to being wound on spools, which in their turn feed the yarn on to a beam for the loom. (*See* Warp Print under Printing of Fabrics, p. 113.) This means that no warp yarns are buried in the body of the fabric as in Wilton, but are all on the surface as tufts of pile. This process naturally calls for less yarn, and the resulting product has considerably less weight and is less expensive than the Wilton variety of carpet. The pattern is quite hazy along its edges on account of unavoidable inaccuracies in the take-up of the printed warp. Velvet carpets are frequently printed in various designs after the carpet has been woven in a rather neutral background color. By this method the dyes do not penetrate very thoroughly into the yarns, and the colors have a tendency to fade. Velvets are made in plain colors, either stock or yarn dyed, as well as in figures. There is no necessity for the Jacquard attachment in the making of carpet with a printed warp, but in other respects the weaving of a velvet rug is similar to that of the Wilton, one warp beam carrying the printed yarn and replacing the many frames which hold the colored yarns for the Wilton construction.

Quality in this as in other types of carpets depends on the grade of wool used and on the closeness of the weave, the number of tufts per square inch, and the number of shots which hold the tufts in position. The better velvet rugs have three shots of weft to hold each row of pile and ten wires or tufts per inch.

Tapestry. Tapestry carpets with their uncut loops are in reality imitation Brussels carpet. The wires over which the warp is looped are without the knife blade at the ends. Like velvet carpet, tapestry is a single-frame fabric with its pile warp printed before insertion in the loom, or the complete design printed on the finished rug. Skill is necessary in the printing of the worsted warp,. but quality in tapestry, as in velvet, depends on grade of yarn and firmness of construction.

Axminster or Mouquette. The fundamental principles of weaving Axminster carpeting resemble somewhat those followed in the making of Oriental rugs. In Oriental rugs each individual tuft of pile is knotted by hand to the cotton chain warp; in Axminster, the tufts are mechanically inserted in rows and bound in place by double shots or wefts of jute.

In the special loom used for the making of this carpet are set up a series of long spools, the width of the carpet, on which are wound the woolen yarns of various colors which follow the order set for them by the pattern. Each spool represents one crosswise row of tufts in the design and is mounted in an endless chain set up above the loom. The ends of the yarn on the spools are threaded through in tubes that are attached to the frame which holds the spools. Steel arms carry the spool down to the chain warp of cotton or linen, and the fringed ends of wool from the tubes are looped into the warp, then held by the jute weft that is carried across by a needle several feet in length instead of a shuttle. Long knives cut the pile yarn, and the spool is returned to its place in the endless chain by the steel arms. The jute weft gives a ridged appearance to the back, and the carpet can be bent or rolled only parallel to the jute strands.

Axminster ranks next to Wilton in cost of production and wearing qualities and may contain an unlimited number of colors. It has a thick, sturdy surface suitable for rather hard wear.

Chenille. In 1838 in Scotland a process was invented for making what is considered a luxury type of machine-made rug, chenille. It can be woven in any desired shape, and in width up to 30 feet without a seam. Its pile is deep with a soft sheen and excellent wearing qualities which, however, are somewhat dependent on the strength of the cotton or linen catcher threads that hold the wool "fur" to the backing.

Two looms are necessary for the manufacture of chenille carpeting. The first one makes the "fur" which is used as the weft pile, in contrast to the warp pile in other types of construction. In this chenille "blanket" loom, cotton warp threads are set up in groups ⅝, ¾, 1, and 1½ inches apart, or according to the depth of the pile wanted in the rug itself. Into these warps are shot woolen or worsted filling yarns, the whole forming the "blanket." The warps are handled as those in the gauze weave, the better to hold in the filling or tufts. Revolving knives inserted between the warps cut the blanket into strips of fur. The strips are then passed through deep grooves in a heated roller which sets them in the shape of a U.

On the second loom is woven the carpet proper with a body or backing of yarn made from wool, jute, and cattle hair. By "catcher" warp threads the chenille fur, used as a weft, is caught into position on the surface. While a guiding ring carries the fur crosswise from side to side of the loom, two men straighten it so that the short, tuft ends stand upright, and they comb it securely in place with a large steel comb.

Rugs and carpets of irregular shape made to fit stairs, hallways, alcoves, etc., are so woven that the body of the carpet is rectangular, but the fur is laid on it to form the desired shape. The body is next cut to fit this shape, and the edges are securely sewn.

To determine the number of tufts, bend the carpet back along the crosswise row of fur, and insert a small ruler against the base of the row of tufts. In high-grade chenille rugs the number of tufts per square inch is as high as 112. The density and the height of the pile, the number of fur shots to the inch, and the strength of the catcher threads determine the desirability of this type of floor covering.

Smyrna. A machine-made Smyrna rug has a pile on both face and back, the pile being formed by the same fur used in the chenille construction but not folded and pressed in the grooved roller. This results in tufts projecting on both sides of the fabric. Jute fillers are inserted between each two strips of fur to give weight and body to the rug. This is a reversible rug.

Brocade and Frisé. Among the newer rugs on the market are those known as brocade. These are made on any type of loom that makes a cut pile—Wilton, Axminster or velvet—from yarns that vary in size and twist. One set of soft and loosely twisted yarns used for the background with another set of finer and more tightly twisted yarns in the design results in a mottled or brocaded appearance. When closely constructed this type is said not to show footprints so plainly as the regular type pile rug.

Frisé carpet, characterized by a pebbly surface, is made of very tightly twisted yarns.

Patent-back Carpets. These so-called seamless carpets are made on velvet looms, and the back is treated with a composition of latex or pyroxylin lacquer so that the bottom of the weave is penetrated and the pile tufts permanently locked in place. The carpet may then be cut as desired, the two edges pushed tightly together, and a tape and cement applied to the back of the seam. The pile of the two pieces interlocks so that the seam is invisible on the face of the carpet.

American Orientals or Luster Rugs. Machine-made rugs of the Wilton or Axminster weave having designs copied from Oriental rugs are designated as American Orientals. The chain warp and the shots are of cotton yarns. This and the absence of sizing make the rug very pliable, like the Oriental covering. After weaving, the pile is submitted to a chemical bath which produces the lustrous effect on the woolen or worsted pile yarn and makes the product resemble that of the Orient. Careless use of the chemical solution will naturally cause some deterioration of the yarn and may affect the dyestuffs. The same standards should be applied to these as to other varieties of machine-made rugs when judging quality.

Hooked Rugs. In the early days of the settlement of America a favorite floor covering was evolved by the industrious housewife by pulling a narrow strip of cloth through a burlap backing by means of a wood or metal hook. This thrifty American dyed her own strips and made her own designs, and these as well as her technique have become the pattern for the modern "hooked" rug made by power machine. The looped pile is made over wires that have no knives on Wilton or tapestry looms. Coarse wool yarns have replaced the strips of cloth of other days, but the designs are decidedly reminiscent of the past.

Finishing of Carpets. When removed from the loom a carpet or rug with a cut pile is passed under a revolving roller containing a spiral knife, much like that of a lawn mower, which shears the pile so that all the tufts are of the same desired height. The shorn bits of wool are removed from the carpet by a thorough cleaning or brushing process, and the carpet is steamed to make the tufts stand erect. It is difficult to remove all these tiny ends, and it is these that cause a fuzz over the surface of a newly purchased carpet and make the housewife wonder if she has bought a good carpet. After a short time and several cleanings they are entirely removed.

Velvet, Axminster, and inexpensive Wilton carpetings have a sizing of starch and dextrin applied to the back.

Non-pile Rugs. A large class of floor coverings may be considered under this heading. The warp yarn is almost invariably cotton; the weft may be of wire grass from the Philippines, flax, or twisted paper fiber, either alone or combined with woolen yarn. The plain weave is used, and a colored design is frequently stenciled on the finished rug. Some rugs are put through a sizing process to give firmness and sometimes to render them waterproof.

Woven rag rugs are also woven with a plain weave, the narrow strips of rags, either wool or cotton, forming the weft, and heavy cotton thread the warp.

Braided rugs are made of narrow strips of cotton or wool fabric braided together, these strips being sewn together invisibly in the shape of an oval or circle. Rag rugs are inexpensive, wear very well, and are easily washed.

Care of Carpets and Rugs. Daily use of a vacuum cleaner or brush is essential for carpets subjected to hard use, because particles of sand brought in on the shoes grind into the pile and cut it. Vacuum cleaning also lessens the danger of attack from moths or carpet beetles. Spots and stains should be treated while fresh, as aging is likely to develop injurious chemical action on the fiber. For washing carpets and rugs, probably the soapless cleansers are the best choice, since they are neutral, and if not well rinsed out do no harm, as far as chemical action is concerned. The difficulty in washing such articles is to secure cleanliness without over-wetting the backing of the rug, which tends to rot the fibers of the backing. With either a soapless cleanser or a mild soap, make full suds in tepid water, and apply the suds rather than the water, in order to avoid soaking the backing. Sponge a small portion at a time until it is clean, following with a cloth or sponge wrung out of the rinsing waters. Overlap the clean portion when proceeding to the next. Dry as quickly as possible, but not near direct heat. The cleansing of large and choice rugs is a job for an expert.

If carpets or rugs are to be stored at home through the warm season, any necessary cleansing should be done, including thorough vacuum cleaning on both sides. Sprinkle liberally with paradichlorobenzene, roll tightly, and wrap securely in cotton cloth or suitable paper, with extra protection at the ends and seams of the roll.

Cashmere. A soft, woolen, twill-woven fabric made originally from the very fine, silky fibers obtained from a goat whose native habitat is Cashmere, India. (*See* Fibers, p 158.) The exquisite Indian shawls so much in vogue at the courts of Napoleon and of Queen Victoria were woven of this down hair in designs typical of Indian art. Today the term applies also to a light-weight material used chiefly for infants' coats and made of very fine, soft wools.

Celanese. *See* Rayon, p. 117.

Cleansing Agents. *Soaps.* Soluble soaps for detergent purposes are sodium or potassium salts of fatty acids. Sodium soaps are always harder than potash soaps, and make up the bulk of laundry and toilet supplies. Specialty products such as shampoo soaps, generally liquid, are potash soaps from coconut oil or a blend of coconut and olive oils. Liquid toilet soaps may be all potash or potash-soda soaps.

A soap made from natural fats and oils is a blend of the salts of a number of fatty acids, since in nature glycerol and a definite group of fatty acids unite to form a given fat. One distinction between a fat and an oil is that a fat is solid at room temperature (20°C.); an oil is fluid. Solidity or fluidity depends upon the nature of the predominating fatty acids in a fat; for instance, stearic and other of the harder acids predominate in tallow, whereas oleic and other soft or fluid acids are in the majority in vegetable oils.

The fats and oils which are the raw material for soapmaking come from many sources, from the poles to the tropics. Whale and fish oils and vegetable oils are used in immense quantities; animal fats are supplied from slaughter houses, butcher shops, and even garbage dumps. The conservation of such material is an example of economical methods in business. The titer or solidification point of fat or oils is a controlling factor in making up a soap recipe. Hard fats such as tallow can be chosen for soaps which are to be used for high-temperature laundry work, but they are not suited to soaps for fine fabric washing, since they do not dissolve well or lather freely in cool water. Soaps for the latter purpose and for toilet use contain at least 10 per cent of oil base.

In commercial soapmaking, as is well known, fats and oils are saponified, with the formation of fatty acids and glycerol. Glycerol is separated and recovered; soapmaking is the chief market source of this product. The fatty acids unite with the alkali present to form soap, according to the typical reaction: $C_{17}H_{35}COOH + NaOH = C_{17}H_{35}COONa + H_2O$.

No soap is neutral in water solution. Because, as seen by the reaction above, it is a salt of a strong base and weak acids, it dissociates in water to give an alkaline reaction. For this reason there is, generally speaking, no such thing as a neutral soap when in use, and the term "mild" more accurately describes soaps which do not contain excess caustic or have not been strengthened by the addition of alkaline salts.

Soaps vary considerably in moisture content. A powdered, flaked, or granular soap may have less than 5 per cent, and seldom more than 8 per cent, of moisture. A chipped soap may contain 15 per cent; a laundry soap in bar form may have as much as 30 to 35 per cent. These are figures as found in soaps leaving the factory, and forming part of the net weight of the package as marked. Soaps which have dried are just as efficient and more economical to use, but their package weight will, of course, be less than the recorded one.

"Builders," including sodium carbonate, sodium silicate, borax, trisodium phosphate, and other alkaline salts, are added to some soaps as stabilizers, water softeners, or for additional detergent effect. If not so much in excess as to cut down the optimum amount of soap and give too high alkalinity, builders have a very legitimate purpose in many soaps.

Resin or rosin is a raw material which in soapmaking becomes rosin soap. All yellow laundry bar soaps contain less or more rosin soap. Its advantages are that it gives to a tallow soap greater solubility and sudsing power in cool water; it is a less expensive soap than one from an all-fat base; it has some anti-rancid action. A well-made rosin-fat soap can be an excellent product; unfortunately, some of the cheapest and least desirable soaps on the market can be found in this category.

The consumer cannot go far wrong in choosing soaps if she buys the well-established and nationally known products. Competition is keen, and manufacturers are always trying to improve their current formulas or devise new and better ones. If a soap does not give satisfaction, it may be that it is not adapted to the particular purpose for which it is used. Very few soaps can be called all-purpose soaps. Certain ones are exclusively in the fine fabric class of mild soaps; they work well for cool-water washing of garments which are not much soiled. Others, designed for heavy-duty washing, lather better in hot water than in cool, and generally are soaps of considerable alkalinity. Between the two classes are some products which might be called all-purpose soaps, so far as the lighter cleansing operations of an average household are concerned.

The Federal Government has made available a set of specifications covering the required composition of all cleansers used in the service of the government.

The cleansing action of soap is not due to the alkali which dissociates, as was once thought. Although alkalies do have a detergent effect on some classes of dirt, on the whole the cleansing power of a soap diminishes in proportion to its dissociation. Soaps form colloidal solutions in water; therefore undissociated soap solutions have:

1. Low surface tension. This allows a soap solution to spread and penetrate; that is, it has high "wetting-out" power. The viscosity of a soap film, which is a property associated with its low surface tension, enables it to stretch to form soap bubbles or suds. This stretching gives it:

2. Emulsifying power. A soap film can surround minute particles of grease or dirt, prevent their coalescence, and float them off with the lifting power of suds. A theory to explain the good emulsifying power of a soap film is that the hydrocarbon radicals of the soap are soluble in oil and enter the globule, leaving the COONa groups, which are insoluble, to project around the circumference as a wrapper.

3. Adsorption. The power to pick up particles of dirt or other substances and cause close adherence is peculiarly a property of colloids. Soap solutions have this power to pick up particles, and the affinity of dirty matter for soap in cleansing operations is much greater than its tendency to adhere to the fabric or other surface to be cleansed.

Soap Substitutes. New products, such as Dreft and Vel, have come on the market which are not soaps, but which lather freely and can be used in place of soaps for many purposes. They are either sulphated or sulphonated alcohols. They are packaged in granule form for domestic use, or modified and in liquid form for shampoos. They are freely soluble in water and entirely neutral. They are not water softeners, but, although they do not remove the cause of hard water, they are not at all affected in their action by hardness, and they have full sudsing and detergent power in water of any degree of hardness. Since there is no alkaline reaction, these products are valuable for washing woolens, silks, upholstery, and rugs. They are also increasingly used in silk degumming, wool scouring, and dyeing operations.

Water Softeners. A large area of the United States suffers from hard water. Hardness is caused by soluble salts of calcium and magnesium. These destroy soap by forming insoluble, greasy curds of calcium or magnesium soap. The function of a water softener is to form chemical combinations with the calcium or magnesium salts which are causing hardness, and remove them by precipitation or otherwise, leaving the added soap free to have its full cleansing effect. Familiar water softeners are washing soda or other form of sodium carbonate, trisodium phosphate (known as TSP), and borax. Theoretically, their action, as illustrated by the following reaction, is effective:

$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$$

and the calcium is thrown down as a precipitate of calcium carbonate, but actually the process is far from satisfactory. The precipitate of calcium carbonate, phosphate, or borate, as the case may be, will deposit on the material and clog the fibers of clothing, unless the water is allowed to stand for some time until the precipitate settles and is then dipped off into another vessel. Also, the soluble salts, such as sodium sulphate, which are formed have a "salting-out" action on the soap and make it insoluble to some extent. And the uncertainty as to how much water softener to use generally ends in using too much and giving the water too great alkalinity. In short, hard water is hard on soap, on clothes, on the pocketbook, and on the temper.

Some recent market products do not have these disadvantages of the water softeners mentioned. One is sodium hexametaphosphate, called Calgon. It brings water to rain-water softness by taking up the calcium and magnesium ions in the form of complex soluble salts which do not have a precipitating action on soap. In itself it has very low alkalinity, and it tends to repress the alkalinity of the soap with which it is used. Tetrasodium pyrophosphate has a similar action.

The correct procedure in all water softening is to treat the water with the softener before adding soap.

Soap powders, which usually contain in the neighborhood of 15 per cent soap, the balance being chiefly alkaline salts, should be classed as water softeners and special cleansers rather than as soaps.

Starches and Bluings. These are not detergents, but they are agents in cleansing processes. Starch not only improves the appearance of any garment to which it is suited, but it makes the fabric more dirt-resistant and easier to launder, so far as dirt removal is concerned. Thick- and thin-boiling starches are on the market, and recently a truly soluble starch, made by treatment with hydrochloric acid, has appeared. For a sheen or sizing effect on thin fabrics, thin-boiling and soluble starches are valuable. Some thin-boiling starches contain added borax.

Three types of bluings are commonly found: ultramarine; Prussian blue; aniline blue. *Ultramarine blue* is marketed in ball or cube form. It is a complex, artificially made clay which will disperse in water in the form of a fine suspension, but which will settle down unless frequently stirred. *Prussian blue* is ferric ferrocyanide, $Fe_4(Fe(CN)_6)_3$. It is the usual pigment in liquid laundry bluing. Its disadvantage is that, if soap or water softeners of an alkaline nature are in the bluing water, the alkali liberated by hydrolysis will unite with the bluing, especially in the ironing operation, and produce iron rust:

$$Fe_4(Fe(CN)_6)_3 + 12NaOH = 4Fe(OH)_3 + 3Na_4Fe(CN)_6$$

The $Fe(OH)_3$ formed is the immediate cause of the iron rust spots. *Aniline blues* are selected blue dyestuffs. A few of these are found in liquid form on the market. They are stable to alkalies and are in the bluing soaps.

Coatings. For protection against cold, wool fabrics are desirable for coats, because wool has the power to hold entrapped in its meshes still air, which acts as a non-conductor, preventing the cold from reaching the body and also retaining the body heat. The greater the amount of good wool in the coating fabric and the firmer the weave to protect against the wind, the warmer the coat will feel. Large amounts of cotton, spun rayon, or inferior grades of reclaimed wool (*see* Reclaimed Wool, p. 122), in addition to causing the material to wrinkle easily, decrease the warmth of the fabric; and open, loose weaves permit circulation of air close to the body with the consequent loss of heat. For these reasons firmly woven, or closely knitted fabrics are good selections for warm coats. The weight of the cloth does not indicate its warmth; fabrics that feel stiff as well as heavy probably contain a large percentage of reclaimed wool or cotton. It must be remembered, also, that tightly woven wool fabrics will felt under heat and moisture and tend to feel stiff and board-like. Good wool is soft and springs back when crushed in the hand. (*See* Wool, p. 207.) Although a napped surface cloth is warm, the nap tends to wear off at the wrist and along the front of the coat where the coat receives rubbing. Rough and napped surfaces catch dust and lint, so that in dark colors particularly the coat must be frequently brushed for good appearance. Dark-colored materials, in addition to being suitable for hard wear against drab winter backgrounds, are also warmer than light-colored fabrics, as dark colors absorb light rays, and therefore heat.

Coats for spring and summer wear are usually made of light-weight woolen and worsted cloths (*see* Wool, p. 208) of smooth surface and light colors.

Very loosely woven materials as well as those containing novelty yarns are attractive in texture for women's coats, but rarely wear well. Loosely woven materials stretch and lose their shape, tend to catch on rough surfaces and pull, causing broken places in the cloth.

For use in raincoats, such fabrics as covert, tweed, homespun, and gabardine are treated to render them waterproof or water repellent. *See* Waterproofing, p. 64, and Raincoats, p. 114.

The fabrics of wool most commonly used for coatings are the following:

For Men and Boys:

Heavy Overcoats	*Light-Weight Coats*
Camel's hair	Cheviot
Chinchilla	Covert cloth
Fleece	Gabardine
Kersey	Homespun
Melton	Venetian
Montagnac	Worsted, finished and unfinished
Polo cloth	

Sports Coats

Mackinaw cloth
Tweed

For Women's and Children's Coats:

Bolivia	Homespun
Broadcloth	Serge
Covert	Tweed
Flannel	Velour
Chinchilla	Wool crêpe
Gabardine	Wool jersey

For Infants' Coats:

Albatross	Eiderdown
Bedford cord	Serge
Cashmere	Wool crêpe

Color. Color does not exist beyond the power of the eye to recognize; therefore, it is purely subjective.

Different frequencies and wave lengths give rise to different optical sensations which we class as colors, just as certain other waves and frequencies affect the ear as sounds. The sensation of red, for example, is caused by wave lengths of 0.647 to 0.8 micron, with a vibration rate or frequency of 39×10^{13} per second; violet, at the other end of the visible spectrum, has a wave length of 0.4 to 0.422 micron and a frequency of 85×10^{13} per second. Middle C on the piano, by contrast, makes only 256 vibrations per second.

All colored bodies are seen by light either *transmitted* through them or *reflected* from them. Consider white light, transmitted through red glass. The red glass might be supposed to cut out all the components of the white light, that is, all the different waves and frequencies which compose it, except the red. As a matter of fact, it allows much red, some yellow, a little green, and less blue, but no violet, to pass through. The result is a complex red. In like manner the color transmitted through other transparent media might be analyzed.

Opaque media give rise to color by reflection. Color by reflection is due to the colored elements of white light which the medium does not absorb. The dominant color reflected from a blue fabric is some tone of blue; the fabric has absorbed the red, orange, yellow, green, and violet elements of the white light in varying amounts.

Practically speaking, white is total reflection of light; black is total absorption. For this reason, white or light-colored fabrics are cooler in summer than black ones of the same construction. *Brightness* or *value* is determined by the amount of light reflected.

The *hue* is named by selecting the dominant color, e.g., blue. *Tone* refers to differences in colors all of the same hue, and includes tints and shades. *Tints* are produced by adding white to a hue; *shades*, by adding black.

The *additive primary colors* are red, green, and blue, because by combining these in the proper intensities white is produced. A color produced by two of them, as purple, composed of red and blue, with the third color, in this case green, will produce white.

Complementary colors are those which when added to a given color in proper intensity will produce white. For example, a certain green is the complement of a certain red, and therefore offers the sharpest contrast to it. Complementary colors are always in sharp contrast to each other.

Subtractive or primary mixing colors are red, yellow, and blue. By mixing any two of these, the binary or secondary colors are produced. Thus blue plus yellow produces green, a secondary color.

The three subtractive primaries, when mixed, produce black instead of white. Each of the secondary colors is complementary to the primary mixing color which is not used in producing it. So, since red and yellow produce orange, orange is the complement of blue.

Color comes to the eye from fabrics both by reflection and transmission. Surface light is white light; if the white light is reflected away from the eye in many directions, as from the smooth, reflecting surfaces of silk or rayon or the many facets of the wool fiber, then the rich, transmitted color of the dye is appreciated. Wool and silk have an inherent richness of color in dyed fabrics which cotton, with its flatter reflecting surface, may not have. This does not mean, however, that cottons cannot be brilliantly dyed with certain types of dyestuffs. In silk velvets, the cut ends of the pile, standing on end, reflect little white light, and the soft richness of the dye in the depth of the pile is appreciated. With cotton velvets, where the nap crushes more easily, a white or faded look increases with age.

Combing. This is a process employed in the manufacture of worsted and fine cotton yarns. Its purpose is: (1) to eliminate all fine impurities not removed by the processes of washing and carding; (2) to extract all fibers below a specified length; (3) to lay the fibers parallel for a smooth, silky yarn. Much waste results from combing; consequently, the process adds considerably to the cost of fine cotton and worsted fabrics, sewing threads, and hosiery for which combed yarns are used. However, the waste products are utilized for inexpensive fabrics and for mixing with other fibers.

Several types of machines are used for the combing of cotton and wool, the chief object of each being the same, namely, the arranging of the fibers in parallel order, but the mechanism of each machine is adapted to the staple of the respective fibers. For cotton and short-staple wool the improved Heilman comb, invented by the Alsatian, Joshua Heilman, just prior to 1851, is in general use in the United States. In this machine the longer cotton fibers are held in a bunch by a nip and combed by the card clothing of revolving cylinders. When one end is combed the other end is held by the nip and in turn combed, the short ends being removed and carried away from the silky, parallel fibers that emerge from the machine in the form of a sliver ready for drawing and doubling, preparatory to spinning.

For worsteds, the circular Noble comb which is adapted to both long- and short-staple wools is very commonly used in this country. This very complicated machine consists in essence of a large metal ring, 48 to 60 inches in diameter, set with fine steel teeth and revolving horizontally in contact with two smaller rings also equipped with fine teeth. These rings are set within the large ring, on opposite sides, and revolve in the same direction as the large ring. A suspended brush drops down on the wool, pressing it into the teeth of the rings, where it is combed and the short ends, or noils, removed by the smaller rings. The long, silky fibers leave the comb as a thick strand known as the top, in which form they are ready for the following operation of gilling.

Comfortables. Much of the value of this article of bedding lies hidden in the type of filling that is placed between the two layers of attractive covering. The best quality of comfortable is warm without being heavy; it is soft and resilient, and it receives these characteristics chiefly from the high-grade wool or the down filling. Australian lamb's wool of long staple makes exceedingly warm, resilient filling, though the cheaper grades of wool, frequently reclaimed wool, are used. Goose and duck down are commonly employed in the "puff," the down from the breast of the eider duck making a very light, warm, but expensive filling. Substitutes for down are chicken feathers.

Various grades of cotton, long or short staple or linters, may be found in comfortables, the best being long-staple, carded cotton from India, which is resilient and does not tend to become lumpy. Cotton filling makes a heavier and less warm comfortable than wool but is considerably lower in price.

To compare the resilience of two comfortables, press them tightly between the two hands and watch the rapidity with which each rebounds to its original position.

Second in importance in a comfortable is the covering. This should be of a fabric firmly enough woven to be durable and to prevent the filling from coming through, particularly in a "puff"; it should have few if any long floats that tend to catch and pull the cloth; it should be of sufficient pliability to drape well on the bed and of a texture that will launder or clean satisfactorily. Chintz, short-float satin, mull, sateen, China silk, and acetate rayon taffeta are common for coverings.

The filling is held in place between the layers of covering by hand or machine quilting, the former being more pliant and desirable, or by tufting with yarn or threads tied at intervals that are close enough together to prevent the filling from moving about.

Sizes of Comfortables

Twin Bed	*Double Bed*	*Extra Size*
60 by 78 inches	72 by 78 inches	80 by 90 inches
60 by 84 inches	72 by 84 inches	

Conditioning. The determination or the fixing of the amount of moisture in textile material under standard conditions of 70°F. and 65 per cent relative humidity. The method consists in drying the material to constant weight, determining the loss of moisture, and calculating the assigned regain for the class of fiber. The latter is the "conditioned" weight of the material, based upon a definite percentage of regain. Figures for these regains are usually calculated as 7 per cent for cotton; 11 per cent for silk, viscose, and cuprammonium rayons; 6.5 per cent for cellulose acetate rayon; 13 per cent for woolen yarn; 15 per cent for dry spun worsted yarn; and 13 per cent for oil spun yarn. *See* Silk, p. 135.

Cosmetics. So far as textiles are concerned, several commonly used cosmetic preparations may be injurious to fibers if brought into close contact. One is a type of non-perspirant, a liquid containing aluminum chloride. This substance is harmful to silk and vegetable fibers; therefore such preparations should be used at night and allowed to dry before coming in contact with these fabrics. A pressing iron placed on a part of a garment where such non-perspirants may have been absorbed will probably cause a hole, owing to the action of heat in producing increased chemical effect of the aluminum chloride on the fibers.

Depilatories which destroy hair will also destroy wool. Damage of this sort is not likely to occur, but the fact that depilatories are usually barium sulphide, a solvent for wool, might as well be remembered.

Nail-polish remover will dissolve acetate rayon. Cuticle remover is somewhat harmful to wool and silk. It is wise, when using such preparations, to protect the clothing.

Cotton. *Sources.* Cotton, the source of much of the industrial activity of the United States, was first planted and grown for commercial use in Virginia in 1607. The plant, a member of the mallow family, attains a height of 4 or more feet. The cotton fiber is the short hair which grows on the seeds contained in the bolls or pods. *See* Cotton Fibers, p. 160.

Originating in India, the cotton plant requires a warm, moist climate, loamy soil, and freedom from frost. The southern section of the United States and Egypt, India, China, Russia, Peru, Argentina, Brazil, and Mexico are the cotton-growing countries of the world, the United States producing nearly 50 per cent of the entire world crop.

Cultivation. The cotton seed is planted in rows in the spring of the year, the blossoms, which change from creamy yellow to purple in color, appearing in slightly over a month after planting. Within 40 to 60 days the boll matures, and its white, fluffy content is ready for picking. Not all the bolls on a plant mature simultaneously; consequently the field must be picked over several times until the entire crop is in. Cotton picking is done in the United States largely by negroes, whole families turning out into the fields; but there are indications that the days of hand picking are numbered. Though the results of cotton picking by machine have not been entirely satisfactory to date, it does not seem possible that in time an efficient method will not be invented with resulting adjustments of labor wherever the machine may be used.

Good weather conditions are highly desirable for a satisfactory cotton crop, but another enemy in the form of a very tiny weevil can quickly wipe out an entire section of maturing cotton. The boll weevil punctures the cotton boll and deposits its eggs, which in turn develop and carry on the work of destruction. Scientists and farmers have been working together for some time in attempts to break the almost strangle hold on the cotton-growing industry in the United States which this small insect has held since it crossed the Rio Grande River from Mexico into Texas nearly 50 years ago. Southern planters are having some success in checking its devastations by spraying calcium arsenate on the plants from low-flying airplanes. The activity of the boll weevil is one of the causes for the fluctuation in the retail price of cottons.

Varieties of Cotton. Different conditions of soil, climate, and plant species produce varieties of the cotton fiber. In the United States is grown Sea Island cotton, one of the finest grades produced, with a silky staple that measures from 1½ to 2½ inches. It is said to have been imported from the Bahama Islands, and was first grown in this country on the islands off the coast of Georgia, Florida, and South Carolina, but is now grown on the mainland. It is used for high-grade fabrics, spool cotton, and laces. Pima cotton from Egyptian cotton seeds has a fairly long staple, is grown in Arizona, and is used for fine cotton fabrics. The variety known as upland, varying in length from ¾ to slightly over 1 inch, grows well in Alabama, Georgia, the Carolinas, Tennessee, and Virginia. Gulf cotton, known as peelers, is raised in the states that border on the Gulf of Mexico and the lower Mississippi Valley, and has a staple averaging slightly over an inch. This is white; Texas cotton, raised in Texas and Oklahoma, is slightly shorter and a pale yellow.

Egypt produces a cotton fiber that is long, strong, and silky; it is much in demand in the United States, which now produces some of this variety. Peruvian cotton is long but wiry and rough; it is well suited for mixing with wool. China raises cotton that is slightly tinged with brown but has considerable resiliency.

Ginning. As the cotton fibers are attached to the forty-odd seeds contained in each boll, these seeds must be removed before the cotton can be cleaned and spun into yarn. The principles of the mechanical saw gin, invented by Eli Whitney in 1793, and of the roller gin used in India centuries ago, are contained in the modern cotton gin.

The saw gin, more common in this country, consists of a set of circular saws, the teeth of which protrude through the openings of a fine grill and as they revolve catch the cotton on the other side of the grill, drawing it away from the seeds. The seeds, being too large to enter the slits of the grill, fall into a container below. In the roller gin, used for long-staple varieties of cotton because it does not tear the fiber, the seeds are brushed off the lint that adheres to the rough covering of the rollers and is carried off by these rollers in another direction. Very short fibers (linters) still adhere to the seeds, but they are later removed and used very largely for the making of rayon, films, absorbent cotton, gun cotton, as well as many other products. The seeds likewise are utilized, being pressed for oil or used as fodder for cattle and as fertilizer.

The ginned cotton, when packed into bales compressed to a size convenient for handling, weighing approximately 500 pounds, are wrapped in burlap ready for shipment.

Marketing and Grading. The cotton planter may dispose of his wares through the local buyer or storekeeper, who advances credit for the planter's supplies on his cotton; through cooperative markets; or to the buyer for a merchant or mill. The cotton merchant concentrates the raw cotton and sees that it is distributed to spinning and weaving mills.

The buying and selling of cotton in large quantities takes place on the cotton exchange, the leading exchanges being located in New York, New Orleans, Liverpool, Bremen, and Havre. Traders engage in buying and selling cotton for immediate delivery ("spot" cotton), and for delivery at some future date ("future" cotton).

The price of cotton, like that of other commodities, depends on crop and market conditions as well as on its classification into standard grades, its elasticity, length, and strength. The grade of the fiber depends on its condition, that is, its freedom from soil or stain, sand, particles of leaf, hulls, etc. Cotton in this country is graded on the condition of standard middling upland cotton, which must be creamy white and free from soil and must contain few immature seeds, pieces of leaf, or cuts received in ginning. Grades above and below this are made on the amount of imperfection the cotton contains. The eight full grades of cotton are:

Fair.	Low middling.
Middling fair.	Good ordinary.
Good middling.	Ordinary.
Middling.	Low ordinary.

Between these full grades are those known as half and quarter grades.

Manufacture of Cotton into Yarn. On its arrival at the mill the cotton is put through the process of opening and cleaning. The closely packed fiber is opened by a machine called a bale breaker, which by means of several revolving spiked rollers loosens the fibers and prepares them for the pickers. These consist of several machines, each of which beats the cotton to free it from the dust, burrs, and twigs that it contains. It leaves this series of machines in the form of a soft, fluffy lap wound in a large roll, ready to enter the card (*see* Carding, p. 7), where it is further cleaned, opened, and freed from its shortest fibers. The cleaned cotton emerges in a cobweblike veil, enters the condenser, and comes out as a soft, untwisted rope with a diameter of about ½ inch, known as a sliver.

For yarns to be used in fine-quality woven or knitted materials such as sheeting, madras, and broadcloth, the cotton fiber must be combed as well as carded and all short fibers removed, leaving the 1⅛-inch, or longer staple, in a smoother, more uniform, and stronger yarn than that which results from carding alone. *See* Combing, p. 24.

The next machine the cotton enters, called the drawing frame, consists of a series of rollers, each set revolving at a slightly higher speed than the set immediately preceding it. Into the first rollers are fed from four to eight slivers, and these are received by the succeeding rollers and gradually elongated and drawn out into one sliver about the size of the sliver received from the carding machine. Three other machines, the slubber, intermediate, and roving frames, in succession, receive the cotton in sliver form and continue to draw it out into a constantly decreasing size of roving, but with some slight twist to hold it together for winding on bobbins that are intended for the spinning frame. *See* Spinning, p. 142.

If desired, for certain types of cloth, the cotton yarn may be mercerized (*see* Mercerization, p. 60), either before or after weaving, to give it a permanent sheen and increased strength, or it may have its projecting fibers removed by passing over or through gas flames or hot metal plates to render the yarn extremely smooth. *See* Lisle Thread Fabrics, p. 97.

Dyestuffs may be applied to the raw cotton, to the yarn, or to the piece goods. When knitted or woven in one of a variety of weaves (*see* Weaves, p. 184), the cotton cloth is ready for finishing, which includes calendering, mercerizing, water-repelling, napping, starching, or other special finishes as necessary for the particular use for which the cloth is intended. *See* Finishing of Fabrics, p. 52.

Cotton Fabrics. The number of cotton fabrics in various widths, weights, weaves, types of knitting, finishes, and colors is enormous, proving the extreme importance of the fiber to mankind throughout the world. Its usefulness in clothing and housefurnishing fabrics appears to be increasing each year with the invention of new finishes. Cotton makes a comparatively inexpensive fabric, is cool to wear, and easily laundered. It does not absorb moisture very rapidly, but dyes well and when specially treated resists wrinkling.

With the increasing willingness on the part of manufacturers and retailers to furnish information concerning their products by means of label or other form, the purchaser of cotton articles or yard goods should be better able to judge the value and suitability of the article purchased for the desired use and how to care for it properly. Cottons that are to receive hard wear should be constructed of well-spun yarns, of high thread count, thoroughly preshrunk, and free from unnecessary sizing, and the color should be fast to washing, sunlight, salt water, etc., according to the use to which the fabric is to be put.

Care of Cotton Fabrics. In laundering, cotton is less affected by alkalies and bleaches than the other fibers. White cotton fabrics of durable construction withstand the action of hot water, alkaline cleansers, and moderate bleaching with little loss of strength. However, prolonged action of a bleach such as chlorinated lime, or too strong a bleach solution, will convert cotton cellulose into oxycellulose, which has no strength and causes holes to appear in the fabric. Some oxycellulose which may form when cotton fabrics rise to the surface of hot alkaline solutions, as in a wash boiler, is a cause of loss of strength in greater or less degree. If boiling is necessary, the article should be turned and kept immersed as much as possible.

Dyed cotton fabrics, like dyed fabrics in general, need intelligent laundering. High-grade dyes such as vat colors are developed in insoluble form in the cotton fiber and have good fastness to light and washing; other dyes, which are water soluble and applied to cottons in a water bath, are, of course, likely to wash out to some extent, particularly in hot water. For this reason only tepid or cool water and a mild soap should be used in washing dyed fabrics, as a general rule.

Some cotton fabrics, if not thoroughly preshrunk, will give trouble by shrinking, and even careful laundering will not prevent this. If the article does not carry a dependable label as to shrinkage, purchase the garment, the sheet, or other article with due regard to a potential shrinkage of 5 per cent, or even more in weaves such as crêpe.

Vegetable fibers are subject to mildew and are more readily attacked if they are starched. If cottons are to be stored through the summer, when heat and moisture favor the growth of mildew, put them away without starch and in as dry a place as possible. In hot weather, articles which are dampened for ironing should not be allowed to lie for more than a few hours.

Staple Cotton Fabrics

Albatross. A plain-weave soft fabric made in imitation of worsted albatross. Used mainly for kimonos and bunting.

Argentine cloth. A plain-woven cloth of very low thread count, sometimes called tarlatan. One side is highly glazed with a substance that stiffens the cloth and is removed if the fabric is washed. Used chiefly for curtains and dress protectors.

Basket cloth. A cloth woven with a variation of the plain weave, known as basket weave, in which two or more filling threads pass over and under two or more warp threads. Used frequently for draperies.

Batiste. A soft, somewhat sheer fabric in plain weave made of combed yarns and given a mercerized finish. Used for infants' wear, dresses, blouses, and lingerie.

Birdseye or diaper cloth. Very soft, absorbent cloth woven in small figure with carded and loosely twisted yarns. Used for diapers.

Bobbinet. A netted fabric of fine or coarse mesh. Used for linings, millinery, and curtains.

Broadcloth. The better grades are woven of combed cotton yarns, and are usually mercerized in the piece. The plain weave has the warp threads more closely spaced than the filling and shows a distinct crosswise but fine rib. Used for shirts, pajamas, shorts, tailored dresses, and uniforms.

Buckram. Two cotton fabrics of loose, plain weave glued together. It is extremely stiff, therefore used for interlining in cloth or leather articles requiring support, and in millinery.

Bunting. A plain-woven, light-weight fabric used for decorative purposes.

Byrd cloth. A raincoat and sports-wear fabric constructed of high-grade, plied cotton yarns closely woven to make the fabric resistant to wind penetration and finished to render it water repellent.

Calico. A printed fabric of plain weave formerly much used for dresses. Commonly found with dark ground and small white figures, obtained by means of discharge printing, but at present made also with small designs on a white ground.

Cambric. A closely woven fabric of plain weave, characterized by a soft finish and a slight gloss on one side obtained by calendering. Used for underwear, handkerchiefs, and shirts.

Canton flannel. A twill weave showing plainly on one side and a heavy nap on the reverse side characterizes this fabric, which is used chiefly for pajamas, nightgowns, and interlining in coats.

Chambray. A smooth, soft cloth of combed yarns and plain weave, very similar to gingham but without pattern. The warp threads are of one color and the filling of white, the selvedges always being white. Used for shirting and dresses. End-and-end chambray has colored warps alternating with white warps, instead of being all of one color.

Cheesecloth. Thin, plain-woven fabric of low thread count used for curtains, bandages, and dustcloths.

Cheviot shirting. A striped or checked strong fabric of plain weave.

Chiffon voile. Cotton voile of great sheerness.

Chintz. A drapery, slip cover, and upholstery fabric, usually of plain weave and fine cotton yarns. It is generally printed with small, bright floral patterns. When treated on one side with a coating of wax and pressed with hot rollers it is called glazed chintz. Starch may be used on the fabric, which is then run through a large calender, or specially constructed machines containing Mexican agates may be used to bring a high gloss to one side of the fabric. This finish is not permanent and will disappear when the chintz is washed. New permanent glazed chintz is available which will stand a number of washings and dry cleanings.

The ancestors of our modern chintz originated in India, the word *chint* meaning in the Hindu language "colored or variegated," and were brought to the western world in the sixteenth, seventeenth, and eighteenth centuries by the Portuguese, the Dutch, and the English, where they flourished under the names "pintados," "chintz," "calicoes," "toile peintes," "perses," and "indiennes." The earlier ones were patterned in typical Indian floral and tree motifs by an elaborate process of wax resist and a combination of mordant and indigo resist dyeing. This method was superseded by the simpler one of wood block printing, and finally by roller printing.

Corduroy. A fabric similar to velveteen, having a cotton weft pile but with warpwise ribs or wales. The foundation may be of twill or plain weave. Used for bathrobes, trousers, suits and wraps, house coats, draperies, and upholstery.

Coutil. A firm twill, plain, or Jacquard woven fabric of considerable firmness. It is somewhat similar to drilling in texture and is used for corsets and brassières.

Crash. A rough-textured fabric made of coarse cotton or linen yarns in plain or twill weave, and in unbleached, white, or colored yarns. Its chief use is for toweling and for dresser and table runners.

Crêpe. A light-weight, plain-weave fabric with a crinkled surface. The yarns are tightly twisted, some in right-hand and some in left-hand twist. *See* Plissé, below.

Cretonne. A printed cotton or linen fabric used for draperies, slip covers, and upholstery. It is generally heavier and coarser than chintz, and has a thick, soft filling yarn. It is found in plain and figured weaves.

Crinoline. A low-thread-count, plain-woven material heavily sized. Used chiefly in millinery and for stiffening the top of curtains made with pinch plaits.

Damask. A figured-weave cotton fabric made to imitate linen table damask, or in heavier textures used for drapery and upholstery material. *See* Damask, p. 44.

Denim. A sturdy, firm fabric in twill weave used for men's work clothing and children's play suits. The warp yarns are usually in a dark color, and the filling yarns are white. The light-weight denims are made of finer yarns and are used principally for furniture coverings and draperies. Figured weaves are used.

Dimity. A crisp, light-weight fabric characterized by small cords running lengthwise, or both lengthwise and crosswise, forming checks. The checked wears better than the striped dimity, owing to a better balance of the different-size yarns. The weave is plain. Dimity is frequently printed in small floral designs. It is used for lingerie, dresses, and curtains.

Drilling. A strong, heavy fabric in twill weave, the diagonal line running upward to the left. Used for uniforms and suitings, and for pocket linings and press cloths.

Druid's cloth. A drapery fabric in basket weave, six or eight yarns in the filling interlaced with the same number of warp threads before changing the shed. Loosely twisted cotton yarns are generally used, sometimes mixed with jute yarns.

Duck. A plain-woven, heavy fabric. In its lighter weights duck is excellent for suitings, uniforms, aprons, and shower curtains.

Eiderdown. A knitted fabric napped on one or both sides. It may contain wool as well as cotton yarns, and is used for bath robes and infants' coats and robes.

Filet net. A type of net with square mesh made from cotton or linen threads. Hand-netted filet has a distinct knot at each of the four corners of the mesh. It is used for curtains and tablecloths.

Flannelette. A twill or plain-woven fabric napped on one side and in plain colors or with printed design. It is used for sleeping garments, kimonos, and shirts.

Friar's cloth. A drapery fabric similar to druid's cloth, but with groups of four warp and four filling threads used in the basket weave.

Frisé. An upholstery fabric in pile weave with uncut loops, made from cotton, mohair, or other fibers.

Gabardine. A twilled material showing on the right side a distinct diagonal, raised cord. It is made of cotton or worsted yarns and used for suitings, riding breeches, and skirts.

Galatea. A closely woven satin or twill fabric used for uniforms, children's garments, and shirts. Piece dyed and printed.

Gingham. A plain-woven, yarn-dyed fabric woven in stripes, plaids, and checks, used for aprons, dresses, children's dresses and rompers, shirts, and curtains. Very fine-quality ginghams are made in Scotland. French and zephyr ginghams are light in weight, made from combed yarns, and always given a soft finish; the type used for aprons is coarse and rather stiff in finish, and is commonly made in blue and white check. Tissue ginghams are much thinner than the usual type and have a heavy cord woven in. Gingham received its name from the town of Guingamp, France, where it was first manufactured in Europe. It was originally made in India.

Glazed chintz. *See* Chintz.

Grenfell cloth. A closely woven, water-repellent, and windproof fabric made of Egyptian cotton. It is used for sport clothes, upholstery, drapery, and shower curtains.

Hardanger cloth. A basket-weave fabric used as a base for Hardanger embroidery. In the Hardanger district of Norway the aprons and blouses of the women are made of this fabric elaborately embroidered in geometric designs.

Hickory. A strong, twilled fabric with colored warp and white filling, similar to but softer than ticking, and used for work clothing.

Honeycomb or waffle cloth. A twill-woven fabric with rough surface resembling the cells of a honeycomb. Because of the softly spun filling yarns this material is used largely for toweling, though it is made into bath robes also, and when wool yarns are employed it is used for coats. Because of the long floats of yarn this is not a material for hard, rough wear.

Huckaback. A cotton, linen, or union fabric in small geometric figure weave, used for towels. For absorbency the yarns are soft-spun.

Indian Head. A plain-woven cotton cloth bearing this trade name. It is used for uniforms, aprons, children's clothes, and tablecloths.

Jean. A sturdy, twill-woven fabric resembling drilling, but much finer and softer in texture. It is used for children's clothes, corset fabric, and men's work clothing.

Khaki. A dusty brown twilled fabric of great durability, used for uniforms, work clothes, and children's play clothes.

Kindergarten cloth. A trade-marked plain-weave cotton fabric of closer weave and heavier yarns than gingham. It is used chiefly for children's dresses and rompers.

Lawn. A sheer, smooth, lightly starched, and soft cotton material with plain weave and frequently a printed pattern. It is chiefly used for dresses, underwear, and sash curtains.

Longcloth. A closely constructed, fine-grade cotton cloth made from softly twisted yarns in plain weave. It is bleached and given a light sizing. Underwear and infants' dresses are frequently made from this fabric.

Madras. Shirting madras is made usually of mercerized, fine cotton yarns with at times stripes or small figures in rayon, and in white or light colors. In addition to shirts it is used for women's dresses. Curtain madras is a sheer fabric of gauze or leno weave with all-over large designs. The back of the cloth has a shaggy appearance from the cut ends of the filling yarns forming the motifs.

Marquisette. When used for curtains this fabric is usually constructed from fine cotton or from rayon yarns in gauze weave. Frequently figures in swivel weave are present. If used for dress fabric, marquisette is made of silk yarns.

Moleskin. A heavy twilled fabric with a short nap on one side. It is used for sport coats and shirts.

Monk's cloth. A heavy, rough fabric in basket weave used for draperies. Yarns of jute or flax may be combined with the cotton yarns.

Muslin. A firm cloth of plain weave, with greater body than cambric or longcloth. It may be bleached or left in the greige, and in lower grades is heavily sized. Wide widths and heavy qualities are used for sheets, finer qualities for underwear.

Nainsook. A soft fabric made of fine yarns in plain weave. One side has a slight luster. It is used for lingerie and infants' dresses.

Organdie. Fine cotton yarns are used for this transparent fabric of plain weave and considerable stiffness. The crispness may be permanent, given by a finish of albumin and casein before calendering, or may be lost after a few washings. It is sometimes printed in colors or by means of chemicals that give an opaque effect to the figure which contrasts with the transparency of the ground. Organdie is used for dresses, hats, and neckwear, as well as curtains and bedspreads.

Osnaburg. A plain-woven coarse fabric made of card waste or of short-staple cotton of low grade. When bleached, Osnaburg resembles a coarse linen fabric. Its many uses include coats, play suits, slacks, trousers, drapery, and upholstery. It is often printed and dyed.

Outing flannel. A plain- or twill-woven fabric napped on both sides, and used for sleeping garments and children's underwear.

Oxford shirting. A mercerized, softly twisted cotton fabric in basket weave chiefly used for sport and casual shirts. If of low construction the warp threads slip readily over the filling.

Pajama check. A heavy dimity-type fabric with small checks formed by heavy cords in warp and filling. Used for men's and boys' underwear.

Percale. A closely woven fabric made of good-grade cotton in plain weave and printed with rather small geometric figures after bleaching. It is given a slight starch finish and is used chiefly for dresses and shirts. Combed cotton yarns woven into high-count fabric form a high-grade sheeting known as percale.

Percaline. This is a thin, dyed, and glossy percale finished by sizing and calendering or moiréing. Its chief use is as a lining fabric.

Piqué. A cotton fabric made from fine yarns and having lengthwise wales or cords running parallel to the selvedge in modern piqué, although in the older type the wales extended crosswise of the fabric.

Its weave may be classed as similar to that used in backed cloth employing extra threads in the warp. The wales vary in size from very fine ones to those of about 1/8 inch. It is frequently woven with figures and with colored threads in the warp. Vests, trousers, dresses, and neckwear are made of piqué.

Plissé crêpe. A cotton crêpe that after bleaching, dyeing, and printing is printed with a gum in stripe effect and then subjected to a bath of caustic soda in a mercerizing process. The stripes covered by the gum resist the action of the caustic soda and do not shrink. When the gum is removed the fabric has a crinkled appearance which remains only if the material is not ironed. This fabric is used chiefly for undergarments and children's rompers.

Pongee. That woven of cotton yarns is in imitation of silk pongee, and is given a lustrous finish, frequently mercerized. The weave is plain, with the filling threads heavier than the warp.

Poplin. Cotton poplin is made with a plain weave employing fine yarns in the warp and coarser ones in the filling, thus giving a crosswise cord effect to the cloth that in fine quality is known as cotton broadcloth. The cloth is usually mercerized. The material is used for house dresses, uniforms, and children's clothes.

Print. Plain-woven staple cotton fabrics with simple all-over printed designs are designated as "prints." They are used chiefly for house dresses, summer frocks, and children's dresses.

Ratiné. A loosely woven dress and suiting fabric made in plain weave with regulation warp and novelty yarn filling, though the latter may form the warp also. The texture is rough and rather stretchy.

Rep. A drapery and upholstery fabric very similar to poplin, but made from coarser yarns, the crosswise rib being very distinct.

Sateen. Sateen is constructed in the same manner as silk satin, but from cotton yarns, the woven cloth receiving a mercerized finish and calendering to increase the luster. The face of sateen may be all warp or all filling, the former being most characteristic. It is used for lining, draperies and garments. That used for sleeve lining in men's coats is usually striped, either yarn dyed or printed.

Scrim. A curtain fabric in open, plain-weave scrim is made of rather coarse two-ply yarns, frequently mercerized.

Seersucker. A light-weight fabric with warpwise crinkly stripes made by different tensions on alternating groups of warp yarns. The weave is plain and the crinkle permanent. It is used for men's summer suits, children's dresses and rompers, and women's dresses.

Shade cloth. A plain-woven cloth bleached or dyed and finished with a filler and finally calendered. It is used for window shades.

Sheeting. A plain-woven cotton in different weights used for sheets. Bleached or unbleached and in wide widths.

Silesia. A lining fabric in twill weave and a polished face resulting from calendering. Originally made in Silesia, a province of Prussia.

Soiesette. Trade name for a fabric made in plain weave of mercerized, combed yarns. Slightly lighter in weight than broadcloth and used for men's shirts and underwear and for women's dresses.

Swiss. A transparent, stiff, and plain-woven fabric used for curtains, neckwear, dresses, and bedspreads. It is frequently made with dots or small figures that are done with the swivel or the lappet, or printed with flocks and paste.

Terry cloth. A pile fabric with loops on both right and wrong sides, the loops being formed by some of the warp threads being held slack. This fabric is used for bath towels, washcloths, bath and beach robes, as well as draperies.

Ticking. A heavy twilled fabric in stripes of blue and white used for mattress and pillow covers. It should be very closely woven to prevent the quills of the feathers from working through the covering. When woven in satin weave and printed in stripes and small floral patterns, pillow covering is known as art ticking.

Velveteen. A cut-pile fabric made to resemble silk velvet but of cotton threads entirely. It is used for curtains, pillow covers, coats, and dresses.

Venetian. A warp-face sateen woven of long-staple, combed yarns and usually mercerized and schreinerized. It is used for draperies, cushion covers, and linings for coats.

Voile. A sheer, soft, plain-woven fabric made from hard-twisted, combed yarns. Used for dresses, blouses, underwear, and curtains.

Cotton Linters. These are the short fibers or down left on the cotton seed after the long fibers have been removed by the ginning process. The linters must be removed from the seeds before the seeds are crushed for the extraction of cotton-seed oil; they form the cellulose base in the making of cuprammonium, acetate, and some viscose rayon.

Counts of Yarn. Yarns are spun and marketed according to count. The count or size of yarn is its classification as to fine or coarse, based on its relative thickness or weight for a given length. There are several standards for determining the size or "number" of a yarn, depending on the type of yarn and the place or country where it is spun. In the French system, used for reeled silk and rayon, the weight in deniers of a definite unit of length of the yarn, 450 meters, designates its yarn number. In the English system used for cotton, linen, wool, and spun silk, the length of a definite weight of the yarn designates the yarn number. The units of length differ in the various types of yarns; they are termed hank or skein when used for cotton, silk, and rayon; lea for linen, hemp, and jute; cut and run for woolen.

The count of cotton yarns is determined by the number of hanks, each measuring 840 yards, contained in 1 pound. For example, No. 20's single has 20 hanks of 840 yards each, or 16,800 yards, as a total in 1 pound. The count of linen, jute, and hemp is determined by the number of leas or cuts of 300 yards each in 1 pound. No. 1 lea would contain 300 yards to 1 pound. The count of woolen yarn, in the United States, is based on one of two methods generally employed. In the cut system the number of hanks of 300 yards contained in 1 pound indicates the yarn number; in the run system the number of hanks containing 1600 yards weighing 1 pound determines the yarn number. The numbering of worsted yarns is based on the number of hanks of 560 yards in 1 pound. Spun silk is numbered in the same manner as cotton, but that of reeled and thrown silk is determined by the weight, expressed in deniers, of a skein measuring 450 meters, a denier being a legal coin weighing 0.05 gram. The original denier was a silver coin descended from the Roman denarius. Standard deniers are expressed as fractions which represent the limits of variation allowed. The count of rayon is determined in the same manner as that of reeled silk, and, as with silk, the higher the denier or count, the coarser is the rayon yarn, No. 200 denier rayon having 22,322 yards to the pound, while No. 1 denier, if it were made, would have 4,464,520 yards to the pound. Coarse yarns of linen, wool, and cotton, on the other hand, are indicated by low numbers. In writing the count of doubled or ply cotton yarns, the number of the threads is given as well as the size or count of the thread: e.g., 20's specifies No. 20 single yarn; 20/2 denotes two-ply No. 20 yarn; and 20/3, three-ply No. 20 yarn. For worsted yarn, 2/30 means two ends of thirty singles yarn twisted together.

Crease Resistance. *See* p. 57.

Crêped Fabrics. A crinkly, pebbly appearance distinguishes the surface of cotton, wool, silk, or rayon fabrics of plain weave designated as crêpes. Owing to the high twist of the yarn employed, such fabrics stretch or shrink when washed or dry cleaned, but generally retain their crinkled surface when pressed.

Crêped fabrics may be produced by several methods.

1. The greatest number of crêpes are made by using hard-twisted yarns, 40 to 90 turns per inch, in right- and left-hand twist in either warp or filling or both. When used in the filling one or two picks of right-hand twist alternate with one or two picks of left-hand twist. When released from tension on the loom and, in the case of silks, degummed, the two twists act against each other in shrinking and cause the crinkling of the cloth.

2. Another method by which the crêpe effect is obtained is by means of groups of warp threads at ordinary tension alternating with groups of warp at a looser tension. Seersucker with a plain and a crinkled stripe is woven by this method.

3. Rollers engraved or grooved may be used to press the crinkles into cotton fabrics that are first subjected to chemicals and heat. This method is employed on cotton crêpes for underwear.

4. Another means of obtaining crêpe effects on plissé crêpes or on organdies consists of printing a resist substance such as wax in stripes on the thin cotton fabric and subjecting the cloth to a bath of caustic soda. Those portions of the cloth not protected by the resist substance shrink, and when the wax is removed the cloth has a series of puckered and plain stripes over its surface.

Crêpe de Chine, Elizabeth crêpe, crêpe Roma, serpentine, plissé, kimono, mourning crêpe, wool crêpon, and albatross are all classified as crêped fabrics.

Curtains and Draperies. Curtains serve a twofold purpose, both decorating and giving privacy to a room, and they fall into two general classifications—draperies and glass curtains. Draperies outline the frame of a window, are usually made of heavy, non-transparent material, and lined if protection against fading of the fabric and body or weight for gracefully hanging curtains are desired. Glass curtains, on the other hand, are placed next to the glass of the window and are generally made of sheer fabric so that, while privacy is maintained, the light is not shut out of the room.

In order to render effective service, material used for curtains and draperies should possess as many as possible of the following characteristics: resistance to sunlight or fading; resistance to the action of light and moisture; non-wrinkling; close enough weave to prevent the threads' catching on rough wood and bricks; easily shaken free of dust and capable of being washed or dry cleaned. The fabric should possess as many of these desirable features as possible as well as be suited in color, line, pattern, and texture to the room and furnishings with which the curtains are to be used. In addition to the initial cost of the material and the labor of making the curtain the cost of its upkeep should be considered by the purchaser. Rich-textured fabrics such as velour, brocade, damask, and satin require dry cleaning rather than washing at home, and as curtains of such fabrics are usually lined, frequently interlined, the expense of dry cleaning them is great.

Action of Sunlight and Moisture. The weakening of curtain fabrics by exposure to sunlight and moisture is governed by two factors: an acid reaction and oxidation. The acid reaction is due in a measure to the formation of hydrogen peroxide from moisture in the air plus free oxygen as ozone. Silks, rayons, cottons, and linens are all susceptible to acid deterioration in the order named. Hydrogen peroxide gives up oxygen, acting as a bleach. Progressive oxygen bleaching causes the formation of oxycellulose, a deterioration to which vegetable fibers are susceptible. On the whole, silk, being the most delicate fiber, will become tender when used in curtain material sooner than rayon or linen and cotton.

The fading of curtain materials depends on the class of dyestuffs used. *See* Dyes and Dyeing, p. 45. Whenever possible, fabrics guaranteed not to fade in sunlight should be purchased for curtains and draperies.

Fibers Used in Curtain Fabrics. Owing to its costliness and the fact that it catches dust and soil readily, wool is not in general use for drapery fabrics. Mohair, however, makes a satisfactory material for this purpose as the smoothness of this hair fiber prevents its holding the dust. As it is subject to attack by moths, the fabric should be mothproofed. The resiliency of mohair prevents the fabric's wrinkling, and its affinity for dyes makes colored mohair fabrics highly resistant to fading in sunlight.

Curtain fabrics made of silk are found in great abundance in the market, although rayon is beginning to displace it in very large measure. Silk fabrics on the whole are very durable but are readily attacked by the ultra-violet rays of the sun and by moisture, and when heavily weighted they slit along the folds. It is for this reason that taffeta curtains, though they are attractive and shed dust, wear out within a comparatively short time. Pongee, made from wild silk, is very satisfactory for sash curtains as well as for use on French doors when a light-weight but opaque material is desired. Curtains of pongee rain-spot badly.

Draperies of linen are usually beautiful but expensive. Unless processed to make the material crush-resistant (*see* Finishing of Fabrics, p. 54), linen curtains wrinkle badly. Linen does not have a strong affinity for dyes; hence for protection against sunlight linen draperies should be lined. For this same reason linen should be yarn rather than piece dyed, and designs that are structural hold their color better than those that are printed or applied. Printed linens, however, are very commonly found on the market either hand-blocked or roller-printed.

The cotton fiber is used very extensively in drapery as well as glass curtain materials. It makes a cloth that is inexpensive; it washes well; when dyed with fast-color dyestuffs it does not fade with great rapidity; and it is not seriously attacked by sun and moisture.

Owing to its natural high luster, rayon fiber makes attractive fabrics for window curtains and draperies, although it is also used in mat or dull fabrics when delustered. Because it is a clean, smooth fiber the fabrics made from it will shed dust readily, but, like linen, unless processed to make them non-crush, fabrics made from rayon wrinkle easily. Some colored rayon fabrics streak when subjected to the sun, but generally speaking they are less subject to attack from sun and moisture than the natural fibers. If of the acetate type the rayon fabric requires a warm iron for pressing (*see* Rayon, p. 120) as under heat it will melt away.

Weaves Found in Curtain and Drapery Fabrics. All varieties of weaves and constructions are to be found in materials used at windows, from the pile of velour to sheer gauze in marquisette. The plain weave in materials of low thread count, gauze and leno weaves, and net are most suitable for glass curtains as they do not shut out the light to a great degree but do prevent the passerby from obtaining an unobstructed view into the room. Loose, open-weave fabrics and nets, however, shrink greatly in washing, so that generous allowance for shrinkage should be made for all curtains made of this class of cloth.

Linings for Curtains. The fading of drapery fabrics is greatly decreased by linings and interlinings, the interlinings also helping to subdue noise. The most generally used lining material is sateen, Canton flannel or outing flannel serving well as interlinings.

Types of Fabrics Suitable for Curtains and Draperies. Listed below are the names of materials most commonly and satisfactorily used at windows:

Name	*Fiber*	*Weave*	*Method Used in Obtaining Design*
Antique satin	Silk; rayon	Satin	
Bengaline	Cotton	Plain; cord	
Bobbinet	Cotton; rayon	Net	
Brocade	Silk; rayon; cotton; mixtures	Figure	Structural
Casement cloth	Wool; silk; cotton; mixtures	Plain; figure	Structural
Chambray	Cotton	Plain	
Cheesecloth	Cotton	Plain	
China silk	Silk	Plain	
Chintz	Cotton	Plain	Printed
Cretonne	Cotton	Figure	Printed; structural and printed
Damask	Silk; cotton; rayon	Figure	Structural
Dotted Swiss	Cotton	Swivel; lappet	Structural
Druid's cloth	Cotton; jute	Plain; basket	Structural
Friar's cloth	Cotton	Plain; basket	Structural
Gingham	Cotton	Plain	Structural
Habutai	Silk	Plain	
Madras	Cotton	Gauze and swivel	Structural
Marquisette	Cotton; rayon	Gauze	
Mohair	Cotton and wool	Plain; figure	Structural
Moiré	Cotton; rayon	Plain; cord	Pressed
Monk's cloth	Cotton; jute	Plain; basket	Structural
Ninon	Rayon	Plain	
Organdie	Cotton	Plain	
Piqué	Cotton	Fancy	Structural
Point d'esprit	Cotton	Net	Structural
Pongee	Silk	Plain	
Poplin	Cotton	Plain; cord	
Rep	Cotton	Plain; cord	
Satin	Silk; rayon	Satin	
Scrim	Cotton	Plain	
Taffeta	Silk; rayon	Plain	
Theatrical gauze	Linen; cotton	Plain	Embroidered
Velour	Cotton; mohair	Pile	
Velveteen	Cotton	Pile	
Voile	Cotton; rayon	Plain	

Damask. A cloth made of figured or Jacquard weave in a variety of elaborate designs; it is reversible and made of combinations of fibers for dress, upholstery, and table use. The weave is a combination of satin and twill weaves and receives its name from the old Syrian capital city of Damascus, which was famous in the twelfth century for the exquisite figured silks woven there. *See* Table Linens, p. 151; Upholstery Fabrics, p. 180; Weaves, p. 189.

Dry Cleaning. *See* p. 146.

Dyes and Dyeing. *History.* The use of color for ornamentation antedates, without question, the arts of spinning and weaving. Drawings in color are found in caves dating back to 25,000 B.C.

Authentic historical records prove that dyes were being applied to fabrics as early as 3500 B.C. A garment from a tomb in Thebes, of this period in history, was found to be dyed with indigo. Chinese classics of 2600 B.C. mention the dyeing of silk in various colors, and early Hebrew literature has numerous references to dyes used for garments and in the service of religion. These dyes were from natural sources, such as mineral pigments and the juices of plants.

The two most famous dyes of the ancient world were Tyrian purple and indigo. Tyrian purple was obtained from species of shellfish which abounded along the shores of the Mediterranean near the ancient city of Tyre. From a vein in the neck of the shellfish a few drops of a whitish fluid were obtained. It is recorded that about 12,000 shellfish were needed to produce 1.4 grams of the pure color. Wool dipped in the dye in its reduced or colorless state, and then exposed to the air, became purple through the oxidation of the dye. So expensive was the dye, and eventually so rare because of the vast numbers of shellfish which had to be destroyed, that purple-dyed garments could be worn only by the wealthy, and were in fact attributes of the royal state. Thus came the expression "born to the purple."

Indigo, or Indian stuff, had a longer life through the centuries, even down to modern times. It was obtained from a plant first known in India. As it existed in the plant, the dye was insoluble, and it could be reduced to a soluble and usable form only by a process of fermentation in a vat; hence the origin of the name "vat" dyes, applied to those dyestuffs which are changed from the insoluble to the soluble form by a process of reduction, and after the material is dipped are brought back to the insoluble state by oxidation. For indigo, organic ferments were used in the early days, and often a week was required before the contents of the vat reached a whitish-green stage indicating solubility. The cloth or yarn was dipped in this solution, then exposed to the air, in order to reverse the process and oxidize the dye back to the original blue, insoluble condition. At present indigo is only one of hundreds of vat dyes, and since about 1894 it has been synthesized from coal tar, the synthesized product having more uniformity and stability than indigo from the natural source.

Modern Dyes. Although a dye had been prepared from coal tar as early as 1834, the dividing date between the dyes of the ancient and the modern world is usually given as 1856. In that year William Henry Perkin, a young English student who was endeavoring to synthesize quinine, accidentally found that the oxidation of aniline, a coal-tar derivative, produced a brilliant violet color. This color became known as Perkin's mauve and was the immediate inspiration for the synthesis of the thousands of coal-tar dyes of the present day. Coal-tar dyes, less accurately spoken of as aniline dyes, have supplanted almost all the natural dyestuffs. Thus coal tar, once considered a noxious waste product of the manufacture of illuminating gas from bituminous coal, has become perhaps the most valuable of all raw materials, if not only dyes, but also medicines, perfumes, and other important products which are made from it, are considered.

What is a Dye? To be a dye, a substance must possess two properties: color, and the power to fix the color on the fabric. Color is inherent in certain chemical groupings known as chromophor groups. The power to fix this color is generally attained by introducing auxochrome groups, or color-aiding groups, into the color-bearing molecule. These groups may be either acid or basic in nature. Wool and silk, having both acid and basic groups in their chemical composition, can unite directly with acid groups in the dyestuff through their NH_2 or basic groups, and also directly with basic groups through their COOH or acid radicals. For this reason, acid and basic dyes can be applied to wool and silk without a mordant to fix the dye.

Classes of Dyes

On the basis of application, the principal classes of dyes are:

Acid Dyes. Direct dyes for wool and silk. The dyebath is acidified with an acid, either acetic or sulphuric, and usually Glauber's salt is added to promote level dyeing. The general fastness of acid dyes to light is good, and many of them launder satisfactorily. Alkalies, as in strong soaps, may alter the color, however. These dyes are important in the trade, and they are found in packages of household dyes where these have a specified use for animal fibers. Vinegar is the household acid used in the dyebath.

Basic Dyes. These are also direct dyes for wool and silk, but they are more generally applied to silk. Most of them have brilliance, but some are less stable than acid dyes. They are applied in a bath of dilute acetic acid. Cotton and other vegetable fibers may be dyed with certain of the basic dyes if tannic acid is used as a mordant.

Mordant Dyes. An intermediary substance, or mordant, is required to fix this class of dyes on the fiber. The word mordant is related to a Latin verb meaning "to bite." A mordant "bites" the dye to the fiber. Fiber plus mordant plus dyestuff make an insoluble color lake. Logwood, the only natural dyestuff still extensively used, is a mordant dye. Mordanted with iron salts, such as iron tannin, it produces a good black on silk; with tin salts purple shades are produced; with other mineral salts, other colors. Mordant dyes are of general applicability. Chrome colors, in which sodium or potassium bichromate or chromate are used, can be classed as mordant dyes and are very generally used for men's wool suitings.

Substantive or direct cotton colors may be applied to both animal and vegetable fibers, although especially adapted to the vegetable ones. It is difficult to make vegetable fibers "take" a dye for wool and silk, but animal fibers may be dyed with cotton colors. Therefore we find selected dyestuffs of this class in household packages labeled all-fabric dyes. These dyes are applied with the addition of salt, usually sodium chloride, to the bath, and so are sometimes called salt colors. The salt acts to hold back the dye from too rapid absorption, and increases its insolubility in the fiber. Since these dyes are water-soluble, and do not, in all probability, make a chemical combination with vegetable fibers, they cannot be expected to have the degree of fastness to washing that a dye should have which does enter into chemical combination, such as acid or basic dyes on animal fibers, or which is developed in insoluble form in the fiber. Hot water, which will expand and loosen these dye molecules, and strong soaps, should be avoided in washing cottons, linens, or rayons dyed with direct cotton colors.

Vat dyes have a high rating as to fastness to light and washing, although some are more valuable than others in this respect. No dye can be considered 100 per cent fast to all influences. Indigo, as has been said, was one of the first vat dyes, and synthetic indigo with its derivatives, and anthracene derivatives, are important vat dyes. These dyestuffs are reduced to the soluble form in a vat. The reducing agent is no longer the organic ferment of olden times, but a chemical such as sodium hydrosulphite. The result is a "leuco" solution, in which the material is dipped. On subsequent oxidation, either by the air or by an oxidizing chemical such as a bichromate, the color appears in its insoluble form. Vat dyes are most valuable dyestuffs for cotton, linen, and rayon, and may be so fast as to resist not only the action of light and washing but also that of oxidizing bleaches such as are used in the commercial laundry. Labels guaranteeing color fastness usually indicate vat dyes.

Sulphur colors are made soluble in a bath of sodium sulphide and are applied to cotton, particularly, but not to wool and silk. Khaki and similar cottons, where dull shades may be used which have good fastness to light and washing, are often dyed with sulphur dyes.

Developed and Naphthol Dyes. These are mostly used on cotton. The cotton is dyed in a manner similar to substantive dyeing in a neutral solution, then treated with nitrous acid (diazotizing), and finally with a solution of beta-naphthol or similar substance, known as the developer. This builds up a new dyestuff in the fiber. Naphthol dyes are similarly used, except that the treatment is reversed.

A special class of developed dyes is known as *ingrain* colors. The dyeing is in a dyebath containing a primary aromatic amine group. This is diazotized, then coupled with a phenol, for example, beta-naphthol. The dye thus built up in the fiber has good fastness.

S R A Dyes. A special class of dyestuffs had to be developed with the advent of acetate rayon. This type will not take direct cotton colors, but will accept some of the basic dyes. However, early difficulties in dyeing acetate rayon have been conquered by the production of a wide range of special colors, some of which are known as S R A (sulphoricinoleic acid) dyes. A selected group of these dyes is now marketed in household package form.

Temperature for Dyeing. In the home, dyes are used for either dyeing or tinting. Dyeing requires a temperature at or near the boiling point, and a certain amount of time in the dyebath, to produce dyed fabrics, that is, those which have permanency of color. Tinting is less permanent; a temperature comfortable for the hand is sufficient, and the time is only that required for dipping.

Wool, silk, and rayon dye satisfactorily below the boiling point, or at simmering temperature; cotton and linen require boiling for a stated time to achieve maximum fastness of color. Silk and rayon have a greater affinity for dyes in general than cotton, and they pick up the dye more rapidly from a hot bath. Therefore, in dyeing mixtures of silk or rayon with cotton, it is well to enter the article in an almost cold bath and raise the temperature gradually, to enable the cotton to take up the dye before it is absorbed too much by the other fibers.

Directions for handling home dyes, and suggestions for their uses in decorative and utilitarian ways, are well given in many booklets prepared by manufacturers of household dyes.

Special Methods of Dyeing

Printing is so important a method of applying dyes that it is treated as a special subject. *See* p. 110.

Raw Stock Dyeing. Fibers such as wool, dyed in the loose state, after washing and scouring, have good penetration of the dye, a fact which gives rise to the saying "dyed in the wool" for something firm or obstinate.

Slub Dyeing. Wool is dyed after being carded and combed, but not twisted; cotton is twisted.

Skein Dyeing. Yarns are often dyed in the skein, especially if they are to be used for plaids and novelties. The penetration of the dye is good.

Piece Dyeing is applied to woven fabrics. The penetration may not be so thorough as in the preceding forms of dyeing, and occasionally a yarn of piece-dyed goods will show unevenness of dye if untwisted.

Cross Dyeing can take many forms. Examples are the dyeing of mixed acetate and viscose yarns in a fabric, where the acetate will not take the dye for the viscose, or of wool-cotton mixtures in a wool dye which does not take a full color on the cotton.

Batik. This is a form of resist dyeing. The elaborate wax resist process by which the Javanese decorate the cotton rectangles and squares used for their draped costumes was introduced into Java from India in A.D. 400. Today the Javanese make batik dyeing one of their major industries, and sarongs, slendangs, and kain kapala articles of native costume are almost invariably batiked for ceremonial occasions, and often for everyday wear, in characteristic designs in brown, tan, dark red, and blue. For good batik, the Javanese use a firm, close cotton weave, soak it in peanut oil, wash it in lye, and pound it, to give the silky, velvety feel associated with their product. Our method of making batik is copied from theirs, without the elaborate preparation of the fabric. A design is sketched in outline and filled in with melted wax. This protects that portion of the cloth from the dye in which the fabric is then dipped. The dyebath must be only lukewarm, in order not to melt the wax resist. After this dip, and rinsing, the cloth is dried and the wax removed. Subsequent waxings and dippings are made until the complete design is built up. A simple batik with two or three colors will sometimes require a number of days of careful labor by the Javanese, and intricate designs and many colors may take months of work.

There are now on the market imitations called "batik prints," cheap cotton fabrics printed to simulate the old and beautiful Javanese fabrics, that wash and clean very satisfactorily.

Tie Dyeing. This simple but fascinating form of resist dyeing was practiced as far back as the sixteenth century in Persia and India. The once famous bandanna handkerchiefs were examples of tie dyeing, originally done in India, where the design was tied in by a girl (*bandhani*). The early Peruvians also used this method of obtaining patterns in fabrics. Exquisite tie-dyed articles come from India, China, and Japan today. The parts of the fabric which are to resist the dye are tied tightly with string or narrow strips of cloth. The method lends itself to much ingenuity in pattern design and the blending of colors.

Elastic Yarns. Until recently, elastic yarns were produced by cutting into extremely narrow widths a thin sheet of rubber somewhat over 100 yards long and winding the square-cut threads with one of the textile yarns. In 1933 a new type of elastic thread appeared on the market known as Lastex. This is produced by forcing one of the compounds of latex in liquid form through a nozzle, as viscose rayon solution is forced through a spinneret, and solidifying it in a coagulating bath. The resulting round rubber thread is then held under tension and wrapped, spiral fashion, with a fine yarn of cotton, silk, rayon, or wool. It is claimed that a finer thread can be made by this process than by the older sheet-rubber method.

Two other ways of producing elastic yarns have been invented recently. One consists of picking up the liquid latex on a grooved wheel, where it is coagulated and dried, then drawn through a tank, filled with a dusting powder, through a set of draw rollers, and finally covered spirally with a textile yarn. By the second method a core yarn is laid on a film of latex tape that is stretched and rolled over the core yarn. The composite yarn is next covered with a suitable textile yarn.

Elastic yarns have made important places for themselves especially in the manufacture of hosiery, brassière and corset fabrics, knitted underwear, and bathing suits.

Embossing. *See* Finishing of Fabrics, p. 58.

Embroidery. Prior to the year 1828, when the first hand-operated machine was invented in Alsace by Joseph Heilman, all embroidery was executed by hand. Today hand work has been very largely supplanted by the work produced by two types of machines, the Schiffli and the Bonnaz, both power driven.

In the Schiffli machine the fabric to be embroidered is stretched on a frame which can be moved up and down and sidewise as necessary, while the embroidery stitches are made by a series of needles held in a horizontal sliding bar. As the needles carrying the thread are placed through the fabric the thread is caught by that wound on a small shuttle at the back of the fabric, and the loop is secured somewhat as in the lock-stitch sewing machine. Attached to one side of the machine is a pantograph, the pointer of which is used by the operator to trace the outline of the design, thus controlling the movement of the needles. The design so outlined is usually six times larger than that actually reproduced by the needles. On the automatic machine a Jacquard device regulates the movement of the needles in the formation of the design.

A form of imitation lace is made on this machine by using a thin silk cloth for the background and a cotton thread for the embroidery thread. When the design has been completed the finished work is immersed in a chemical bath that destroys the silk and leaves the cotton embroidery intact.

In the Bonnaz machine the fabric is held stationary and the needle made to move freely about, outlining the design and forming a chain or loop stitch.

Fabric Gloves. Fabrics for gloves are knitted rather than woven, as knitting gives greater elasticity. The warp-knit fabric is made of cotton, silk, or rayon threads and thoroughly shrunk before being cut by dies in various sizes and designs. Novelty gloves are made from velvet, net, piqué, or organdie as dictated by fashion.

Cotton-knit fabric is sometimes emerized to raise on the surface a soft, short nap that makes it resemble suede. Silk glove material is usually of the Milanese type of warp-knitting. For added strength the tips of the fingers are reinforced with an extra thickness of cloth. Wool gloves may be fashioned into the proper shape during the knitting or, like cotton and silk gloves, may be cut by pattern from yard goods.

Light-colored fabric gloves are easily cared for by washing in warm water and mild soap suds. The water should be squeezed out and the gloves wrapped in a Turkish towel so that excess moisture may be absorbed. Before being hung to dry they should be lightly pulled into shape. Wool gloves and mittens should be dried on forms. Gloves of dark colors keep their freshness and color when dry cleaned.

Felt. Felt is made from wool, either alone or combined with fur, hair, rayon, cotton, silk, or reworked wool. The raw stock is first scoured, carbonized when necessary, and blended, then carded into a filmy web approximately 80 inches wide. Layer after layer of these webs are placed one upon the other, until the amount necessary for a certain weight and thickness of fabric has been obtained. The next step consists in matting the fibers together by means of moisture and friction, the friction being supplied by vibrating hot metal plates between which the carded layers are placed. Fulling is the next and important process, in which the matted fabric is moistened and lubricated by a soap solution, then pounded and rolled by wooden hammers suspended from a shaft over a wooden, bowl-like machine. The heat, moisture, and rubbing cause the tiny scales of the wool fiber to interlock and fuse together into a hard, firm fabric of any desired weight and thickness.

When fulled, the felt is dyed or left in its natural color state; occasionally it is sized, then stretched on a tentering machine for drying. The final finishing processes consist of shearing with revolving blades to ensure smoothness of surface, sanding, brushing, and ironing on a heated cylinder press. Felt may be mothproofed, fireproofed, or made water-repellent. It does not fray; it is inelastic and generally lacks strength; but it is good for insulating, for deadening sound, and for warmth.

In the making of the best fur felt for hats the hair of rabbit, nutria, and beaver is employed. The required amount of fiber for each hat, an average of 3 ounces, is carried by air blast and deposited on a damp metal cone approximately 30 inches high and 16 in diameter, placed on a revolving platform in an enclosed chamber. The tender felt is removed from the form and subjected to hot water and pounding operations until it has been shrunk to the size desired for blocking, stiffening, and finishing.

Fibers. *See* p. 155.

Filling. (1) The name of the crosswise threads in a fabric, also called weft or picks.

(2) The filling in of the spaces between yarns in cloth with various agents, for the purpose of making the cloth appear heavy and closely woven. Too heavy filling is unfair to the consumer, as the filling washes out or flecks off, leaving the material sleazy and thin. China clay,

starch, talc, and chalk are some of the substances used on cottons and linens; flocks, very short wool fibers, are blown and felted into inexpensive woolen fabrics. Rice powder is used on cheap pongee, and silk is treated with solutions of salts of tin, lead, or iron. A vigorous rubbing of cotton and linen fabrics will cause the heavy filling to drop out in the form of fine powder. A simple test for ascertaining the presence of starch in cotton and linen materials is to dip a sample in very dilute iodine solution; starch, if present, is turned a dark blue color. Weighting in silk may be determined by burning a sample of the silk. If the sample retains its original shape after the flame disappears, weighting is indicated. *See* Finishing of Fabrics, p. 56; and Textile Tests, p. 166.

Films Used with Fabrics. Within recent years the texture of woven and knitted textiles has been affected by the introduction of Cellophane. This substance is combined in a variety of ways with textile yarns and fabrics. Cellophane is usually produced in sheets by the extrusion of a rayon solution from broad slits into a coagulating bath. By means of engraved rollers, patterned and embossed effects may be produced. A special machine produces Cellophane in narrow, thread-like slits, for interweaving in fabrics. These slits may be either knitted or woven with silk, rayon, or wool yarns into a plain or patterned fabric, for dresses, draperies, and hat braids. Many fabrics suited to household uses, as lamp shades, dress bags, or shelf coverings, are coated on the right side with Cellophane by means of a special process. Open-weave materials are given greater body and usefulness by this protective coating, and may be cleaned with a damp cloth.

A non-tarnishable metallic coating may be deposited upon one side of a sheet of Cellophane, two such sheets laminated together, and the resulting sheet slit into narrow yarn widths for decorative effects in fabrics.

Finishing of Fabrics. When a piece of cloth has been removed from the loom or knitting frame its appearance is not such as to appeal to purchasers, and it lacks certain textural qualities and attributes, such as resistance to water and fire, desirable luster, stiffness, or warmth, which make it suitable for specific purposes. For cheap fabrics and those that imitate more costly products, certain treatments are necessary to make them salable. Many of the cotton fabrics which we know as organdie, batiste, nainsook, or lawn are all the same type of material when they leave the loom, but by means of particular so-called "finishes" attain their distinctive characteristics. The number of ways in which fabrics are treated is enormous and constantly increasing with the advancement of chemical research in this field.

In general, the finishing processes applied to fabrics made from the five major fibers are more or less the same, but the various fabrics are not all subjected to the same number of finishes. Linens, for instance, undergo very few finishing processes; wools, on the other hand, usually receive many finishes before they are considered salable products. In addition to those finishes generally applied to practically all textiles, there are many which provide a certain effect or characteristic and are known as special finishes, such as glazing, waterproofing, or embossing.

Finishing of Worsteds and Woolens. One of the first steps in the finishing of all wool cloths is inspecting or perching. The fabric is taken directly from the loom and drawn by an operator over rods on an inclined plane that faces a window for good light, all defects of weave or dyeing being marked with chalk. This is followed by burling, the removal of knots from the surface of the cloth, and the mending or reinforcement of broken or weak threads and touching up of small flecks of color. If the wool fabric is to be piece dyed it must first be thoroughly washed to remove oils and spots received from the loom during weaving. If it has already been dyed in the raw stock or skein, the cloth, chiefly woolen, is put through the *fulling* or *shrinking* process, during which it is subjected to heavy hammering while in a trough containing warm, soapy water or other alkaline solution. At this time the cloth shrinks in both length and width, becoming firmer and denser in weave. After further washing and drying to remove all traces of soap the weave is set in the process known as *crabbing*, which consists of passing the fabric smoothly over rollers, subjecting it to hot water and steam, and then pressing.

In order to straighten the material and keep the warp threads at right angles to the filling, it is next placed in the *tenter*, a very long frame similar to a curtain stretcher, with pins set in the traveling chains at each side of the frame to grip the selvedges, and passed over steam coils.

Fabrics that are to be napped are next taken to the *gig* or napping machine. Worsted fabrics, which are to show a very distinct clear-cut weave, are napped very slightly and in the dry state. Such woolens as broadcloth or velour, on the other hand, are kept moist and passed several times through the gig so that the teasels or the card clothing on a revolving cylinder may brush or rough up the surface into a thick nap. To make the height of the nap uniform the cloth is put through the *shearing* or *cutting* and *brushing* machines, where sharp revolving knives cut the nap to the desired height; then the brushes, also on a revolving cylinder, brush up the surface, the tiny fibers known as flocks being carried off in suction funnels to receiving bins. In order to bring out the weave more clearly, worsted suitings are sometimes *singed* after a slight napping. The fine, protruding fibers are burned off when the cloth is passed rapidly over white-hot copper plates or over a flame in gas jets set in a special machine.

If it is desired to protect lustrous-surfaced wools against water spotting and the loss of some of the finished appearance, the cloth is frequently wound very tightly with a cotton cloth around a perforated cylinder through which steam is blown. In this finishing process, known as *decatizing*, the cloth is permitted to cool before being removed from the cylinder. A final pressing in a *calender*, a machine containing several highly polished and sometimes heated rollers pressed tightly together, may be given some wool cloths before they receive a last inspection and are wound on boards or in rolls for delivery to jobbers or retailers.

Some wool cloths are subjected to mechanical finishes that render them decidedly individual in texture. An example is found in chinchilla, a heavy, double-weave coating material that has been heavily napped, then placed in a special machine with a rotating attachment that rubs the long nap into small, tight tufts or bunches. A suede finish is given to wools by running them over an emery-covered roller.

Finishing of Linens. Unless it is desirable to retain the natural color of the flax fiber, linen fabrics are bleached (*see* Flax, p. 68) to give them the degree of whiteness required and to prepare them for dyeing. The bleaching may be done by means of chemicals or by spreading on the grass and permitting sun and dew to rid the flax of its natural coloring matter. The linen, bleached or dyed in the yarn or piece, may then undergo the process of *beetling* to give a greater luster and improved handle to the cloth. This treatment consists in winding the dampened linen about an iron roller and passing it under rising and falling hammers that beat the threads flat and help to give a leathery feel to the material.

In order to minimize to a large degree the crushing of linen, due to the natural non-resilience of flax, many dress and drapery linens are today impregnated with a synthetic resin before the final pressing on calenders. *See* Crease Resistance, in special processes following.

Finishing of Cottons. Cotton as well as wool fabrics need much attention when they leave the loom, to make them salable. The processes of cotton finishing are many, usually only a few being applied to any one piece of cloth, the number and kind depending on the use for which the textile is intended.

The operation of dyeing or printing of piece-dyed or printed cottons takes place after inspecting and mending of the woven cloth, unless the cloth must be bleached.

White goods are bleached by soaking for a few hours in chlorinated lime and boiling in a solution of sodium carbonate, then washed. A second soaking in the bleach solution, followed by a scouring in hydrochloric acid and a subsequent washing and drying, leaves certain types of cotton goods ready for a final finish of starching and calendering. If a size or dressing is desired, the cloth is dressed before calendering.

Sizing of Cotton Fabrics. The use of sizing compounds on any fabric is for the purpose of (1) stiffening the fabric; (2) softening it; (3) imparting to it body and weight; (4) giving it a glazed or smooth effect. For stiffening, fabrics are treated with starches, such as rice, corn, sago, and wheat, or with glues or gums; for body and weight, with china clay, talc, or starch; for softness, with paraffin, glycerin, or oils; and for glazing, with waxes of various types. Luster is obtained on the dressed fabric through calendering, the friction and pressure of the rolls giving sheen and smoothness.

Dressing substances such as those mentioned above will largely be removed from the fabric when it is laundered, and materials treated with starches and clay to cover up sleaziness of weave are rendered lifeless and sievelike by washing, and unable to withstand wear and tear. For some fabrics, such as organdie, secret chemical formulas are prepared and used by finishers to render the cotton permanently crisp even after repeated washings. *See* Permanent or Swiss Finish, below.

Mercerizing. Cottons woven of high-grade, long-stapled fibers may be given a permanent luster by the mercerizing process. *See* Mercerization, below. Ordinarily the fabric is singed before it is immersed in the caustic soda bath, bleaching and dyeing following the mercerizing.

Schreinerizing. Sateen and other cotton linings are frequently passed between steel rollers, one of which is engraved with oblique lines, 600 or more to the square inch. Under great pressure the rollers break up the surface of the cloth, creating a greater reflection of light and hence increased luster, which, however, disappears in laundering.

Silk Finishes. Pure silks woven in the gum must have the sericin removed by boiling the goods in soap and water, until the inherent luster of the silk is brought out. The degummed fabric may then be dyed, washed, sized, tentered, and calendered or mangled, and is considered ready for shipping. If the silk is to be weighted, the weighting agents, such as salts of tin or lead, may be applied either before, during, or after the dyebath. This addition of loading substances is to compensate for the loss of weight that occurs in the boiling off of the sericin, but may be overdone and result in a fabric weighted from 50 to 200 per cent, that will crack and disintegrate badly. *See* Pure-dye Silk, p. 113.

Stiff silks may be run through a breaking machine or be dressed with oil, glycerin, or paraffin to soften them. Soft silks, on the other hand, may be stiffened with gelatin or glue to produce the requisite crispness.

The pile of silk velvet (*see* Velvet, p. 180) is sheared for uniformity and thoroughly brushed and steamed; and panné velvets are pressed flat in one direction.

Like cotton and rayon, silk fabrics may receive such special finishes as moiréing, waterproofing, and flameproofing, described in the special finishes following.

Rayon Finishing. Rayon as well as silk and cotton fabrics is treated with sizing, filling, softening, and stiffening substances to produce the desired appearance and "hand." If a dull finish is called for, the luster of rayon goods may be decreased by both mechanical and chemical means. *See* Luster of Rayon, p. 119. The delustering of rayon, if produced by surface treatment with metallic soaps or wax emulsions, is not necessarily permanent.

Most manufacturers decry the weighting of this type of fabric, claiming that the strength and elasticity of rayon are weakened by the process. Nevertheless, weighting of rayons is sometimes practiced. Epsom salts and barium sulphate are two substances employed, although for the major purpose of delustering.

In the finishing of rayon goods great care must be taken in the handling of the fabric, owing to its loss of strength when wet. A special hydroextractor is used for removing the excess moisture, while either the loop dryer or a machine containing a number of revolving copper cans or rollers filled with steam dry the fabric, a certain percentage of moisture being allowed to remain in order to facilitate the process of tentering, in which the material is straightened, set at the desired width, and dried ready for the calender.

One outstanding characteristic of cellulose acetate is its extreme sensitivity to heat, becoming very glossy and melting or fusing at high temperature. In order to protect the acetate fabric in pressing, its surface may be treated with caustic alkalies or padded with aluminum acetate or sodium or calcium chloride, and quickly dried. The process is termed "ironproofing." *See* p. 121.

Special Finishes

In addition to the general finishing processes through which most textiles must pass are a few that are not so commonly applied, but which give certain desirable effects to the textile so treated.

Air Conditioning. The porosity of fabrics may be increased by gassing, or by "sealing" the yarns by a chemical finish.

Animalized Cotton. Cotton may be impregnated with a solution of albumin or casein, fixed with steam, or treated with an alkaline solution of silk fibroin. The cotton, so animalized, is then capable of taking dyes for animal fibers, and thus lends itself to more even dyeing in mixtures with silk or wool, or to cross-dyed effects with untreated cotton. Cotton may be made to resemble wool as to crimp, if treated with cold, fairly strong nitric acid.

Bacterial and Fungicidal Control. Several methods are being used for treating fabrics to inhibit or destroy bacterial organisms and fungi. Some seem to have merit, but at this writing it is too early to evaluate them.

Bellman-Brook Finish. This is applied to many types of cottons to prevent a limp and dull appearance. Embossed and white frosty patterns are given to organdies by this process, after weaving. The finish is considered permanent to laundering.

Ceglinizing. This is a patented process by which a solution of a cellulose ether is applied to cotton fabrics, chiefly sheet and pillow-case muslins and mercerized cotton tablecloths or napkins, in order to increase smoothness and luster, and bind the fiber ends so that they do not rough up with use. The cellulose ether is dissolved in a dilute solution of sodium hydroxide and padded upon the fabric. The excess is removed, and the material passes into a bath of dilute sulphuric acid, which coagulates the cellulose ether to an insoluble coating on the fibers. Neutralization of any excess acid, and washing, complete the process. Cottons so treated are claimed to keep this finish, sometimes called "permanent," through the ordinary life of the article.

Crease Resistance. Creasibility of fabrics is due both to the natural lack of elasticity of some fibers and to the construction of the fabric.

Inherently elastic fibers such as wool and silk do not need crease-resisting treatment, but fabrics of cotton and linen, which do not have the molecular structure which makes for elasticity, and rayon, need special treatment to overcome their tendency to take and hold creases. *See* Fiber Structure, p. 164.

Crease-resisting treatment does not imply that the fabrics will not crease, but that there is a resistance to wrinkling and an added resiliency which causes the creases to shake out when the garment is hung. Sometimes crease resistance is obtained by construction; the material is given a wiry, springy nature by the kind of yarn and weave used.

Under an English patent, cottons, linens, and rayons have been successfully treated chemically to make them crease-resistant. This involves the impregnation of the fiber with a synthetic resin. The resin may be a formaldehyde condensation with urea or phenol. The fabric is impregnated with the solution and dried at fairly high heat, but in a moist atmosphere, to complete the formation of a clear, insoluble resin in the fiber itself. Any surface adherence of the solution is removed in a soapy boil. The anti-crease treatment increases the weight of the textile perhaps 15 per cent, depending on the kind of fabric, but thin materials and even velvets remain soft and pliable, and are quite decidedly improved as to resiliency, or springing back after crushing. It is claimed that dyes in crease-resistant cottons, etc., are less likely to fade in washing, nor should washing affect the treatment appreciably.

"Tebilized" is a term applied to English fabrics of good quality carrying this finish, and an American licensee is using the word "Vitalized."

The finish adds from 6 to 12 cents per yard to the cost of the material.

Embossing. This process consists in pressing any clearly defined design or pattern onto cotton or rayon fabrics. The two-roller calender used for embossing has a metal roll, the top one, which carries the engraved design, usually a close, all-over pattern, and a lower roll on which the pattern has been impressed. When the fabric passes between these rolls, meanwhile being subjected to heat, moisture, and pressure, it receives the imprint of the design. The pattern is not permanent except on acetate rayons, which retain the design permanently, owing to the plasticity of their filaments under heat.

Flameproofing. Chemicals which give flameproof or flame-resistant properties to fabrics must either give off incombustible gases in action, or dilute the oxygen surrounding the fabric beyond its power to support combustion, or they must fuse with heat to form a vitreous coating. Strictly speaking, asbestos fabric is the only flame-proof material; others may be repellent, resistant, or retardant toward fire, according to the treatment.

A report published in the British Fire Prevention Committee's Red Books outlines the following treatment to produce a fire-repellent effect lasting through several washings: The cloth is steeped in a solution of 3 pounds of sodium stannate per gallon of water. After wringing and drying, it is passed through a solution of 1¼ pounds of ammonium sulphate per gallon of water, after which it is rinsed and dried.

Another solution of less permanent effect, when washed, is composed of 2 pounds of ammonium sulphate and 4 pounds of ammonium chloride in 3 gallons of water. Such solutions are better adapted to stage properties, theatrical curtains, etc., than to fabrics for wear.

Sodium silicate (water glass), 1 volume of the commercial water glass being diluted with 1 to 5 volumes of water, may be recommended for the branches of Christmas trees on or near which candles are placed.

A home method for dipping articles, without subsequent rinsing, consists of 7 parts of borax and 3 parts of boric acid, in 10 times that weight in water. Squeeze the fabric through the solution. It will be sufficiently flame resistant to make such articles as children's play suits, theatrical properties, and lace curtains much safer. A hot iron should not be put on the fabric, as the heat will cause tendering. This treatment will not stand washing.

Gassing. A process of removing superfluous fiber ends from yarns, especially fuzzy ends of cotton yarns, in order to make them more lustrous and increase the porosity of the fabric. The material is passed rapidly over gas flames, which singe only the exposed ends.

Ironproofing. See Finishing of Rayon, p. 63; and Saponification, p. 121.

Lacquer, Ciré, and Glaze Finishes. Silks and rayons are frequently treated to render their surfaces extremely smooth and highly glazed.

Lacquer finishes may be produced from cellulose derivatives such as nitrated cellulose, or rubber derivatives, or resinous condensates of urea or phenols. These substances are applied in a thin film, which hardens by evaporation or by polymerization and oxidation.

Cirèd silks and rayons likewise have a brilliant sheen on the face, but are less leatherlike in texture. Heavy silk satins may be surfaced with a coating of wax or a tragacanth-gelatin solution, with some sulphonated oil as a softener, then run between the rolls of a mangle before being tentered and calendered on a friction calender.

Acetate rayon satins are run several times through a hot friction calender, the fibers fusing under the heat and pressure and a brilliant sheen resulting. Cottons may be glazed with coatings of starch or wax deposited on the face, the heat and pressure of the calender bringing out the glazed, polished appearance.

London Shrunk. This finish is given to wool fabric to reduce as much as possible the shrinking qualities of the cloth before it is made into garments. The process consists of placing the lengths of wool fabric, full width, in alternate layers between wet blankets, weighting the entire pile, and leaving it for about 12 hours, or until the wool has been thoroughly dampened. The fabric is then hung up and allowed to dry naturally without any tension to stretch it, and when completely dry is pressed. Garments made of thoroughly shrunk wool material should not pucker or shrink when dry cleaned and pressed, or rained upon.

Mercerization. Mercerization is the name given to that process by which a high degree of luster is imparted to cottons through the chemical action of caustic alkalies, applied while the cotton is under tension. The term is taken from the name of the originator of the process, John Mercer, a calico printer in England, who in 1844 first noticed that a cold, strong solution of sodium hydroxide made cotton cloth shrunken and transparent. In 1850 he patented his discovery, claiming increased strength and transparency, and greater affinity for dyes, for the cotton so treated.

John Mercer did not profit by his discovery, owing partly to the prohibitive cost of caustic soda at that time. Later, Lowe of England, Thomas and Prevost of Germany, and others contributed improvements to the process, notably control of shrinkage and increase in luster by means of tension, and with cheaper methods of manufacturing caustic soda mercerization became not only economically possible but even of great and increasing importance.

The process consists essentially in thoroughly impregnating the yarn or fabric with cold, strong caustic soda solution. Tension must be applied if shrinkage is to be reduced and luster increased. Mercerization is done in the skein, which is stretched on revolving rollers; the warp, which is stretched and passed through vats; or the piece, either entirely or in printed effects. Ten minutes usually suffices for the process.

High-grade mercerization demands a fine, long-staple cotton. Egyptian, American peeler, American upland, etc., are used. Combed and gassed cotton yarns give more lustrous effects than carded cotton. Combed yarns for high-quality knitted underwear as well as for fine dress and shirting fabrics, such as broadcloth, batiste, and nainsook, are mercerized.

The cost of mercerized cotton of high quality is about three times that of unmercerized of the same count, from commoner grades of cotton.

Novelty effects are secured in several ways. Protected mercerized yarns may be used for the warp and plain yarns for the filling; subsequent mercerization of the fabric without tension produces crêpe effects. Other effects are secured by printing a resist paste—casein, albumin, or some mineral salts being the basis—in pattern effects on the parts of the fabric which are not to be mercerized. Mercerization then affects only the exposed surfaces and gives contrasts of luster and shrinkage. Stripes of caustic soda paste are also printed on the goods, by another method. The printing paste is washed off and the material washed in water and dilute acid as usual.

The nature of the chemical change in mercerization is not entirely clear. Physical effects are the change from a flat, twisted cotton fiber to a smooth, rounded form, with only an occasional suggestion of a twist. The elasticity is increased. Luster is markedly increased, because the rounded shape of the fiber gives more faces for light reflection.

Mildew Resisting. Cotton and linen fabrics treated with a starch dressing are subject to mildew when damp, but a suitable antiseptic added to the finishing bath will retard or prevent the growth of the organisms on these fabrics. Several preparations are used for this purpose. Treatment with copperas is said to retard mildew on sails, tobacco tenting, and other fabrics for out-of-door use. Salts of the lower fatty acids, such as mercury, zinc, and other salts of propionic and butyric acids, have been used, their solutions being sprayed on the surface of the material. Since most of these substances are water-soluble, their application is limited to fabrics which are not frequently laundered.

Moiréing or Watermarking. The attractive marking known as moiré on such fabrics as cotton, silk, and rayon is somewhat akin to embossing. A ribbed fabric with heavy filling threads is always used for this purpose, the selvedges of two pieces of cloth being sewn together with the right sides facing, in such a manner that the crosswise ribs of one piece are at a slight angle to those of the second piece. The fabrics, slightly dampened, are then run under great pressure through a calender, one of whose rolls is heated.

Another way in which the watered effect may be obtained is to pass a single layer of cloth between rolls that have been engraved with the moiré pattern. Like the pattern in embossing, the watermark left on the face of the fabric is not permanent except on acetate materials. *See* Fig. 23, p. 190.

Mothproofing. Under Moths and Moth Control, on p. 99, the life cycle of the clothes moths is described, and suggestions are made for home methods of safeguarding articles from infestation. These methods are preventive or temporary; there are processes which claim permanently to mothproof garment fabrics, carpets and rugs, upholstered furniture, blankets, etc.

Permanent mothproofing requires the thorough impregnation of the article with a stomach poison or an unpalatable or "recoil" substance, that is, a substance which is irritating to moth larvae but not to humans. If by chance larvae are hatched on articles so treated they are killed as soon as they attempt to eat, or, being definitely repelled, are unable to eat. One such substance, Eulan CN, is a complex organic compound which is introduced in the dyebath, preferably of goods dyed in the piece, and withstands washing and dry cleaning. Another stomach poison, Konate, is a cinchona derivative, soluble in naphtha, and used by professionals for spraying upholstered furniture and other articles which are not washed. A third efficient substance, effective on carpet and furniture beetles as well as moths, is Amuno, a complex organic fluoride, which can be applied in any wet process, dyeing, sponging, shrinking, or other treatment, and which makes a chemical combination with the fiber permanent through washing and dry cleaning. Other fluorides of the inorganic type, more or less effective, are on the market.

If the practice were more generally followed of permanently mothproofing carpets, blankets, and other articles which are stored through the warm months, the worries of the housewife would be diminished and her income less depleted by replacement of damaged articles.

Permanent or Swiss Finish. Many Swiss cotton fabrics, as well as in recent years domestic cottons, are subjected to a chemical process which "sets and seals the quality and the original finish in the fiber of the yarn." Though it is known as a Swiss process and applied in

Switzerland as a permanent finish on organdie, licensees in the United States produce a variety of cotton fabrics so treated.

The process is reputed to be similar to the production of imitation parchment from paper. When unsized paper is treated with cold sulphuric acid of a certain strength for a few seconds only, it becomes translucent, and after washing and drying has a parchment texture. In a similar way a cotton fabric, for example organdie, is treated with cold diluted sulphuric acid just long enough to make an alteration in the fibers characterized by increased transparency and permanent stiffness. It has been suggested that this effect is partly due to the liberating and spreading of pectinlike constituents in the cotton fiber.

Other processes for permanent finishing effects of similar nature are treatments with solutions of cellulose or cellulose derivatives, such as the rayon solutions; casein-formaldehyde resins; caustic soda solution followed by one of viscose or cuprammonium—in fact, the methods of producing such finishes seem to be increasing.

Pyroxylin Coatings. Such coatings are used for shower curtains, waterproof draperies, coverings for outdoor furniture and suitcases, shades, artificial leather for upholstery, and many other fabrics. Pyroxylin is a solution of a nitrated cellulose in an organic solvent such as benzol. It may be colored in the solution by the addition of pigments, such as titanium dioxide, ultramarine, red oxides of iron, and chrome yellow. Castor oil or other plasticizer, and gums, are usually incorporated. The whole is spread in a thin coating on the fabric, the excess taken off with a doctor knife, and the solvent evaporated, leaving a transparent, water-repellent film.

Sanforizing. A shrinkage process which if fully carried out leaves no more than ¼ inch per yard or about 0.75 per cent residual shrinkage in the material.

Cottons, linens, and some rayons are frequently Sanforized-shrunk, and as a rule carry a label to that effect.

The steps in Sanforizing are: (1) the wash shrinkage of the material is determined by laboratory test, following the procedure set up by the Federal Specifications Board in CCC-T-191a; (2) the Sanforizing machine is set to produce the shrinkage shown by the preliminary test. Water and steam, and the action of the machine, combine to bring about this shrinkage. (3) The fabric is checked for its correspondence with the required shrinkage.

Saponification. Acetate rayon is saponified, that is, converted on the surface to regenerated cellulose, by the action of a hydrolytic agent such as a solution of sodium hydroxide. The dilute solution is applied for 30 to 45 minutes at about 180°F. The loss in weight of an all-acetate fabric may be 8 per cent for partial or surface saponification up to 40 or 50 per cent. Saponification is usually done before discharge printing of acetates in order to use substantive dyes, which are direct dyes for cotton and regenerated cellulose rayon. *See* Dyes and Dyeing, p. 46; and Rayon, p. 121.

Spray Finishing. Thin, wavy, or other soft fabrics of silk or rayon, and some colored or printed fabrics such as brocades, do not stand a full finishing process. To these a method of spray finishing is sometimes applied. The solutions are very dilute mucilages, gums, gelatin, or gelatin and glycerin, agar, and even beer because of its sugar content. These are applied by spraying through nozzles in a fine mist.

Tarnish Prevention. Heavily napped cotton flannel is impregnated with a solution of silver nitrate, from which it passes into a hot solution of sodium carbonate. This precipitates silver oxide on and in the fibers. The cotton flannel so treated is used as a protective wrapping for table silver, since the sulphide in the air, which causes silver to tarnish, will presumably unite with the silver in the wrapping cloth and be prevented from reaching the silver articles. Boxes for storing silver, lined with treated cloth, are patented and trademarked. They are more efficacious if kept tightly closed.

Trubenizing is one of several finishes given to men's collars, cuffs, and shirt bosoms to prevent wilting. The cotton fabric used for the lining is woven with some cellulose acetate yarns in the warp. The lining is inserted between the outer layers, and the made-up collar is soaked in a solvent for acetate rayon, such as acetone, then heated and pressed. The acetate yarns become fused with the outer cotton layers, resulting in a single layer of material that may be washed without losing its original quality and needs no starching.

Waterproofing, Water-repelling, Water-resisting, Water-retarding. These terms, applied to fabrics, stand in the order of resistance to wetting.

Waterproofing implies the highest degree of resistance, of being practically impervious to water. An essential of the fabric to be waterproofed is a tight weave, because no openings must remain after this treatment. Hence in the construction of waterproofed garments arrangement for ventilation should be made. Rubberizing is a common method of waterproofing, the rubber being either applied by vulcanizing in the fabric or deposited on the surface by calendering.

Acetylene derivatives, formaldehyde resins, drying oils and varnishes, pyroxylin coatings, and waxes, give waterproof to water-retarding effects in varying degrees. According to the hydrostatic pressure test of the American Association of Textile Chemists and Colorists and the National Bureau of Standards, waterproofed fabrics should withstand a pressure of 50 cm. for 1 hour.

Water-repelling. According to the standards accompanying the above test, a resistance to a pressure of 17 cm. of water gives satisfactory shower-resisting property. Between this standard and that for waterproofing come different degrees of water-repelling and water-resisting. This is still a tentative test method. Spray tests are also used by some laboratories, in an effort to simulate actual shower conditions. There is no good correlation at present between the spray and immersion tests and the hydrostatic test. The subject of standardization of test methods for water-repellency is under consideration by a committee of the A.A.T.C.C.

A water-repelling rayon taffeta is said to be made by treating the fabric, after dyeing, with a dilute solution of oxymethyl pyridinium chloride oleyl ether, with subsequent drying. This is given as an instance of the new and complicated chemical treatments sometimes used in producing such finishes.

Water-retarding. A simple method of water retarding is by impregnating the fabric with an insoluble metallic soap, such as an aluminum soap. This may be done by soaking the material in a saturated, or rather milky, solution of basic aluminum acetate, then passing it into a hot 5 per cent solution of soap, in order to form insoluble aluminum soap on the fiber. The process may be reversed, the soap bath coming first. In case the material shows slipperiness, it is passed for the final dip into a dilute solution of aluminum sulphate, then rinsed and dried. A similar method is to follow the basic aluminum acetate impregnation by steam treatment, which tends to dissociate the salt and form insoluble aluminum hydroxide in the fiber.

Water-repellent finishes are now applied to almost every fiber and class of goods. Wool goods are made water-repellent without losing porosity by immersion in a water emulsion of a wax. This is not a permanent effect, and will not stand washing or dry cleaning.

A more durable repellent finish has been applied to cotton, rayon, linen, silk, and mixtures of these fibers by an English process called Zelan. It is claimed to be resistant to repeated washings and dry cleanings, to weathering and exposure. The process uses a certain long-chain organic compound which is applied by special equipment in the finishing process, but not to finished garments.

The process adds materially to the cost of the goods, but this increased expense is somewhat offset by lighter maintenance costs such as dry cleaning, because, although the fabric is porous, spilled liquids and other sources of stain and dirt roll off.

Firsts. Before shipment from the mill, woven and knitted fabrics or articles are inspected, and goods with no imperfections are classified and sold as firsts. Slight flaws will put the goods in classes designated as second, third, irregular, etc. Many retailers subject the merchandise to a second inspection when it reaches their receiving room. Run-of-the-mill is a term which in general means that the merchandise has not been inspected and the consumer purchases it as it comes from the mill. Sheets and pillow cases are frequently sold as run-of-the-mill. Sometimes the flaws are so slight that they can be repaired and the article will render excellent service to the thrifty purchaser.

Flameproofing. *See* p. 58.

Flax. This plant, which produces a bast fiber used for the making of linen cloth, is grown chiefly in Ireland, Scotland, France, Belgium, Germany, Russia, and Czechoslovakia, where climate and soil are particularly favorable. In the United States it is grown chiefly for the seed, which produces an oil, linseed, for commercial use. The seed, scattered on the land in the spring, grows into a plant 3 or 4 feet in height and in August usually is ready to be pulled by its roots from the soil by hand to preserve the tapering ends of the fiber for greater ease in spinning.

After the flax has been pulled it is tied in small bundles and left for several days on the ground to dry. Next the seeds and leaves are removed from the all-important stem, the heads of the plants being drawn either by hand or machine through a coarse comb in the process known as rippling. Again tied in small bundles, the straw is allowed to cure for several days before it is subjected to the most important of all the many processes through which it must pass. This retting, or the dissolving of the gums which hold the wood and the fiber together so that the small surrounding tissues disintegrate, must be carefully done, the flax being taken out of the water, the chemicals, or from the grass, depending on the method used, at exactly the right time. Flax that has been over-retted is weak; in that which has been under-retted it is difficult to separate fiber from wood.

There are several methods of retting: (*a*) chemical or steam retting, which weakens the fiber and is little used; (*b*) decortication, by which the outer bark is removed by a machine—another method not in general use; (*c*) dew retting, in which the flax straw is spread in thin layers on the grass and for 3 or 4 weeks exposed to sun and dew for fermentation; (*d*) water retting, where the straw is placed in crates in a stream of running water. This process is considered the most favorable for good fiber and is quite generally used in Belgium. Pool retting is practiced in Ireland. Here the straw is allowed to stand for 10 to 14 days in pools of stagnant water.

When thoroughly dry, the flax straw is ready to be removed from the fiber. This is done by the processes of breaking and scutching. In breaking, the woody bark is broken along its entire length by fluted iron rollers between which the straw is fed by hand, or by a series of knives and a beater known as a flax break. The resulting short pieces of stem and bark, or shives, are shaken from the sheaf and beaten out by the scutching machine, which consists of rotating paddles of wood that knock out the shives, dirt, and short fibers known as tow.

Next follows the dressing of the flax by means of hackling—by hand for extremely fine linens, by machine for coarse ones. The object of this process is to clean, comb, and divide the short fibers, tow, from the long fibers or line. The hackle consists of a series of blocks of wood set with steel pins of different degrees of fineness and closeness of arrangement. The number of hackles through which the flax is drawn determines the fineness of the "dressed" flax.

Flax for fine yarn is sorted into different qualities; then, with ends overlapping, it is laid on an endless apron before a machine called a spreadboard which by means of fine wires combs the flax into a continuous sliver. The drawing and doubling machines next receive the slivers of flax preparatory to spinning, which is done on upright frames. In the spinning of flax, moisture is necessary for fine, strong linen yarns; water is dropped on the yarn in dry spinning, or humidifiers are used in the spinning room, while in wet spinning the flax is passed into troughs of hot water before being placed on the spinning frame.

Tow fibers, and the waste resulting from the preparation of the line, are carded, combed, doubled, and drawn, then spun by the wet or dry spinning system for use in inexpensive fabrics. Owing to the shortness of the fiber, material made from tow has a tendency to lint.

Linen yarn from the spinning frame is next bleached or taken to the warping room where it is prepared for warp by being given a coating of a paste made from Irish moss or another starchy substance, to give it smoothness to withstand the strain of the filling threads rubbing against it during weaving. If desired, the cloth is then bleached in the piece. It may be boiled and spread on the grass, both processes being repeated until the degree of whiteness desired is obtained. This type of bleaching, though slow, does not injure the fiber and is used on high-grade fabrics. Dew bleaching requires still longer time, and is considered the most satisfactory method for the best results. Bleaching by means of chemicals, chiefly chlorine bleach, hydrogen peroxide, or sodium peroxide or perborate, is quite generally practiced because of the shorter time required, but the chlorine bleach especially is detrimental to the fiber. The natural color of linen is a dull gray brown, but it is bleached in varying degrees of whiteness known as one-fourth, one-half, three-fourths, and full bleach. The last makes the most attractive but the least durable cloth.

Linen may be dyed in the yarn or in the piece. In order to give luster and uniform thickness to the threads, linen fabrics are usually run through wooden rollers and beaten with hammers in the process known as beetling. Linen fabrics of the round-thread type are not subjected to this treatment and consequently lack luster. *See* Linen, p. 94.

Flocks. The very short fibers clipped from pile or napped woolens, cottons, rayons, or silks in the process of cropping or shearing the cloth. They are sometimes blown into cheaply made woolen fabrics to add weight and give the appearance of a closely woven cloth; with friction and wear they drop out of the fabric.

Flocks are also used in combination with a paste for printing dots and other very small figures on thin cotton materials, such as flock-dot voile or swiss. If well secured they are comparatively satisfactory, but in general the dots drop off with laundering and wear and frequently turn brown when ironed.

Flock-covered Fabrics. Within recent years the process of giving a suede or velvetlike surface to a knitted or woven fabric by covering it with flocks of cotton, rayon, wool, or silk has been developed in the United States. The ground cloth is first coated with an adhesive substance, rubber cement, pyroxylin, or a latex compound, by means of rollers, then passed under movable boxes that contain the flocks. The bottom of each box is made of fine wire or coarse canvas which permits the flocks to be sifted evenly over the surface of the adhesive-coated fabric. By another method the flocks are blown evenly onto the surface. Excess flocks are removed by suction, the rest being pressed into the coating compound by rollers.

Such fabrics are suitable for pillows, purses, raincoats, and sport jackets as well as for belts and slippers.

Fortuny Prints. Mariano Fortuny, artist and scientist, of Palazzo Orfei, Venice, as a result of his researches in ancient Grecian documents as to early methods of dyeing and printing, has perfected a process of stamping fabrics with gold and silver. He reproduces the Renaissance patterns of old French and Italian velvets, damasks, and brocades on modern fabrics of velvet, silk, and a finely twilled cotton of interesting texture, for use as panelings, wall hangings, curtains, and furniture coverings, as well as for evening coats and robes d'intérieur.

Fur Fabrics. Furs are simulated by weaving fabrics with a long pile, then subjecting them to special finishing processes to make the pile surface resemble the hair and curl of certain furs. Acetate yarns are used to reproduce such furs as ermine, antelope, caracul, and galyak; broadtail is reproduced by mohair.

Gassing. *See* p. 59.

Grenadine. A silk yarn composed of several singles, each of which is given a twist in one direction of 32 to 48 turns per inch, then the ends are brought together and twisted in the opposite direction with 28 to 44 turns to the inch. The dull-finish yarn which results is used in silk hosiery.

Handkerchiefs. To the short list of handkerchief linen and fine lawn, for many years the only accepted fabrics for use in handkerchiefs, have been added pongee, radium, and habutai silk for men; voile, batiste, nainsook, wash silk, georgette crêpe, crêpe de Chine, and chiffon for women. For general use the linen and lawn still hold chief place; linen, though expensive, retains its position as favorite because of its absorptive and quick-drying powers and hygienic properties. Hand-spun linen, designated chiefly as French linen, is extremely soft and beautiful; linen lawn, somewhat heavier, is rather transparent and has unevenly spun threads. The Irish linen is heavier in texture and very durable.

Harris Tweed. On the Isle of Lewis off the west coast of Scotland is made the enduring, sturdy fabric called Harris tweed, after one of the districts of Lewis. Originally all the processes of manufacturing this material were done by hand; today only the weaving is done at home by the cottagers, the preparation of the yarn and the finishing of the cloth being carried out in mills on modern machinery. The name is protected by patent and stamped on each piece of cloth. The characteristic odor of peat smoke and soft, shaded effects distinguish this particular type of woolen fabric that is made exclusively from Scotch wools.

Hemp. The structural fibers obtained from leaves of a plantain grown in the Philippine Islands, and of an aloe produced in Mexico, Central America, and the West Indies, are known as Manila hemp and sisal hemp, respectively. They are used for cordage, hammocks, and sacking, the Manila hemp sometimes being made into fine muslins. True or common hemp is a bast fiber from tall plants grown in Russia, Italy, and the United States. Its preparation into yarn resembles the treatment given to flax, but the yarn is used chiefly for rugs, cordage, and canvas, its resistance to the rotting action of salt water making it suitable for sailcloth. *See* p. 163.

Hosiery. In the budget of every individual today the stocking plays a more important rôle than any other small article in the wardrobe, both on account of the number of pairs bought in a year and also the amount of money spent on them. A knowledge of their construction as well as their care will enable the wise shopper to obtain more satisfaction than mere reliance on color and appearance alone.

The fiber of which the hose are made must be considered in selection. With the exception of flax all the major fibers, silk, wool, cotton, together with the new member of the family, rayon, are manufactured into yarns for the making of hosiery. Wool, alone or combined with silk or rayon, is largely used for socks and stockings for men, women and children, particularly for sport hose for women. Cotton forms the bulk of the cheaper stockings and in the finer qualities of lisle and mercerized yarns has excellent wearing qualities. Rayon entering the hosiery field in the last few years is found largely in the circular knit type. It lacks the natural elasticity of silk, causing the stocking to bag at ankle and knee, and looks fuzzy after several wearings. Silk, being the strongest of the textile fibers and very elastic, is one of the most satisfactory fibers for hosiery, provided, of course, that the twist, construction, and final use are all appropriate. Two manufacturers of rayon yarns are experimenting with new types of yarn, one of which is termed Nylon, which it is hoped will be quite satisfactory substitutes for silk yarn and eventually replace that fiber to a very large extent.

The four fibers are used either alone in yarns or are combined with others for certain types of hosiery. Plated yarns are frequently used at the heels or in Jacquard designs where the silk or rayon threads show on the right side and the cotton on the wrong side of the stocking. Unfortunately the outer thread may wear through first, revealing the contrasting yarn, or look peculiarly fuzzy. A silk stocking with a foot made of cotton, or reinforced with cotton, wears longer than one of all silk, as cotton is less susceptible than silk to deterioration from perspiration. Wool hosiery is made of woolen yarns; of worsted, which is of combed wool and more tightly spun; of cashmere, a variety of worsted yarn spun with a woolen finish; and of merino, a combination of wool and cotton mixed before spinning. Wool hose requires special care in laundering.

Machine-made hosiery is either circular or flat knit. Circular-knit hose are made on a circular machine which turns out the fabric in tubular form and of any desired length. After the stated length for the hose has been cut off, the tubing is given the shape of the leg by shrinking it or by removing a section from calf to heel and sewing up the resulting seam. Sometimes the shaping is done by tightening the stitches about the ankle. The heel is next added, then the toe, and finally the top, which for socks consists of a few inches of ribbing which makes the sock cling to the leg. Down the back of some circular-knit hose is a mock seam that stops at the heel and is accompanied on either side by mock fashion marks.

Another type of seamless hose is made on a special circular machine which begins knitting the stocking from the foot, gradually adding needles as the size increases toward the welt. In this method of knitting the stitches converge in the form of a V at the back of the leg.

Circular-knit hosiery is inexpensive to manufacture; consequently it is found in the cheaper grades of women's stockings, but is used for all types and grades of men's and children's hose. It does not fit the leg and foot as well as the full-fashioned hose which, however, is much more expensive to produce and which requires very costly machinery. Circular-knit hose may be either flat or ribbed knitting. *See* Knitting, p. 80.

Full-fashioned hosiery is made on a huge, flat, and very complicated machine that automatically drops stitches back of the knee and along the calf when needed as the knitting proceeds from the welt to the ankle line. At this point the boot is removed from the first machine, known as the legger, and transferred to another needle bar which is then placed on the footer, where the instep, foot, and toe are knitted. A recently invented machine knits the hose from welt to toe, thus eliminating the transfer steps. The seam in the foot of the stocking is knitted together on the looper machine for the purpose of having the seam as flat as possible, then the seam of the leg, along the back, is stitched with a fine lisle yarn. A well-made seam should be narrow and straight and have from 14 to 16 stitches to the inch. The full-fashioned stocking is ready for degumming and dyeing, if of the dip-dye type, and drying. The hose are placed on flat metallic leg forms that are electrically heated to the right temperature for the silk, then inspected, stamped as to size and grade, and boxed ready for shipment. Hose that contain flaws or imperfections of any kind are marked irregular or seconds and sold at a reduced price.

All full-fashioned hose have a seam the entire length of the back and under the foot. The fashion marks along the leg seam indicate where the tapering off of the stitches on the machine to conform to the shape of the leg has taken place, so that the wales or ridges are not parallel to the seam. These fashion marks, also under the arch of the foot, are characteristic of full-fashioned hose and furnish a means by which the customer may distinguish them from circular-knit hose. In the hose that have mock fashion marks the wales are parallel to the seam.

Two very important points in the wearing quality and appearance of silk hose are the number of threads in each yarn and the closeness of the loops. The varying degrees of sheerness of stockings are known as their weight and are classified as: sheer chiffon, when one or two threads of silk are used in each yarn; chiffon, with three threads; as semi-service or service sheer, with four or six threads; and as service weight, with six to twelve threads. Generally speaking, the greater the number of threads used, the better the stocking will wear; definitely a two-thread stocking cannot be expected to last long when given hard usage and worn with heavy shoes.

The number of twists per inch given to the threads not only adds to their strength, up to a certain point, but also influences the amount of luster they have and makes them more resistant to snags. Twists vary in number from three to thirty or more turns per inch, the dull, sheer stocking having about fifteen. As the process of twisting requires a lot of thread the higher twists are not to be found in the low-priced article. Grenadine yarn, because of its particular construction, gives a very dull appearance to the stocking. In this yarn each strand of silk has a twist of from thirty to thirty-six turns to the inch to the left; the combined strands are then twisted to the right with thirty to thirty-two turns to the inch. Crêpe yarns, which also give a dull luster to the hose, may have a total of fifty to one hundred turns per inch, both left hand and right hand, depending on the number of strands combined.

Within the last few years what is known as the three-carrier process has been invented to eliminate as far as possible bands of cloudiness or rings in silk hosiery, which are due to the natural unevenness of silk filaments as spun by the silkworm. This process carries yarns from three different cones in alternate progression across the knitting frame, so that slight degrees of thickness or thinness in the yarn may not all come close together. As rayon is uniform in size, cloudiness or rings are not found in hosiery made of rayon.

The closeness of the loops or stitches in a stocking is spoken of as its gauge, the number 39, 42, 45, 48, 51, 54, 57, or 60 indicating that these are the number of stitches or wales per 1½ inches counting horizontally; or more technically, the number of needles per inch and a half on the needle bar of the flat machine. Generally speaking, the higher the gauge, which is not always stated on the label of the stocking, the closer the knitting and consequently the greater the elasticity and the stronger the fabric. The average four-thread stocking has 45 gauge, the higher gauges being found in hosiery of very few threads.

Another indication of the quality of the knitting is the number of crosswise rows of loops or courses per inch. These are seen on the wrong side of the knitted fabric. The smaller the loops the greater the number of courses and the greater the elasticity of the fabric. In full-fashioned hosiery the courses are from forty-eight to sixty-one to the inch. In order to cut the cost of a pair of silk stockings, a manufacturer may reduce the number of courses per inch, enlarge the loops, and also leave unused some of the end needles on the needle bar of the knitting frame. This causes the stocking to be tighter and shorter than it normally should be.

To judge of the elasticity of the hose being purchased, the consumer should stretch the stocking crosswise at the top of the welt and at the instep. In a satisfactory stocking the top should stretch to 11½ or 12 inches and the instep to 7 or 8¼ inches, and spring back into shape when released. The top of a properly made outsize stocking should stretch to 15 inches.

The standard length of hosiery is 30 inches, measured from the top of the welt to the end of the heel, with the ruler parallel to the front fold of the hose. Usually there is considerable variation in the length of stockings sold in one box. They may have all been knitted the same length but when placed over the boarding form to be shaped and dried they may have been pulled slightly longer or shorter than the measurement to which they were knitted. When laundered they will naturally shrink back to their original size. Some manufacturers are now making their products in three lengths, 28, 30, and 32 inches, while others make what are called adjustable tops that may be folded back to accommodate customers requiring shorter than the standard length. For the woman who does not wish to roll down her hose below the knee there is a short stocking ending just below the knee and finished with an elastic band at the top which holds the stocking securely in place. Especially long hose are known as opera length and measure 34 or more inches. Outsize hose are knitted both longer and wider than standard sizes.

Stamped on each pair of stockings is the size of the stocking foot, which, however, is likely to vary with different manufacturers. To be sure of getting the desired size, measure the foot from the tip of the toe to the back of the heel. The number of inches indicates the size number of the stocking. Stockings should be about ½ inch longer than the foot, a point particularly to be remembered when purchasing hose for children.

Hosiery is usually dyed after it is knitted, when it is technically known as "dip-dyed," though in some, as in ingrain hosiery, the yarn is degummed and dyed before it is knitted. This method gives a richer, more even color but is expensive as a very high grade of silk must be used. The ingrain hosiery may be distinguished by the contrasting colored thread used to sew up the heel and the top of the toe. If the dyeing is carelessly done the color in dark hose is likely to bleed and ruin striped or figured hose. When buying striped hose it is wise to ask if they are guaranteed color fast. Improper laundering, however, may cause the color to fade in spots or patches. Different shades in silk hose may result from the different treatment in soaking which the silk received at the mill or may be due to the use of different batches of silk.

Those parts of the stocking which receive the hardest wear are reinforced with extra threads during the knitting process. Heel, toe, and foot reinforcements are frequently plated with silk over cotton but should be firmly knitted and securely joined to the thinner fabric of the boot. The welt is the heavy, 3- or 4-inch-wide band at the top of the stocking into which the garter is fastened. It may be entirely of silk, or silk only on the outside and mercerized cotton on the inside. The reinforcement of cotton usually adds to the durability of the silk stocking and helps to prevent runs. In high-grade sheer hose a shadow welt, the flare, made of single threads but slightly heavier than those used in the boot of the stocking, is placed between the welt and the boot, the part that extends from the welt to the heel. The welt is usually joined to the boot by a row or two of lock stitches which should prevent a run that starts in the welt from extending into the boot. As yet manufacturers have not been able to make a stocking entirely resistant to runs. Experiments are being carried on with mesh stitches which may prove satisfactory. Runs may be caused not only by snags while the stocking is being worn, or by catching on rings or rough finger nails, or by a garter fastened below the welt; they may also be due to faulty construction. Stitches may be dropped by the operator when transferring the boot from the legging machine to the footer, or there may be a splitting of threads during the narrowing process.

As in women's hose, those for men are knitted of silk, wool, cotton, or rayon yarns either alone or in combination. The majority of men's hose are circular knit with ribbed top that may be knitted to the leg of the sock, the entire sock being made on the same machine. The top may be made separately and joined to the leg by a seam, or knitted and each loop transferred to the needles of the machine which knits the leg of the sock. In somewhat the same manner as in women's full-fashioned stockings the boot is transferred to the footer machine. In whatever way the ribbed top is made it should be elastic and fit the leg well. Within the last few years lastex yarn (*see* Elastic Yarns, p. 49) has been used in making the ribbing of socks.

Because of the weight of men's shoes, socks should be well reinforced at the heel and above, through the foot, and across the toes. As in women's hose the reinforcements may be made by plating with cotton yarns or by knitting extra yarns directly into the heel or foot.

The standard length for men's hose is 14 inches for sizes 9 to 10, with an additional half inch in length for sizes 10½ to 12. Boys' golf hose range in length from 10½ for the smaller to 18½ for the larger foot sizes.

Children's stockings and socks are made on the circular machine and are either flat or ribbed knit, with ribbing present at the top of the plain-knit sock. Children's hose of the five-eighths and three-quarter lengths measure from 9 to 17 inches; that of the seven-eighths length from 10½ to 18½ inches. Infants' and children's socks vary from 5 inches to 11½ inches in length.

Care of Hosiery. As perspiration is injurious especially to silk fibers, stockings should be washed in lukewarm water and soap suds as soon as possible after each wearing. In order to avoid straining the loops of the knitting, squeeze rather than rub all stockings. After rinsing in clear, lukewarm water, squeeze the stocking, shape it gently, and dry slowly over a line or smooth rod. Stockings need not be ironed and should never be dried near a hot radiator as excessive heat damages the fiber. In the laundering of wool or part wool hose great care should be taken in the matter of heat; otherwise the wool will felt and become harsh and brittle and shrink. Whenever possible, wool hose should be dried over forms.

Spot-proof hosiery are those that have been treated with a chemical to make them more or less permanently resistant to water spotting. It is a common practice to finish hose with a water-repellent finish in order to have a binding effect on the fibers and prevent fuzziness.

Hygiene of Clothing. The selection of our clothing, how it is worn, and how cared for, affect immeasurably our bodily health.

Clothing may be so selected and treated, for the child and the adult, that it will perform at its best its functions of helping the body maintain a constant temperature, be unrestricted, be moderately dry, clean, and well ventilated. These are the chief criteria to be applied to clothing with reference to its hygienic values.

As equal a distribution of clothing upon the body surface as possible will conserve body heat better than warmth in certain parts and exposure in others. The snow suit on little children is better adapted to this end than bare legs below a warm coat. A body insufficiently or unevenly clothed is forced to draw upon reserve energy for heat regulation, energy which should be used for growth.

The principle that still air is a non-conductor of heat should be applied to the choice of undergarments for winter wear in cold climates. Whatever the fiber, the open mesh of proper construction is superior to a close weave for warmth-giving as well as for other reasons. On the other hand, a loose weave which allows free passage of wind would not be chosen as a warm garment for outer wear. As to the fibers themselves, wool and silk, protein in nature, are poorer conductors of heat away from the body than are cotton, linen, rayon. In summer, underwear of the latter three sources carries away body heat.

It is obvious that both bodily and mental health suffer from restrictions in clothing, whether from too tight shoes, girdles, or what not. Fortunately, modern dress emphasizes an unrestricted body as far down as shoes; it still can improve its dictates with regard to footwear.

Perspiration should be removed insensibly as fast as formed, through proper absorptive property in the garment next the skin. It should not be removed so rapidly as to cause a chill. Wool next the skin, except where violent exercise is followed by exposure, is not hygienic, in that it holds considerable moisture, dries slowly, and has the effect of a wet poultice on the skin. Under ordinary circumstances, people find that an open mesh of silk, cotton, or certain rayons responds well to the body's needs in this matter.

The cleanly fibers, by virtue of their physical form, are silk, rayon, and linen. Cotton, though less inherently clean, is easiest to launder. Wool is hard to keep clean and difficult to cleanse. Modern fashions in undergarments and hosiery can be praised in that no impediment is put in the way of achieving cleanliness. The sheer silk stocking and equally sheer and scant undergarment can be washed each night with ease and dispatch. Certainly our bodies know a degree of cleanliness not realized in the days of heavy undergarments perhaps changed only once a week.

Modern emphasis on a well-groomed appearance is also standing on the side of hygiene through cleanliness. Dresses are simpler yet more effective in style and are more frequently washed or dry cleaned. Knowledge of proper washing methods is almost universal, and the standard of cleanliness in wearing apparel is correspondingly high.

Clean, comfortable, suitable clothing, its selection and care, are worth thoughtful consideration, not only as affecting body hygiene, but more subtly, the best health and operation of the mind.

Ironproofing. *See* Saponification, p. 121.

Jute. A tropical plant grown in China, India, and West Africa, and known as jute, furnishes a bast fiber, 13 to 14 feet in length, that is used in the making of burlaps, cordage, and rugs, and as stuffers in machine-made carpets. It is unsatisfactory for dress fabrics, though it is occasionally used in upholstery and drapery materials. It deteriorates when subjected to moisture and readily loses color if dyed. *See* Textile Tests, p. 164.

Kapok. Filling for cushions and mattresses is frequently made of the floss from the seed pods of the kapok tree, grown in the Philippine Islands and Java. This vegetable fiber, light, soft, lustrous, and resilient, makes inexpensive pillow filling, but has a tendency to mat, become lumpy, and break down after prolonged use. *See* Textile Tests, p. 164.

Kemp. Kemp fibers have been considered a malformation of natural wool fibers, but more recently are regarded as an inherited fiber condition from primitive strains of sheep. The fibers are coarse, hairy, with a thin cortical layer and enlarged medulla. The medulla, being filled with air, causes the uneven dyeing of wool mixed with kemp fibers.

Knitting and Knitted Fabrics. Cloth is made from yarns in one of three ways: by looping, interlacing, or twisting. The first method is used in the construction of knitted fabrics and may be done by hand or by power-driven machines. All knitting was produced by hand on two or more needles until 1589, when William Lee of England invented a knitting machine worked by hand power. Improvements made on this machine during the eighteenth century very materially increased the output of the operators. In 1775 appeared the first warp-knitting machine, so called because the threads were placed side by side on a beam as are the warp threads in a loom, the principles of which are still used in the large warp knitting machines that make such a great proportion of the fabrics used for modern gloves and underwear.

Knitting is the construction of a fabric with needles by a series of interlocking loops from one or more yarns. Whereas hand knitting is done with two to four straight needles, machine knitting employs short needles with a hook at one end set in bars in the knitting frame. In the circular-knitting machine, one of the two types in use today, the needles are placed in a circular bar, thereby producing a tubular fabric. In the flat machine the needles are placed in a straight bar and knit a fabric that is perfectly flat.

Regardless of the type of machine used, circular or flat, knitted fabrics have on the right side rows of loops running up and down the fabric known as wales, and on the wrong side rows of ends of loops running crosswise and known as courses. The construction of a fabric is defined by the number of loops, wales, and courses, to the square inch, such as 45 wales and 60 courses. (In a woven fabric the count or construction is designated by the number of warp and filling threads to the square inch.) The fineness or coarseness of a knitted fabric depends on how closely or how far apart the needles are placed in the bar holding them. The terms cut and gauge are also used to describe the construction of such a fabric. Both terms indicate the number of needles in the space of 1 inch on the knitting machine, cut being used chiefly in connection with circular knitting and gauge in connection with warp knitting and full-fashioned hosiery. (*See* Hosiery, p. 70.) For full-fashioned hose, gauge denotes the number of needles in 1½ inches on the machine. A 45-gauge full-fashioned hose is made on a machine having 30 needles or stitches to the inch.

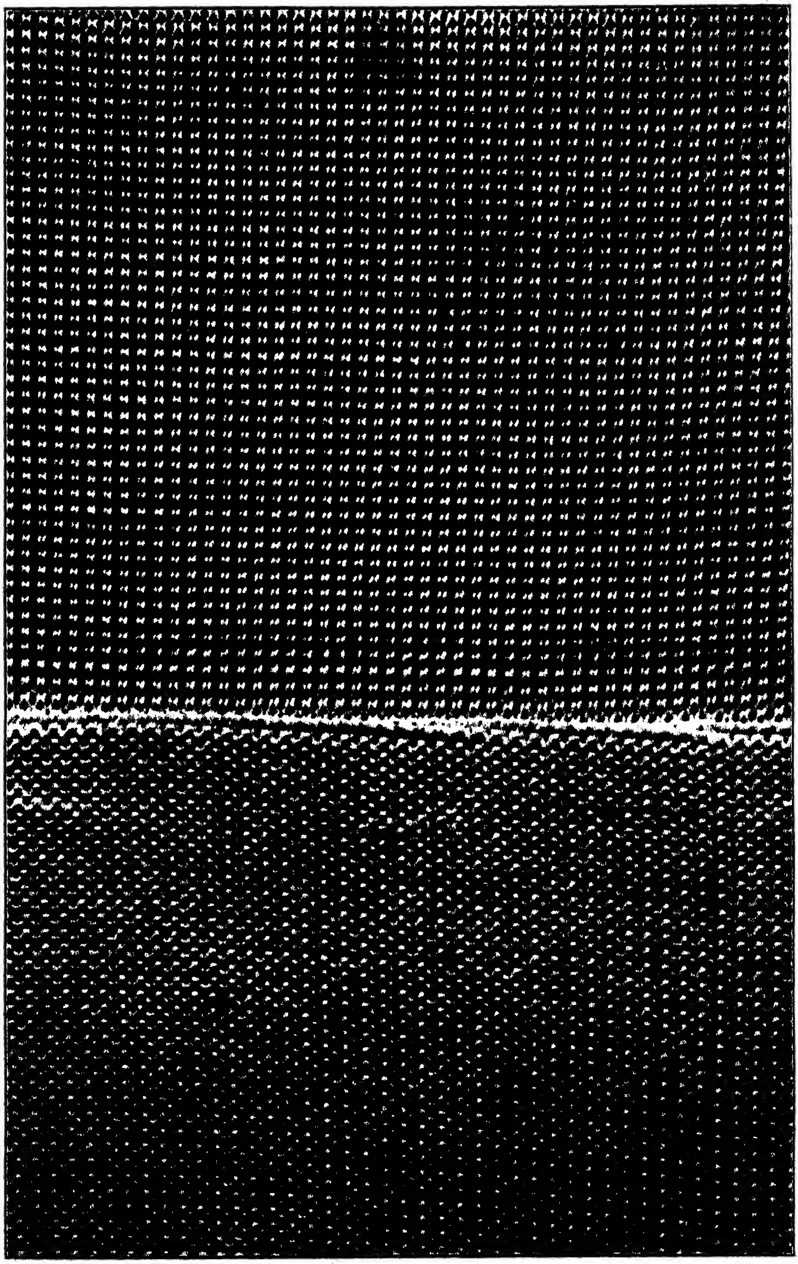

FIG. 1. Weft knitting, right side showing wales and wrong side showing courses.

Classes of Knitting. The two general classifications into which knitted fabrics fall are weft knit (Fig. 1) and warp knit (Fig. 2). Weft knitting may be done on either the circular or the flat machine and requires but one thread to form all the wales, traveling crosswise from needle to needle, forming a row of loops each time it traverses the width of the frame. It is based on the same principle as hand knitting. Warp knitting, on the other hand, must have at least one thread for each row of wales in the fabric. The threads are wound on

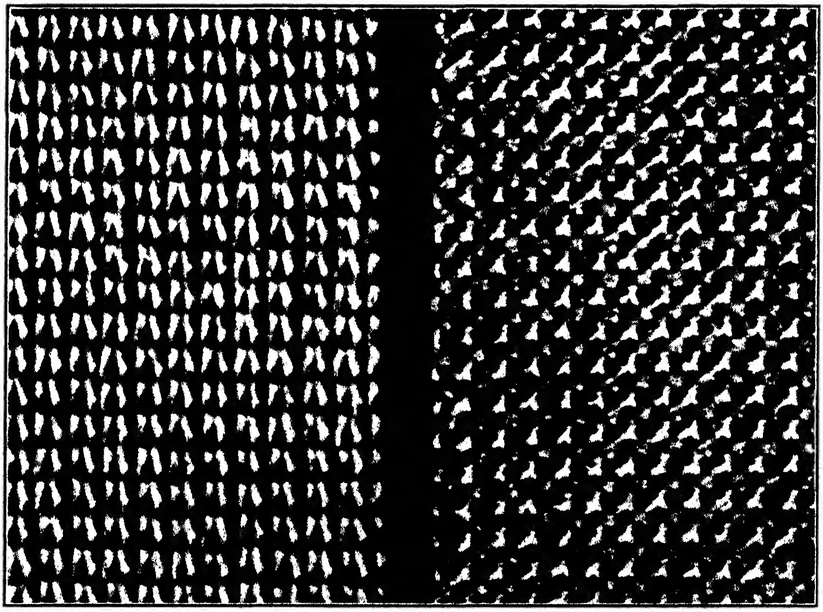

FIG. 2. Warp knitting, right and wrong sides.

a beam, and each thread is controlled by a guide which lifts it from one needle to another so that the loops of the adjacent threads are interlocked and a continuous fabric is formed.

Types of Weft-knit Fabrics. The plain or flat weft-knitted material has the loops all on one side, the right side of the fabric, forming vertical rows or wales, and the ends of the loops forming interlocking semicircles all on the back as courses. This type of weft knitting is used for jersey, balbriggan, and other underwear fabrics. It makes a firm, close, and smooth-textured material that is fairly elastic.

Ribbed fabrics are knitted on a machine equipped with two sets of needles which draw the loops alternately to the back and to the face, forming ribs which give an identical appearance to the two sides of the cloth (Fig. 3). Such fabrics fit closely but are extremely elastic. Because of this characteristic, ribbing is used at the wrists and leg ends of underwear and the tops of socks. Ribbed knitting with several rows of loops drawn to the front and several to the back, forming

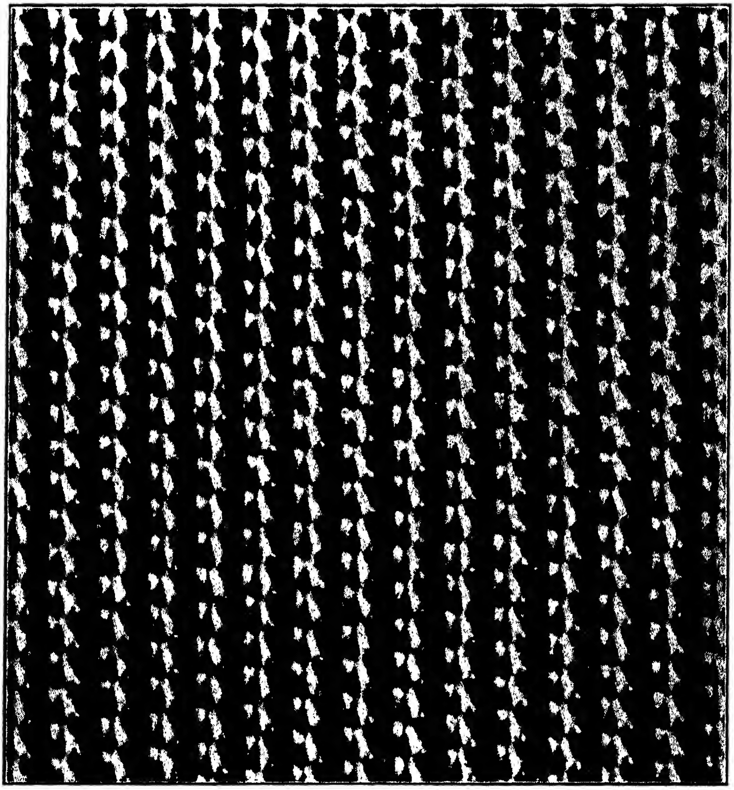

FIG. 3. Ribbed knitting.

quite decided ridges, is known as Swiss rib and used largely in underwear and bathing-suit fabrics. Rib-knit fabrics ladder or run less readily than plain or flat-knit goods, but as the knitting is a slower process such fabrics are a trifle more costly.

In purl-knit fabrics the stitches are reversed in each row of courses so that the loops appear first on one side then on the other side of the material in crosswise rows, causing face and back to appear identical. Purled fabrics are more elastic lengthwise than crosswise, whereas ribbed fabrics are more elastic crosswise.

Variations of Weft Knitting. More or less elaborate effects are given to plain, ribbed, or purled knitting by varying the stitches. Where greater elasticity and bulk are desired in a material, several stitches are held on certain needles. This is termed tucking or the tuck stitch. For greater resistance to runs in the weft-knit fabric, particularly that used for underwear, the mechanism of the machine is so arranged that as the thread progresses crosswise it skips every other needle. This prevents the loops from running upward and the floats of thread appear on the wrong side of the material. Fabrics so constructed are known as run-resist.

For a vertical but somewhat wider rib than plain rib the cardigan stitch is used. This is obtained by alternating the tuck and plain stitches in the ribs on both face and reverse sides of the material; it makes a thick, warm fabric.

Elaborate patterns are obtained by using a Jacquard attachment in conjunction with the knitting frame.

Types of Warp Knitting. Two types of warp-knit fabrics are in general use—the tricot, made on what is known as the tricot machine; and Milanese, made on a different type of flat machine. Tricot cloth may be of the single bar or warp type, using only one set of warp threads; or double bar, in which one set of threads knits in one direction, a second set in the opposite direction. Double-warp tricot has a fine wale on the right side and is run-proof in both directions; the single-warp tricot will run downward only when subjected to heavy strain. Tricot cloth is made in stripes, mesh, drop stitch, and elaborate designs for use in gloves, bathing suits, and dresses, as well as underwear. With the exception of the varieties with intricate designs, tricot fabric is less expensive than Milanese owing to the rapidity with which the tricot machines are operated. Tricot when used for glove silk underwear is always made with the up and down of the cloth running crosswise of the garment.

A coarse warp-knit fabric very similar to tricot, and also used for underwear, is known as raschel. It is constructed in plain stitch or with elaborate Jacquard designs.

The warp-knit type of fabric known as Milanese is made with two sets of threads, one knitting continuously in a downward direction to the left, the other continuously in a downward direction to the right. The crossing of the two sets of threads produces on the back or wrong side a diamond effect that is characteristic of all Milanese fabrics and a means by which they may be easily distinguished from other knit fabrics. The face has a very fine wale. Milanese is considered a run-proof fabric and though it does not ladder, a break in one thread when the fabric wears thin will develop into a hole that constantly increases in size. Milanese fabric does not have variety of pattern, but when some of the warp threads are in color simple designs of diagonal plaids and checks are created. Gloves, brassières, and other articles of underclothing are made from Milanese fabric.

Warp-knit fabrics as a class do not ladder or drop stitches readily if properly constructed, but they do not possess the elasticity of weft-knit ones.

Fashioning. Cloth knitted on the circular machine is always the same width throughout; that is, when finished it has the same number of loops or stitches crosswise as when it was started. This is also true of fabrics of the weft type made on the flat knitting frame unless they are to be shaped while the knitting is in progress. This process is called fashioning and is done by a mechanism which adds or subtracts the desired number of loops at specific points along the edge of the material. Full-fashioned hose are made in this way to conform to the shape of the leg, ankle, and foot. (*See* Hosiery, p. 71.) Some undergarments, sweaters, and dresses are made of circular or flat-knit fabric cut to the desired shape and size from patterns, then seamed. Some hosiery is shaped by decreasing the size of the loops around the ankle.

Yarns Used in Knitting. Knitting yarns, in contrast to those used for weaving, are very slightly twisted or "soft spun" so that their elasticity, softness, and absorbency may be as great as possible. All the major fibers, wool, silk, cotton, rayon, and flax, are made into knitting yarns, though linen, because of its cost, is not in very general use. It does, however, make a satisfactory mesh fabric that is very absorbent, soft, and cool. Yarn may be made of only one fiber or of a combination of fibers for reasons of expense chiefly, though cotton, silk, or rayon combined with woolen or worsted yarn reduces not only the expense and harshness of the resulting fabric but also its tendency to shrink. Silk or rayon fibers mixed with wool add interest of texture as well.

Cotton knit goods may be made of carded, double-carded, combed, mercerized, or lisle yarn, and wool knit goods of woolen or worsted yarns. Egyptian cotton, long in staple, combed and unbleached, was used in the original balbriggan underwear, but today other cottons are dyed and substituted for this soft, resilient yarn. Yarn composed of cotton and wool in equal part is used in knitted underwear known as merino.

In plated goods two yarns are so knitted that one is on the face, the other, usually of a different and less expensive fiber, on the back of the material. This is found frequently in hosiery. Fleece-lined fabrics are in reality plated fabrics employing three yarns, cotton, wool or mixtures, in each stitch: a heavy yarn loosely twisted for the back, a fine yarn for the face, and a very fine one for the connecting yarn. The heavy backing of this fabric, made in tubular form on a flat machine, is napped during the finishing process to form the fleece. Fabrics of this type are made into underwear and gloves. Eiderdown is an example of fleece-lined knitted material used for bathrobes and wraps for infants.

Finishing of Knitted Fabrics. Knitted material like woven cloth must pass through some finishing process before it is salable. Silk goods must be degummed, sometimes dyed, and dried on a tenter frame. Cotton fabrics for underwear are washed and usually bleached to remove the wax of the cotton, thereby increasing its absorbency, then dried to the width already determined in the process of knitting. Drying of cloth is carried out under tension on the tenter frame. If at this time the knitted fabric is stretched unduly, as may easily be done because of the elasticity of the knitted fabric, when again immersed in water and dried without stretching it will decrease greatly in width and length.

Characteristics of Knitted Materials. Fabrics of looped construction are much more elastic than those of interlaced or woven construction. They permit of freedom of movement; are durable when well made; are easy to pack, as they compress into a small space; and do not wrinkle readily. They do, however, shrink, particularly if the fabric has been overstretched in finishing as noted above, and some garments of loose, openwork pattern stretch beyond their original size. Loosely twisted yarns cause greater shrinkage than those tightly spun. Fabrics of the weft-knit type drop stitches, causing defects that are difficult to repair successfully.

Care of Knit Fabrics. The above characteristics of knitted materials, together with those of the fiber or fibers in the yarns from which they are constructed, condition their care. Runs and holes should be repaired immediately. In laundering, the fabric should never be rubbed, wrung, nor should outer garments be hung up as the friction mats wool fibers, causing shrinkage, and the weight of the garment on the loops of the knitting causes them to stretch. Thick suds of mild soap in lukewarm water should be squeezed through the garment, especial attention being given to soiled spots. Two rinse waters of the same temperature as the first should be used, the excess water squeezed out, and the garment rolled in a Turkish towel and left for a time to absorb as much of the moisture as possible. A knitted dress, blouse, or sweater should be laid on a padded surface and blocked by checking it with a paper pattern cut from the garment before it was placed in water. Wool hose and gloves should be dried on appropriately sized frames.

Silk and rayon knit underwear should be pressed on the wrong side with a moderately warm iron.

When not in use, knitted sweaters, skirts, and blouses should be folded and kept on a shelf or in a drawer, not hung on hangers.

Labels and Identifications. The past few years have seen a great increase in the use of informative labels on yard goods and manufactured articles. This is a trend in the right direction, for the consumer is entitled to know what she is purchasing. For instance, if she is buying a cotton house dress, she should know whether the color is fast and whether the material will shrink unduly. But a label which does not tell the truth, or which confuses the purchaser by technical facts which she does not understand, can be discounted as of little value. Labeling does put a responsibility upon the consumer to make herself familiar with the meanings of some common terms descriptive of materials or their finishes, and to look for labels when she buys.

For example, rayons are often labeled according to the method of manufacturing the yarn, and to an intelligent consumer these labels indicate certain properties and sometimes the need of special treatment.

Blankets and underwear may carry labels indicating the percent of wool content, and sometimes also store labels grading them as to warmth and durability.

Silk which is labeled "pure silk" and "pure-dye" silk indicates that the silk in colors is carrying not more than 10 per cent of weighting or of other fibers, or in black 15 per cent. These terms have been under criticism, and promulgations from the Federal Trade Commission as to the labeling of silk and silk mixtures were issued on November 4, 1938. Now, any labels on silk must give certain information.

Commercial standards proposed by the Bureau of Standards are not government standards and do not have the effect of law. They are trade practices or standards recommended to an industry for adoption as minimum standards, which when adopted by a majority of the companies in an industry are promulgated as "Commercial Standards."

Much more study is needed to determine the type of label for certain basic materials and their finished products, which shall be informative to the consumer, and be fair to the manufacturer and his competitors.

The student of textiles should make a collection of labeling terms as she finds them in print or in stores, and seek to understand and evaluate them.

Lace. The exact origin of the delicate, openwork fabric known as lace is not recorded in history, but Italy in the fifteenth century had developed laces of exceeding beauty for the decoration of church and household linens. In the following century lace was used profusely by men and women of fashion in Italy, France, England, and neighboring countries as an adornment of costume, a use it has retained up to the present. Until the middle of the eighteenth century lace was made entirely by hand, and it held its place in fashion until the French Revolution sounded the death knell of many of the luxuries of dress for many decades. Today the majority of laces are machine-made products and largely adaptations or copies of the real laces of other days. Very beautiful handmade lace is still produced in some countries of Europe and in China where the cost of labor is low, but it is obviously much more expensive than that made by machine in England, France, and the United States, the three countries which manufacture the bulk of the laces used today. An understanding and appreciation of modern laces depend to a large extent on a knowledge of the older laces and of the techniques employed in their construction. This is a comprehensive subject and will be discussed only briefly here.

The main divisions into which the different types of laces fall are as follows: real or handmade, including drawnwork, darned work, cutwork, needlepoint, bobbin or pillow, knotted, crocheted and knitted, and machine-made laces.

Drawnwork, one of the earliest types of laces, depended upon a fabric ground for its foundation, as does the modern version. In the older drawnwork the threads of loosely woven linen were drawn apart from each other and closely sewn over with a linen or silken thread. The effect was that of a network forming the background with the pattern left in the plain linen. In modern drawnwork the threads of the fabric are drawn completely from the fabric foundation, the remaining threads being drawn together in small bundles or sheaves with a linen or cotton thread as is found in the commonly used hemstitching form of drawnwork.

Cutwork. This development of the earlier drawnwork was made by cutting out rectangular sections of the foundation cloth, whipping over the cut edges of the fabric, and filling the spaces with transverse threads worked over with buttonhole and darning stitches. In many museums may be seen today exquisite examples of cobweblike cutwork executed in the eighteenth century. The Italians developed a form of cutwork known as reticello in which practically all the linen foundation was cut away, just a few threads being left to form the framework of the characteristic geometric pattern. A modern lace of the cutwork type is that known as Carrickmacross (guipure), made chiefly in Ireland. The design is stamped on fine lawn, a thread outlines the design, then the background fabric is cut away. After the edges of the pattern in the lawn are buttonholed, short connecting threads are placed between various parts of the pattern and closely buttonholed to form "brides."

Darned Work. The forerunner of the commonly used filet lace of the present was known as darned work and had as its foundation a netting of silk or linen thread knotted to form square meshes. The design was then worked on the netting by weaving an extra thread in and out of the meshes.

Needlepoint Lace. The term needlepoint is applied to those laces made entirely without a woven foundation, as used in cutwork and drawnwork, and the design and background worked with the buttonhole stitch alone. The design for the lace is stamped on heavy paper (parchment in older days), and along the main lines is laid a thread of linen or cotton which is caught to the parchment by tiny stitches that are cut away when the lace is completed, thus freeing it from the parchment background. Additional threads are caught to the couched outline as called for by the pattern, and all are closely worked over with buttonhole stitches, tiny picots or loops being incorporated along the edges of the motifs that form the substance of the pattern (toilé) and the ties (brides) that connect the different parts of the pattern together. Typical examples of needlepoint lace are seen in the justly renowned laces made in various European countries and known by the names of the towns in which they were originally and largely made. The chief needlepoint of Italy is Venetian point, made in the variations known as gros point, rose point, in both of which parts of the pattern are padded or thickened, and coraline; of France, point d'Argentan and point d'Alençon; of Flanders, Brussels point and point de gaze (Fig. 4).

Bobbin or Pillow Lace. This type of lace is made by the interlacing of numerous threads wound on bobbins. The design stamped on parchment is placed on a pillow for convenience in working. Pins are placed along the design, and the threads from the bobbins are interlaced and plaited about the pins to form both the motifs and the ground (réseau).

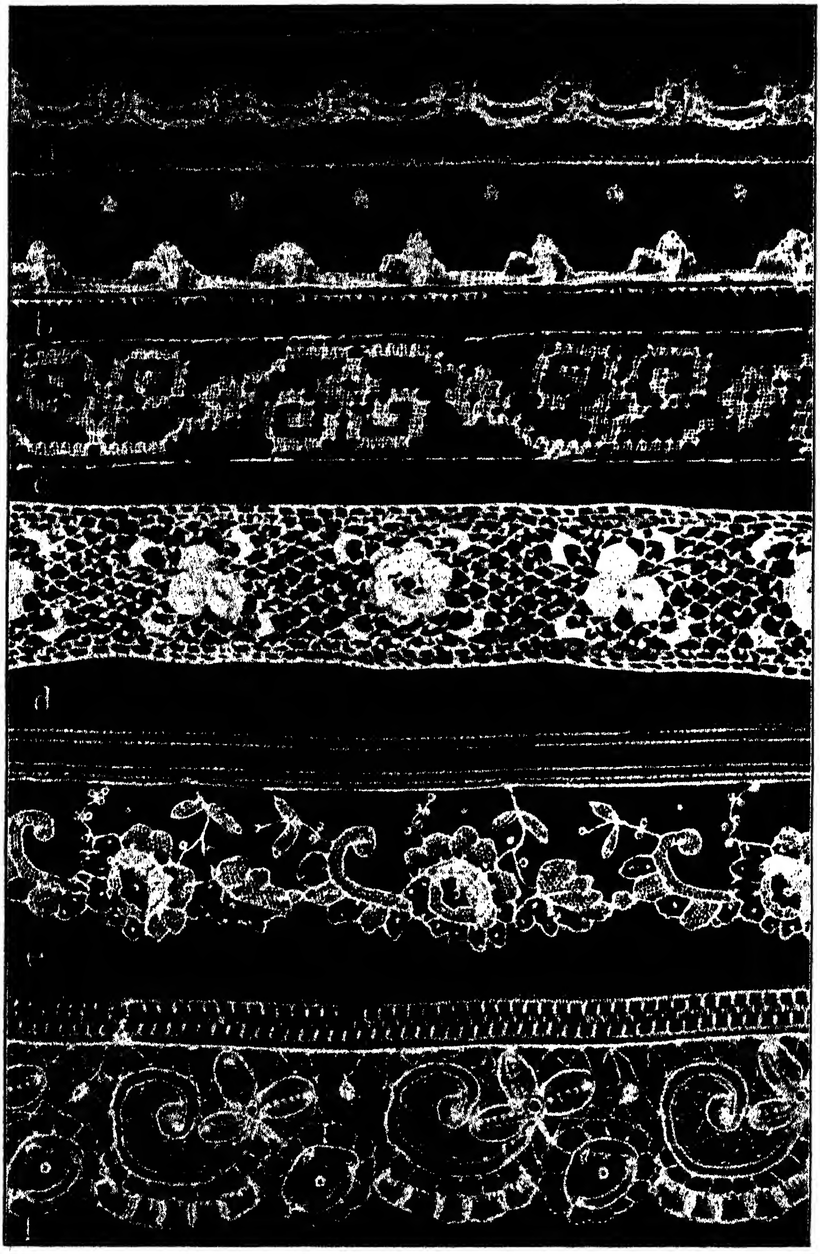

FIG. 4. Handmade laces. (*a*) Mechlin; (*b*) Binche; (*c*) filet; (*d*) Irish crochet; (*e*) point de gaze; (*f*) duchesse.

In some laces motif and ground are made at the same time, as in Valenciennes; in others, Milanese pillow lace for example, the pattern is made on the pillow first and the ground is worked in around it later. Examples of laces made with bobbins are Genoese, Milanese, and various peasant laces from Italy; Valenciennes, Lille, Chantilly, Blonde, and Cluny from France; Brussels, Mechlin, duchesse, and Bruges from Belgium; Honiton and Buckinghamshire from England (Fig. 5.).

Crochet Lace. This is a type of real lace made chiefly by the peasant women of European countries. It is constructed with a hooked needle and is distinguished by a looped or crochet stitch. One of the best-known examples is Irish crochet, made in two varieties: baby Irish, which is flat or fine in character; and rose point, which is raised and heavy with the rose as its characteristic motif.

Knotted Lace. Lace constructed by knotting threads with the fingers is known as knotted lace. The two types made in this way are macramé, one of the oldest forms of lace and generally rather heavy and coarse in texture, and tatting. In tatting the thread is wound on a small oval shuttle that is manipulated by the worker to knot the thread into the pattern desired.

Knitted Lace. This, like crochet lace, is a single-thread lace constructed on knitting needles but seldom made at present.

Machine-made Laces. Real lace has been very largely displaced by excellent reproductions made entirely by machine and of such fine quality that in some instances it is difficult for anyone but a connoisseur to distinguish between the real and the imitation. What were probably the first efforts to duplicate handmade laces by machine occurred in the sixteenth century with the invention of the stocking frame by the Reverend William Lee in 1589. By the second half of the eighteenth century many inventors were at work on machines to reproduce figured laces, using the principles of the stocking frame. In 1809 John Heathcote of England received a patent for his machine which made a net that did not ravel, and this in 1813 was followed by the machine invented by John Levers on which figured laces could be made, and the principles of which are employed in the machines for making modern laces.

The Levers machine of today is an expensive, complicated mechanism weighing 10 tons and measuring 10 feet in height, 10 feet in width, and from 40 to 50 feet in length, a decided contrast to the very small and simple instruments used in the making of real laces.

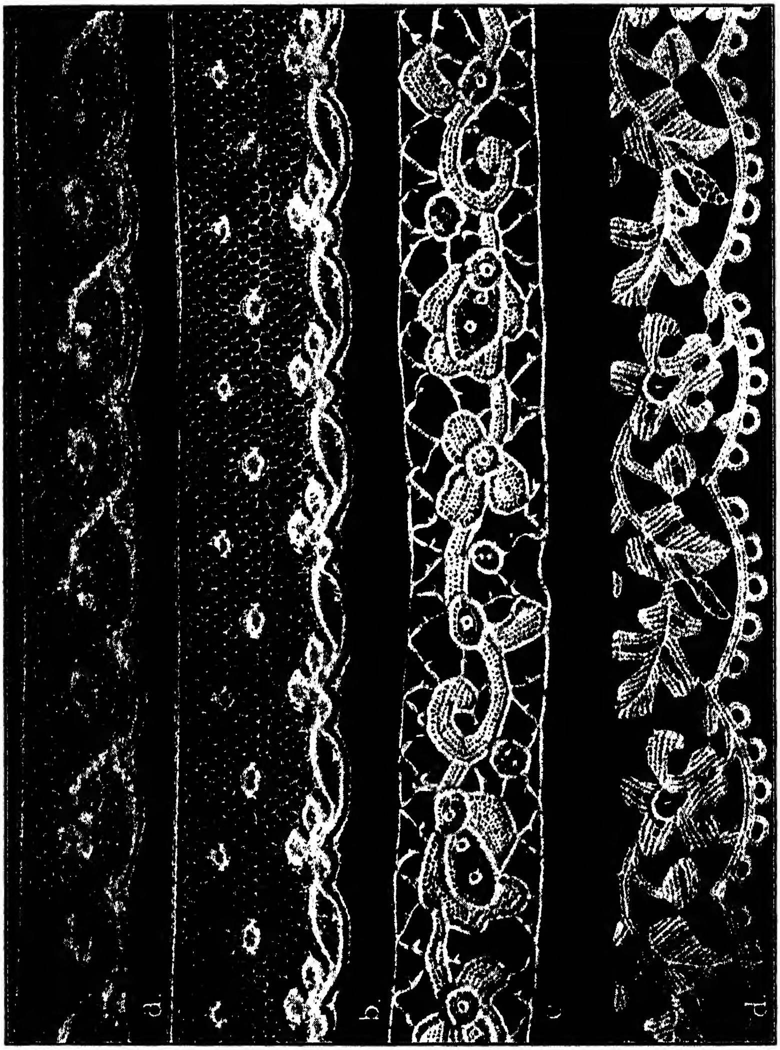

FIG. 5. Handmade and machine-made laces. Valenciennes (*a*) real; (*b*) imitation; Venetian point (*c*) real; (*d*) imitation.

Crosswise beams hold the ground warp, the outlining threads which define the various parts of the design, and the gimp threads which fill in the small figures—in all, three types of warp threads. Extremely thin bobbins of brass hold the weft threads, which are carried in thin chariots or carriages. Bobbin and chariot swing on the bobbin thread like pendulums back and forth between the vertical warps, which are shifted slightly to right or left as needed to become interlaced with the bobbin threads by a Jacquard attachment which controls the warp threads in the formation of a pattern (Fig. 6).

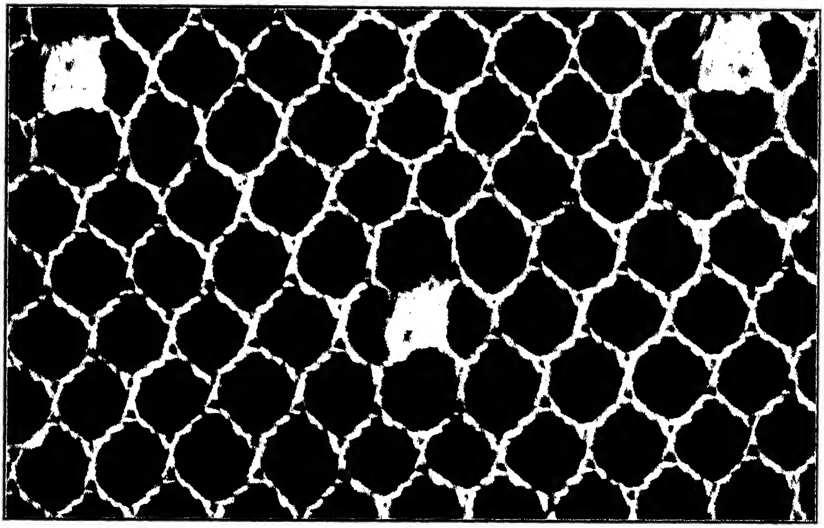

FIG. 6. Point d'esprit, showing mesh of machine-made net.

Machine-made laces are constructed usually of Egyptian or Sea Island cotton, though rayon is now frequently used for wide novelty laces, and silk is occasionally used. Lace is made the width of the loom, narrow strips being caught together by a binding thread. When the "fabric," many feet in width and length, has been inspected, and if necessary mended, sometimes bleached, it is dressed with a mixture of gum and starch, run between rollers to distend and set the mesh, then placed in a huge tenter frame to dry; the binding thread is pulled out and the narrow, individual strips of lace are ready to be wound by machine on cards ready for shipment.

The Barmen or lace-braiding machine is much smaller than the Levers machine and circular in shape, and like the circular-knitting machine turns out its product in tubular form, consisting of one or more strips of laces. On it are made excellent reproductions of bobbin laces.

Imitations of point de Venise and crochet laces are made on the Schiffli machine, which in about 1884 was employed in the town of Plauen, in Germany, where burnt-out laces are made in large quantities. An embroidery machine with many horizontal needles is threaded with linen or cotton threads and embroiders the desired design on a background of silk or wool which is later burnt out from the fabric in a chemical bath. The linen and cotton are unaffected and form the lace.

On the Pusher machine are made laces without cordonnet or picot, though these are sometimes added after the lace has been removed from the machine. The popular Alençon of today usually is made on this machine and the cordonnet run in by hand. The warp threads traverse or run diagonally across the fabric, some warp threads to the left, others to the right. This same type of construction is followed in the making of Brussels net, or bobbinet, for which threads of cotton, silk, or rayon are used, light-weight silk nets being designated as tulle. In maline, which is less compact and lighter than tulle, the diamond-shaped mesh is formed by entwined vertical warp threads. Machine-made net has played an important rôle in lace-making since the invention of the machine for making bobbinet early in the nineteenth century. It forms the foundation to which are applied motifs made with needlepoint or bobbin technique, as in appliqué lace; it is embroidered with various designs in chain stitch as seen in tambour laces, or with darning stitches as found in the products known as Limerick laces.

Distinguishing Laces. Needlepoint and bobbin laces are distinguished from each other by the nature of technique used in the pattern and the ground. In the former the pattern (toilé) is always worked in rows of buttonhole stitches, the same looped stitch being used in the brides or in the net groundwork (réseau). In bobbin lace the pattern is composed of threads approximately at right angles to each other, and the ground is formed of plaited or braided threads. In machine-made laces the work is extremely even, does not have the buttonhole stitch, is usually of cotton rather than linen thread, and is very white. Very wide flouncing and all-over pattern laces are of rayon or cotton usually, and when fashion dictates, dyed in a wide range of colors.

Care of Lace. Most lace is so delicate in texture that special care must be given to its cleaning. It is particularly necessary that a very fragile lace should receive as little handling as possible while being cleaned or washed. It may be basted to a piece of cotton cloth and very gently squeezed in warm water with abundant suds, or wrapped around a bottle and shaken vigorously in the suds and water. A third method suggested for washing fine lace is to put it inside a glass jar well filled with soap flakes and water. A thorough shaking of the bottle should loosen all soil from the lace. After rinsing, needlepoint, bobbin, and crochet laces should be rolled in a towel until the moisture has been partially absorbed, then stretched over a padded ironing board and carefully shaped and pinned in place. Laces combined with linen should be lightly pressed on the wrong side over a well-padded board. Turkish toweling or soft flannel makes a satisfactory padding.

Laces of silk and extremely fine mesh should not be washed but well covered with Fuller's earth or French chalk and allowed to remain covered for a few days until the powder has absorbed the soil and grease contained in the lace. Every vestige of powder should then be removed by firm patting of the lace between the hands. Black lace may be freshened by squeezing and rinsing it in a strong infusion of tea; laces of any color may be successfully dry cleaned in carbon tetrachloride.

When it is desirable to impart a creamy tint to white lace it may be dipped in a weak solution of tea or coffee or placed in a covered box containing yellow ochre powder mixed with cornstarch or talcum. Shake the box well, and on removing the lace pat out all excess powder.

Lacquer Finish. *See* p. 59.

Lanital. A new man-made fiber derived from casein of milk. It is the result of experiments conducted by Antonio Ferretti in Italy, and was patented in that country in 1935, where it is being produced in large quantities for both domestic and foreign consumption. Lanital is made by dissolving casein in dilute caustic soda solution, and coagulating the filaments from the spinneret in a hardening bath of formaldehyde, alum, or other coagulant. It is chiefly used as a staple fiber in fabrics having the appearance of wool, and is sometimes called artificial wool. As reported, it requires some 264 gallons of skim milk to obtain 7 pounds of casein, from which about 12 pounds of staple fiber can be produced. A comparison of artificial and natural wool, as given from the Rome office of the United States Bureau of Foreign and Domestic Commerce, is as follows:

	Natural Wool	*Artificial Wool*
Carbon	49.25%	53.00%
Hydrogen	7.57	7.00
Oxygen	23.66	23.00
Nitrogen	15.86	15.50
Sulphur	3.66	0.70
Phosphorus	.....	0.88

According to the above analysis, tests for sulphur and phosphorus would serve as identification, but the microscope is the most convenient differentiator. Wool fibers have scales; artificial wool filaments, of course, do not.

Lanolin. This is a complicated chemical substance, mainly a mixture of cholesterol esters, obtained from wool grease. It acts as an emollient for the skin of the sheep and the fleece, and in its purified form is used as a softener in ointments and skin creams. It is absorbed by the skin.

Liberty Fabrics. These are silk and cotton fabrics of high quality, manufactured at Merton Abbey, England—where William Morris did so much of his designing and weaving—by the firm of Liberty, Ltd., of London. They are characterized by the charm of their hand-blocked, all-over floral patterns and delicate pastel coloring.

Linen. A yarn or cloth made from the fibers obtained from the stem of the flax plant (*see* Flax, p. 66). Linen is used chiefly for table linens, towelings, handkerchiefs, dresses and suitings, sheetings, draperies, and slip covers. When well woven of high-quality yarns, linen fabric is strong and enduring, absorbent, and free from lint. It is lustrous, and it is cool to wear because the threads pack tightly and close the air spaces, the fibers do not hold still air, being free from curl or crimp, and because moisture evaporates rapidly from the average linen fabric. Unless specially treated, linen fabrics crush easily (*see* Crease Resisting, p. 57). Because flax does not readily retain stains and soil, linen fabrics are easily cleaned, but they are likely to fade when subjected to sunlight.

Linen is a comparatively expensive textile in the United States for several reasons. The preparation of flax fibers for spinning into yarn is dependent largely upon hand labor and requires considerable time for the different processes, including bleaching. It is also difficult to grow a flax plant that will produce a high percentage of fiber of uniform quality. Practically no flax for weaving is grown in this country, but must be imported from Europe.

Linens are most generally found in plain and in damask or satin weaves, because the stiffness of the flax fiber does not lend itself to lacy, open, or pile weaves. Small-patterned weaves such as diaper and huckaback are used for towels

Today linens are frequently combined with spun rayon threads in novelty dress fabrics, while cotton threads are unevenly spun to resemble linen yarns and the resulting fabrics chemically treated to look like linen. Simple tests to help the consumer distinguish all-linen materials are given on p. 166.

Care of Linen. Good linen is costly and deserves good care. If given proper care it is enduring and its beauty does not diminish.

Hand laundering of fine linens is practically a necessity, either at home or in a laundry specializing in such treatment. If washed before they are badly soiled there is less wear and tear on the articles. Many people have the habit of using bleaches on white linen far more often than is advisable. Flax fibers are highly absorbent, and if strong bleaches enter the fiber and are not fully rinsed out, a weakening of the fabric results. If bleaching is necessary for stain removal or whitening, use as dilute a solution of the bleach as will do the work, in cool water and for a brief period of time. Always rinse thoroughly; otherwise a hot iron will cause havoc by activating the chemical attack of the bleach.

Linen damasks especially should be ironed wet with a moderately hot iron, to bring out gloss and give body to the fabric. But, since the flax fiber is stiff and stemlike (*see* Fibers, p. 162), do not press tight creases always in the same place in table linen, for eventually the stiff fibers will crack along the crease. Change the method of folding a napkin or tablecloth from time to time.

When linens are stored, they should be starchless, and put away clean and dry in a dry place. They are susceptible to mildew unless so stored. Blue paper wrappings are of some use in preventing the yellowing of white linens with age.

Colored linens should be washed with a mild soap and tepid water, to avoid fading. Dry in the shade, and iron with moderate heat.

Staple Linen Fabrics

Art Linen. A plain-woven linen made from round and hard-twisted yarns, and in wide and narrow widths. It is used for embroidery, drawnwork as well as undecorated runners, luncheon sets, dresses, and uniforms.

Cambric. A sheer, fine white linen in plain weave used chiefly for handkerchiefs, neckwear, and doilies.

Canvas. A heavy, firm fabric made from rather coarse linen yarns and used for interlinings of coats.

Crash. A coarse linen toweling in either twill or plain weave. A rough-textured material in plain weave is used for suitings and dresses.

Damask. A cloth made of figured or of satin weave in a variety of elaborate floral or geometric designs, and reversible. The terms single and double damask are applied to damask used for tablecloths and napkins, the former term being used to describe either cotton or linen damask woven with both ground and pattern, or the ground only, in five-shaft satin weave, i.e., the filling threads pass over four warp threads and under the fifth. The term double damask designates linen damask woven with both ground and pattern in eight-shaft satin weave, wherein the filling passes over seven warp threads and under the eighth. *See* Table Linens, p. 151.

Glass Toweling. A plain-woven white or cream linen material characterized by colored cotton warp and filling threads woven in to form checks. Used for wiping glassware and dishes, as good linen does not lint.

Handkerchief Linen. A sheer, fine, plain-woven fabric used for handkerchiefs, dresses and blouses, as well as lingerie. Heavy warp or filling threads are sometimes inserted to form checks.

Huckaback. A toweling material woven in small geometric patterns.

Sheeting. A plain-woven fabric similar to the cotton fabric used for sheets and pillow cases, but made entirely from linen yarns.

Linings. Linings for overcoats, topcoats, and suits are exceedingly important, as for complete satisfaction they must add to the beauty of the garment, be durable, and slippery enough in surface to permit of slipping easily over a dress or suit. For this last reason sateen and similar cotton fabrics, though durable, are not happy choices for linings, as coats lined with them are difficult to put on. Silk and rayon satins and damasks slip readily, but for durability should not have long floats. Very light-weight satins as well as crêpe de Chine and flat crêpe do not stand up well under abrasion at neck, cuff, armseye, and hem. Cotton-back satins, though somewhat heavy and stiff, give excellent service, as do also twill-woven silk and rayon fabrics. Rayon fabrics are now made in a variety of weaves, either alone or combined with silk or cotton.

Lining fabrics should be closely enough woven to resist slippage at the seams. The color should not crock, and the material should be resistant to perspiration and water spotting. Weighted silks are undesirable for linings as they are deteriorated by perspiration, shrink more than pure silks, and tear readily. Rayon fabrics, particularly the cuprammonium and acetate types, are less affected by perspiration than pure-dye or weighted silks, and they resist abrasion. However, unless very closely woven, they slip badly at seams. For this reason rayon linings should be set into coats with considerable ease or fullness. Rayon linings wrinkle more than silk ones.

For extra warmth and durability women's coats and men's overcoats are sometimes lined with flannel, serge, or kasha. The lining may be sewn to the coat or be detachable. In either case sleeve linings of silk or rayon will greatly simplify the putting on and off of the coat by the wearer, as sleeves lined with wool fabric cling to dresses and suits.

Alpaca, mohair, and brilliantine are very durable lining materials for men's suits particularly, and permit the wearer to put the coat on and off with ease.

The following listed materials are commonly used for linings: satin, sateen, crêpe de Chine, damask, foulard, radium, mohair, alpaca, serge, flannel, and rayon fabrics.

Interlinings. Outing flannel and flannelette are used as interlinings in cheaper coats. They are not warm, however, because when the nap of these cotton fabrics is flattened it can no longer hold still air in its meshes. All-wool flannels or lamb's wool quilted to cheesecloth are more satisfactory interlining fabrics, when warmth is important. The latter is more bulky than the former.

Lisle Thread Fabrics. Knitted gloves, underwear, and hosiery are sometimes made of lisle threads which are composed of long-staple cotton. The fibers are carded, combed, and very tightly spun; the thread is sometimes glazed or mercerized to give it luster, then gassed by passing it over a very hot plate to burn off all protruding ends of fiber. This treatment gives a smooth, compact thread, usually two ply, that slips readily and in consequence is very desirable for knitted articles.

Llama. A wooly-haired ruminant whose habitat is Peru. Llama hair is coarser and shorter than that of alpaca. *See* Fibers, p. 158.

Mattress Covers. Unbleached or bleached muslin of comparatively high thread count is used generally for covers to protect mattresses from dust and rusted springs. These covers when ready-made are boxed to fit the mattress, with either enclosed or bound seams, and are usually of preshrunk muslin to ensure good fitting after washing.

Mattress Protectors. Bed pads, as they are sometimes called, are quilted pads made of two layers of bleached muslin with a thin layer of cotton between, the edges being bound with bias cotton cambric binding. In the better-quality pad, bleached cotton, from which the natural oil has been removed, is used for the filling, as it is more absorbent than the unbleached cotton and does not discolor the covering when washed. Good-quality muslin with little if any starch or clay filler is desirable for the pad covering.

Padding may be purchased by the yard or made up in the following sizes:

Bed:	*Single*	*Twin*	*Three-quarter*	*Double*
	36 by 76 inches	39 by 76 inches	48 by 76 inches	54 by 76 inches

Mercerized Yarns and Fabrics. Mercerization is the name given to that process by which a high degree of luster is imparted to cotton yarn or cloth, by means of subjecting it to the chemical action of a caustic soda solution while the cotton is under tension. *See* Finishing of Fabrics, p. 60.

Metallic Threads. Metallic threads are either all-metal filaments, or cotton or other threads serving as a core around which these are wound. Gold, silver, copper, and various alloys have been used for this purpose, but the more expensive metals are rarely found. Tin, copper, copper-gilt, and some alloys are generally used to simulate silver or gold. Sometimes a transparent varnish coating is applied to retard darkening. The fabrics made from such threads are rich-looking at first, but soon lose their beauty as the metal darkens, and are very unsatisfactory as to dry cleaning.

Mildew. *See* p. 61.

Mohair. The technical name of the silky, very long-staple white hair of Angora goats, raised in large numbers in Turkey and South Africa and rather recently introduced into Canada and the southwestern section of the United States. This fiber, from 5 to 10 inches in length, has very few scales or serrations on its surface and its consequently smooth, hard surface does not catch or hold dust. Its pleasing luster and elasticity make it very desirable for use in mohair velvet and plush upholstery and draperies, for coat linings, men's suitings, as in Palm Beach cloth, and dress fabrics, as well as imitation furs. Owing to its natural stiffness mohair is practically always woven with a warp of cotton or some other fiber.

Mohair dyes well but is subject to attack by moths. Furniture covered with mohair fabric should be frequently and thoroughly brushed or cleaned with a vacuum cleaner. If possible it should be treated with a moth repellent. Many manufacturers of overstuffed furniture now sell their products with a guarantee against moths for a specified period of time. *See* p. 156.

Moiréing. *See* p. 61.

Mothproofing. *See* Finishing of Fabrics, p. 62.

Moths and Moth Control. The annual damage in the United States due to moths is estimated at between one and two billion dollars. The most expensive wool and fur garments, and the finest rugs, are their chosen food. Two species of moths, the webbing or *Tineola bisselliella* and the casemaking or *Tinea pellionella*, the black carpet beetle or *Attagenus piceus*, and the furniture beetle are some pests of this sort from which modern heated houses suffer.

Taking the life cycle of the webbing moth, a common species, as an example, the only function of the moth itself is reproduction. The eggs are laid through an extended ovipositor in deep places in garments or upholstery. They are white, fragile, and scarcely the size of the head of an ordinary pin. In warm environment, the eggs may hatch in 4 to 8 days and larval development may continue for 40 or more days, the larva eating steadily throughout that time. The life cycle then proceeds to pupa, to moth, and back to egg again. It may be complete, in hot weather, in 50 to 60 days, hence two or more generations may appear through the warm season. In fact, in heated houses, there is no closed season for moth depredation.

There are some simple and effective means of combating moth damage. Vacuum-cleaner treatment of both sides of rugs will separate moth eggs from the nap and backing. Good brushing, beating, and airing of all wearing apparel of wool, furs, etc., twice a month, will protect. Moth larvae never injure clothes in daily use. Summer woolens and furs should not be put back in a closet and forgotten. Cedar chests are effective if kept tightly shut. The aroma kills only the newly hatched larvae; therefore, if worms of larger growth, or moths, are present they will survive and work havoc. Clothing which is to be stored through the warm season should be put away, thoroughly protected, as early as possible in the spring.

Dry cleanings kill both eggs and larvae; water immersion for 10 minutes at 140°F. is also effective, and the time is shortened if soap is used. In laundering woolens, if the temperature is held for 1 minute at 130°F., the subsequent washing may be done with a mild soap at the usual temperature of 90° to 100°F.

Moths are active at 70°F. but inactive at 50°F. Ordinary cold storage at 40°F. provides protection by stopping larval feeding, but does not destroy the larvae. If destruction is to be accomplished, a temperature of about 18°F. should be maintained for several days, alternating with about 50°F., then held at 40°F. as the storage temperature. Alternating the freezing and thawing destroys these pests.

Again, if all the infested material reaches a temperature of 130°F. all are destroyed.

A good liquid insecticide has merit if used in closets and storerooms weekly or twice a month. These sprays are respiratory poisons. An insect spray of strong pyrethrum content is efficient. The oily carrier of the pyrethrum should not stain fabrics, nor be so volatile that it evaporates too readily. In this case it loses its effectiveness too rapidly and is a fire hazard.

Paradichlorbenzene and napthalene are effective respiratory poisons if correctly used. Both are easily obtained. At temperatures of 70°F. or above, the vapor of paradichlorbenzene, for example, is freely given off. One pound of this substance for each 75 or 100 cubic feet of space, as in a closet, is effective if the closet is kept tightly closed. This would mean stoppage of the cracks of the door. The crystals may be placed in two or three shallow pans on the shelves.

Upholstered furniture may be made free from infestation by introducing two or three pounds of paradichlorbenzene deep in the crevices of the upholstery and immediately wrapping the article with blankets to exclude air. All stages of the moth will be killed in a few days, or even in 48 hours.

If rugs are to be stored in the home through the summer, vacuum them thoroughly on both sides, sprinkle generously with paradichlorbenzene or naphthalene, roll, and wrap in paper with seal-tight overlappings.

Some vacuum cleaners have an attachment which blows the powdered chemical into the nap of the upholstery or rug, and removes it after it has done its work.

The carpet beetle can be destroyed by the methods used for the moth.

Tar-paper bags cannot be depended upon unless the article is free from infestation when it enters the bag, and unless the bag is so sealed that no moth can enter. Tar paper is simply a repellent through its odor.

An excellent method of protecting small woolen articles is to enclose each separately in a paper bag, put in some paradichlorbenzene, and seal the bags. Then, if one article is by chance attacked, the infestation cannot spread.

Napped Fabrics. Materials with a napped surface, soft, usually dull and pleasing in texture, are made of wool or cotton yarns not too tightly spun, generally in a plain, twill, or double cloth weave, and are sometimes knitted. The woven or knitted fabric during the finishing process is passed through a special machine (*see* Finishing of Fabrics, p. 53) containing a roller covered with wire teeth, or for fine-quality wool fabrics, with teasels, which roughen the surface, drawing loose ends of fibers up from the yarn, and giving a fuzzy surface to the cloth. In the finishing of some materials, notably wool velour and broadcloth, the nap is sheared to give uniformity of surface. In broadcloth the nap is pressed flat, giving luster to the cloth. A very light nap is sometimes raised on wool cloth, to make it have the appearance of suede or chamois, by means of an emery covering on the cylinder.

Blankets, whether all wool, all cotton, or a union of these fibers, are napped on both sides so that the protruding fibers may hold still air in the tiny pockets of the napped surface and render the fabric warmer. (*See* Blankets, p. 5.) Owing to the lack of resiliency of cotton, blankets made of this fiber as well as articles made of Canton flannel, outing flannel, or flannelette should be thoroughly brushed on the surface to raise the nap that has been flattened in washing.

Napped fabrics tend to catch and hold threads, dust, and soil and in dark colors need constant brushing to keep them looking fresh and clean.

Navajo Rugs and Blankets. The Navajo, the most numerous of the tribes of the American Indians, are famed for the colorful blankets and rugs that are woven on simply constructed upright looms. Wool obtained from their own herds of sheep furnishes the yarn. The women card, spin, and weave the wool, which they also dye with some vegetable dyes of their own manufacture as well as the commercial aniline dyestuffs. Particularly for tourist trade the brightly colored blankets are woven of Germantown wool.

To the Navajo, like other primitive peoples, color has a definite significance, red denoting to him the warmth of sunshine; black the north with heavy clouds of storm; yellow the golden sunset of the west; blue the cloudless south; and white the east with its morning light. Authorities on the lore of the Indian seem agreed that the geometric patterns woven in blankets for sale are undoubtedly copies of designs that were symbolic of the old Navajo legends, but are without special meaning for each individual piece woven.

Though the plain weave is very generally used, varieties of the twill in zigzag, diamond, and diagonal weave are popular, as well as a double weave with a different design showing on either side of the fabric.

Copies of true Navajo rugs are made entirely by machine in some of the modern blanket mills.

Nylon. E. I. du Pont de Nemours and Company expects soon to place on the market a filament to be called Nylon, which is a generic name designating it as being made from polymeric amides having a proteinlike structure. It is claimed that Nylon filaments will have superior toughness, strength, and elasticity, and will largely enter the hosiery field.

Oiled Silk. A light-weight, thin silk of plain weave rendered waterproof by boiling it in linseed oil. It is now extensively used for raincoats and capes, umbrellas, shower curtains, and bathroom window curtains. When subjected to continued heat it tends to become brittle and tear, and under certain conditions it becomes sticky.

Curtains of this material should be washed on a flat surface by sponging with soap and water, thoroughly rinsing and drying to prevent mildew.

Oriental Rugs. The term Oriental used in connection with floor coverings usually means to the uninitiated a pile surface. There is, however, a class of non-pile carpet which historians claim antedates the hand-tufted rug. The Khilim rugs, comparable to hand-woven tapestry, and the Shemakha are the two types of Oriental rugs that have no pile and are still made in the old primitive manner. The former is constructed by interlacing the weft threads of different colors with groups of warp threads by means of a needle or shuttle. The weave is identical on both sides, with open spaces between the warp threads where changes in the color of the filling threads occur. The latter rugs have the filling threads, in colors, so interlaced with the warps that the effect of a herringbone twill results. The back of such rugs has a decidedly shaggy appearance due to the free hanging ends of the filling yarns which are drawn to the back when one unit has been completed and filling of another color is introduced. The design is always outlined in black.

The Oriental rugs in most common use in this country today are of the hand-knotted type with a pile surface. This type is also still constructed in the primitive manner on simple looms consisting of two poles stuck upright in the ground and supporting two cross poles, one at the top, the other near the ground. To these are fastened the warp threads. The worker, or group of workers on a large rug, starts the rug near the lower pole and about every two warp threads binds or knots the wool pile yarn, then cuts off the ends with a scissors so that an even, velvety pile is formed. When a row of pile tufts has been tied across the entire width of the rug a filling thread, sometimes two or more, is placed under and over alternate warp yarns, as in plain weaving. With a comb the worker presses the filling and rows of knots close to the preceding ones.

The loop or knot with which the Oriental rug maker twists the pile warp about the stretched warp yarns is of two varieties: one, known as the Ghiordes, or Turkish knot, is used on all Turkish and Caucasian as well as on most Persian rugs; the other, the Sehna or Persian knot, is used on some Persian and in most Turkoman and Chinese rugs. The Sehna knot permits of a greater number of tufts to the inch, with resulting closeness of texture and shortness of pile. The number of tufts in an Oriental rug may vary from less than 20 to more than 400 to the square inch. The closeness of the warp yarns as well as the fineness of the tufting and the filling yarns determine the closeness of the texture of a hand-knotted rug; the higher the number of tufts to the square inch, the better the quality of the rug. Very fine, high-quality filling yarns give flexibility to the fabric; heavy ones give it body and weight.

The materials used in Oriental rugs are native wool, camel's and goat's hair, silk, and cotton, the cotton forming the ground warp in most rugs, especially in the fine Persian rugs where it is used for the filling also.

Since the introduction of aniline dyestuffs into Oriental rug-weaving countries in 1860, the older vegetable dyestuffs have been to some extent displaced by coal-tar products. Antique Oriental rugs are exquisite blendings of beautiful color, but the modern products are usually so brilliant in color that for American buyers they must be washed with an acid and alkali bath to render the colors more mellow.

The patterns found in Oriental rugs are either geometric or floral, and were formerly entirely symbolic, expressive of religious beliefs and tribal customs. The patterns in the chief rug-making countries are decidedly characteristic, although the variation within each is very large. The student interested in this fascinating phase of Oriental rugs is referred to the many excellent books which deal thoroughly with this topic, as space for adequate discussion is lacking here.

Rugs are known by the name of the country or the district in which they were made. Under the heading of Persian fall the rugs made in Feraghan, Gorevan, Hamadan, Herat, Ispahan, Kermanshah, Kirman, Khorassan, Kurdistan, Saraband, Saruk, Sehna, Shiraz, and Tabriz. These rugs are characterized by a distinctly floral pattern, such as lilies, tulips, roses, and connecting vines. The finest examples of Persian workmanship are of fine wool pile and cotton warp and filling. The Ghiordes knot is used in the Kurdistan, Hamadan, and Herat rugs; the Sehna, in all the others above mentioned. With the exception of the rugs of Shiraz, the Persian rugs usually have a narrow webbing at the ends and are considered the most choice of all Oriental loom products.

The Turkish rugs most commonly used in this country are the Ghiordes, Karaman, Kulah, Ladik, Meles, Melhaz, Mosul, Mujur, Smyrna, and Yuruk.

Turkish weavers as a rule use coarser yarns than the Persian weavers, and the Ghiordes rather than the Sehna knot. The warp and filling threads are always of wool of the hair of goats; consequently the weave is coarse, and the pile long and heavy. The designs are usually geometric, the octagon and medallion being great favorites, the representation of human beings, animals, and birds being forbidden by the Moslem religion.

Rugs classified as Turkoman are those known as Beshir, Bokhara from Khiva or Tekke, Kashgar, Samarkand, Yarkand, and Yomud. Rich dark reds form the usual ground color with yellow, white, rose, blue, and green freely used in small units. The octagon, circle, star, and diamond are characteristic design motifs of most Turkoman rugs with Chinese floral, fish, fret, and dragon forms used in the products from Kashgar, Yarkand, and Samarkand.

Turkoman rugs are made with the Sehna knot, a short wool pile, and warp and filling of wool or goat's hair. As a class they are readily distinguished by the wide webbing at either end, with fringe of the threads forming the wool or hair warp.

Closely allied in design and color to the Turkoman rugs are those made in Beluchistan. Stars, octagons, and hexagons on grounds of dark red or brown with touches of blue and white are characteristic. The Sehna knot, wool or hair pile, and warp with a filling of dark wool are always employed. These rugs, like those of the Caucasus region, are usually small.

From the Caucasian district of Southern Russia come the rugs designated as Baku, Daghestan, Derbend, Genhis, Kabistan, Karabagh, Kazak, Shemakha of pileless construction, Shirvan, and Tchetchen. Made with the Ghiordes knot and warp and filling of wool or cotton, the Caucasian rugs have decidedly geometric designs, the conventionalized flower forms of Persian derivation, and very prominent borders. The webbing at the ends varies in width; in some rugs it is very narrow with short, knotted fringe.

From Peking, Tientsin, and Thibet have come the popular Chinese rugs that are practically identical in construction with those classed as Turkish, Persian, Caucasian, and Turkoman. Both Sehna and Ghiordes knots are used, though the Sehna is more common. The wool yarns, however, are coarse and permit fewer knots to the square inch, but give a deep rich pile. The designs traditional with old Chinese porcelains, woven silks, and embroideries are used in the rugs also. Conventionalized fruit and flowers like the peach, lotus blossoms, the chrysanthemum and citrus, and bats, butterflies, the shou, fret, and swastika form all-over designs, borders, and medallions.

Judging Oriental Rugs. The average consumer who purchases a modern hand-tied rug does so chiefly because of the appeal made by the color, pattern, and texture of the rug and suitability of these and its size to the room in which it is to be placed. As in other types of wool floor covering, the durability of the rug depends on the quality of its materials and construction. High-grade rugs have many knots to the square inch, the knots being so securely tied to the warps that the pile tufts cannot be pulled from the rug. A closely tied rug has an almost erect pile that has great resiliency when crushed in the hand, and, when the rug is placed upright on the floor somewhat in the shape of a cone with the center of it pulled up, it will stand alone like a piece of stiffened woven fabric. The number of warp threads to the inch and the number of filling threads between the rows of knots indicate the quality of the rug, closely placed warp threads and few filling threads permitting a higher number of knots with a resultant greater density of pile. A closely woven selvedge denotes a rug of firm construction; a closely woven webbing at the ends, or well-tied fringe, protects the end rows of knots.

Care of Oriental Rugs. Like machine-made rugs, the hand-knotted ones, which are always more expensive to purchase, require care in use and frequent cleaning to prolong their life. Shaking a rug causes breakage of the warp threads; hanging it on a clothes line places undue strain on these same threads. Weekly cleaning with a vacuum cleaner, and daily brushing with a carpet sweeper, keep the pile free from the grit that when embedded cuts the pile threads and, in time, ruins the rug.

If a vacuum cleaner is not available the rug should be placed face down on the floor or grass and beaten with a flexible beater. It should then be turned face up, well swept in the direction of the warp, and then wiped with a damp cloth. When the Oriental rug needs washing it should be entrusted, whenever possible, to an expert, as sometimes the colors in the modern rugs dyed with aniline dyestuffs may run somewhat.

Worn and torn spots should be repaired as soon as possible by an expert.

Frequent and thorough cleaning will prevent moths from infesting the Oriental rug. When stored for the summer, rugs should first be thoroughly cleaned, sprinkled with moth-preventive crystals, well wrapped in heavy paper with all ends and openings securely sealed, and stored in a cool, dry room. *See* Care of Carpets and Rugs, p. 16.

Pattern in Fabrics. Each season consumers are offered by stores an almost bewildering array of "new" or "latest" fabrics for their use and enjoyment. A critical examination of these "new" productions will bring out the fact that the chief new element in these offerings is the design or pattern.

Variations in design are many. (1) It may be brought about in the structure or weave of the cloth; (2) it may be applied to the surface by printing, pressing, or embroidering the material after it has been removed from the loom.

Structural Design. By means of the figure weave (*see* Weaves, p. 189) or a combination of fundamental weaves a great range of designs is possible in fabrics of all classes. However, by using one of the fundamental weaves as plain weave, simple but interesting designs may be obtained by (1) using some novelty yarns together with the regularly spun yarns in either warp or filling or both; (2) placing some heavier yarns in groups in either warp or filling or both; (3) grouping yarns of similar size but different color, as is done in ginghams, organdies, dimities, the geometric borders of handkerchiefs, or Scotch plaids in wools or cottons; (4) introducing arrangements or groups of yarns of the same color but different fibers as warp or filling.

Applied Designs. In addition to the variety of designs it is possible to obtain structurally, many more may be applied to woven or knitted fabrics. One of the most common methods of applying design to the surface of cloth is printing in one of its varieties—direct, discharge, or resist. Fabrics of all weaves and made of any textile fiber may be printed, though in general plain-weave cottons, silks, and rayons form the bulk of print goods.

In direct printing the design is placed directly on one side of the fabric by means of engraved rollers. A film of color is deposited by each roller used and does not necessarily penetrate through the fabric to its reverse side, particularly in compactly woven materials. By means of duplicate printing both sides of the cloth are printed with the same design, sometimes, when well done, giving the appearance of a structural design, particularly to striped fabrics. This type of printing is found frequently on men's shirting materials.

When done by direct printing the design is usually in color, one or more, on a white or light-colored background, with the edges of the pattern clearly defined. It is a comparatively cheap method of producing design, as once the rollers have been engraved thousands of yards of fabric may be printed from the one set, changes of color in the design being possible to make greater variety at low cost. Furthermore, the used metal rolls may be smoothed down and engraved with other patterns. Unless the penetration of the dye is thorough and the dyestuff quite fast to washing and to light, direct-print fabrics may fade even with careful laundering.

Composition or flock-dot printing is a form of direct printing used very commonly today on inexpensive cottons. Copper rolls are engraved with the dots or small designs desired and print the face of the material with an adhesive paste, such as glue, rubber cement, pyroxylin, or latex compounds. These pastes, either white or colored with some dyestuff, may contain flocks from the shearing of napped wool and cotton materials, mica, or particles of ground glass. Very often this type of figure may be flecked off with the finger nail or may discolor when ironed.

Warp-print fabrics may always be distinguished by the softened outline of the design. There are on the market many attractive warp-print cretonnes for draperies and slip covers, taffeta for dresses, and ribbons of various width. As the prepared warp is printed with the design before weaving takes place the penetration of the dye in the warp yarn is thorough but the interlacing of the warp and filling threads subdues the color and softens the edges of the printed pattern. *See* Carpets, p. 12; Printing, p. 113.

In a second common type of printing by which design is obtained in fabric a previously dyed fabric is printed with a chemical substance which discharges the dye from those parts of the dyed fabric on which it is printed, hence the name "discharge print." Many of the small light-pattern-on-dark-ground fabrics are obtained by this method. Usually only two colors are possible in such a design, and if the chemicals are too strong and the material is not freed from any excess of the discharge agent by thorough rinsing the fabric is definitely weakened and when subjected to strain in wearing is likely to have the designs fall out of the cloth.

Still another method of printing designs is known as the resist. Small, white figures on dark backgrounds may be produced by this as well as by the discharge method. Before dyeing, the thoroughly bleached cloth is printed with a paste which resists the penetration of the dye when the cloth is immersed in the dye bath. After the paste is removed the original white of the material shows in the design formed by the paste which covered it. Fabrics printed and dyed in this manner absorb the dyestuff well and are usually very satisfactory after laundering.

Transparent velvets are frequently patterned by the discharge method. On the back of the velvet is printed a paste containing a chemical which destroys the rayon pile with which it comes in contact, leaving the silk ground and the rest of the pile untouched. Fabrics of great transparency such as chiffon, organza, rayon voile, and organdie may be printed with chemicals that give a frosty, self-toned design to the fabric. At times this shadow printing is combined with roller-printed designs in colors.

Less commonly used commercially for the application of surface design to textiles are the effective methods of stenciling and screen printing, the second a development of the first (*see* pp. 112 and 150). Screen-printed fabrics have greater depth and intensity of coloring than those printed by the roller method, but the lines of their designs are less distinct and regular. Owing to the application of the coloring matter by hand in screen printing the penetration of the color is less uniform so that the wrong side of the fabric may show the design very clearly in some places and indistinctly in others. This method is used chiefly for small-quantity orders, rendering possible special and exclusive designs at a somewhat higher cost than possible with roller printing. Stenciling is used chiefly as special craft work.

Surface designs may be applied to woven fabrics by means of specially engraved rollers, heat, moisture, and pressure. Except in acetate rayons the pressed design is non-permanent, disappearing after a few washings. *See* Finishing of Fabrics, p. 61.

Borders and all-over designs may be applied to all types of woven fabrics by means of embroidering them on special machines. (*See* Embroidery, p. 50.) Open and cutwork effects are especially attractive, but for satisfactory service the threads which finish off the cut edges should be sufficiently deep in stitch and close enough together to keep the fabric from fraying.

Batik and tie-dye are two forms of resist dyeing by means of which designs are obtained on fabrics. (*See* Dyes and Dyeing, p. 48.) Batik is very extensively used in Java and tie-dye in India and Japan, but neither is used commercially in this country. Craft workers obtain interesting designs on velvet, but sheer silks, rayons, and cottons offer the best textures for this form of applied design.

Permanent or Swiss Finish. *See* p. 62.

Pile Fabrics. Fabrics with a pile are those so woven that extra threads in the warp or the filling are held in the form of loops at right angles to the ground of the cloth. The pile may be on one side only and cut, as in velvet, or uncut as in frieze, or it may be on both sides of the fabric and uncut in definite loops, as seen in Turkish toweling. (*See* Weaves, p. 189.) In some fabrics, notably velvet, the pile may be pressed flat during finishing processes, to create a more lustrous surface. *See* Velvet, p. 181.

Fabrics with pile, as those with nap, catch and hold dust and grit; consequently they should be brushed thoroughly and frequently. This is particularly necessary in wool and mohair pile materials used for upholstery and draperies, to ensure against the ravages of moths. The pile of dress velvets has a tendency to crush and flatten during wearing. It may be raised by holding the fabric over a container of steaming water, or pressed with the pile resting on the needles of a velvet pressing board.

Pillow Cases. These are made from sheeting muslin, percale, and linen, in narrow widths or in tubular form. As for sheets, the material for pillow slips should be judged for quality by the evenness and strength of the yarn, the closeness of the weave, and the freedom from sizing. *See* Sheeting, p. 127.

To avoid strain, the pillow case should be about 2 inches larger in width than the pillow; the length of the case is a matter of personal preference, being from 6 to 9 inches longer than the pillow, for its protection.

Muslin and percale tubing woven as double cloth is made in the following widths: 36, 40, 42, and 45 inches. Because of the presence of only one seam and for somewhat greater ease in ironing, many housewives prefer to use tubing for pillow slips.

Average size of cases and pillows:

Pillow	*Pillow Case*
20 by 28 inches	42 by 40½ inches
22 by 28 inches	45 by 36 or 45 by 38½ inches
24 by 30 inches	50 by 38½ inches

Printing of Fabrics. All evidence seems to bear out the belief that the application of color and design to woven cottons originated in India hundreds of years before the Christian era. The designs were apparently applied by means of brush work, resist dyeing, and stamping with carved wooden blocks. The Indian and Persian printed cottons, carried into Europe by Venetian and Genoese traders, stimulated the textile arts of England, France, and Germany enormously during the seventeenth and eighteenth centuries, though printed materials were known in Europe during the late Middle Ages. Not only the original Eastern textiles were much in vogue for costumes and housefurnishings among the Continental fashion leaders but those made in England and France as well.

Wooden blocks cut in relief were used at first, but in 1770 the brother of Christophe Philippe Oberkampf, who owned the famous print works at Jouy (*see* Toile de Jouy, p. 174), introduced printing by means of engraved copper plates. In the decade between 1770 and 1780 Thomas Bell of Scotland invented the engraved copper cylinder for printing the outline of a design on cloth, the colors being filled in later by hand. By 1785 Bell was using five cylinders, each one printing a color in the fabric, thus laying the foundation for the multiple-cylinder process in use today.

Block Printing. Printing by means of hand blocks is not in general use today in the United States, but beautiful hand-blocked linens for use on tables and as draperies and upholstering are made for customers desiring exclusive designs by firms and craftsmen equipped with the proper facilities. The design, transferred to the wooden block, is cut in relief about ¼ inch in depth, one block for each color. When the carved block has been impregnated with the dyestuff it is placed on the cloth laid on a padded table and hit with a wooden hammer to ensure even printing. When the color is thoroughly dry the next block carrying another color is placed on top of the first motif.

Printing by Rollers. Printed materials of all types are enormously popular at present and may be turned out at the rate of approximately 10,000 yards in a day by one machine.

The actual printing of the design on cloth, whether in two or twelve colors, consumes but a few minutes of time, but the transference of the accepted design to the copper rollers which do the printing takes many days, as the engraving must be meticulously done, otherwise any small flaw will show up on the fabric. After the design has been worked out on paper in the predetermined colors it is photographed and enlarged to bring out all details clearly. Next the enlargement is photographed on a zinc plate, engraved by hand, and placed in a pantograph; an operator then traces the lines of the design with a pointed instrument connected with a framework carrying diamond points which trace the design in its normal dimension on a varnish-covered copper roller. The roller is as long as the width of the cloth to be printed; the number of diamond points corresponds to the number of units of the design to be made across the fabric's width. As the operator guides the metal point around the enlarged design, pressure on a foot lever causes the desired number of units to be traced on the roll all at the same time. As many rollers as there are colors in the design must be so treated, covered with a coating of varnish, drawn upon, then immersed in a nitric acid bath which etches or eats into the copper along the lines drawn on the varnish coating.

The intaglio engraved rollers are next arranged in the printing press with a pan of dyestuff in a suitable thickening agent (starch, starch derivative, natural gum, or thickener derived from insoluble gums) placed under each roller. As the roll turns it picks up the color from the pan and a knife scrapes off all the dyestuff that has not dropped into the engraved lines. It is this color in the engraved lines which is pressed into the cloth as it comes into contact with the copper roller, each roll contributing its own color in designated units to the other units comprising the complete design.

In an unbelievably short time the printing is completed and the cloth ready to be run over heated rollers or through live steam so that the colors may be permanently fixed. This process is followed by a washing or a chemical treatment and calendering to render the fabric ready for sale.

Duplex Printing. Usually all printing by rollers is done on only one side of the material. For some purposes cloth printed on both sides is desirable, and the method of accomplishing this is known as duplex printing. Great care must be exercised to have the pattern fall exactly on itself.

Discharge Printing. A method used extensively today is that known as the discharge method, in which the piece goods are first dyed the color desired for the background, usually dark in value. With the same rollers used for direct printing the fabric is printed with a chemical substance, such as a formaldehyde sulphate, which discharges or destroys the dye already on the cloth, when subjected to after treatment. Very effective results are obtained by this means, but great care must be exercised to free the fabric completely from all chemicals, otherwise those threads on which the chemical was placed are weakened and will break when subjected to strain or friction.

Photographic Printing. This process is similar to photographic methods in newspaper and book printing, in which gelatin-chrome films are rendered insoluble in desired portions by exposure to light. In fabric printing, a clean copper roller is coated with a glue-ammonium-bichromate film. The design is worked out in the actual size on transparent paper, and colored to the shades desired. The principle of the following process is that of light filtration. Photographs are made of the design, with filters which allow only certain light rays to pass to the plate. The negatives thus obtained are transferred to the treated copper rollers, three or four rollers being used. The rollers are then exposed to strong light, which renders insoluble the portions of the coating to which the light has access through the negative, while the portions of the design which do not contain the colors photographed are not affected, hence the rollers have a protective coating only where the light has penetrated. Washing removes the soluble portions of the coating, and the rollers may then be etched to work out the pattern.

Photographic screen printing enables the transfer of designs in less time and with less effort. The silk bolting cloth of the screen is evenly and thinly covered on both sides with the same coating as is used for the above roller printing. After the transparent paper carrying the design is placed on it, with the inked side of the paper touching the silk, the screen is exposed to strong artificial light. This changes the exposed parts of the bichromatic film to an insoluble condition; the parts covered by the inked-in design are left in the original soluble state and can be washed out in a gentle stream of water. After a hardening bath, the screen is ready for the application of the dyes or paints, which will be carried through the open areas of the silk to the fabric on which the screen is placed.

Resist Printing. Frequently white or light-colored fabrics are printed in the desired design with a paste, then placed in the dyebath. The paste prevents the dyestuff from penetrating the parts which it covers; hence design and background are in different colors. *See* Dyes and Dyeing, p. 48.

Printing by Screens. Special and small orders for printed fabrics may be executed by means of screens rather than by rollers, as it is considered a more economical procedure. All classes of materials may be handled by this method, which is in reality a development of stenciling.

Over a wooden frame, the most usual dimensions of which are 4 by 6 feet, silk bolting cloth or brass wire cloth with very close meshes is tightly and evenly stretched. On this are outlined all those portions of the design that are to be the same color, each color requiring, therefore, a separate screen. The areas of the silk through which it is desired that the coloring matter should not pass are next filled with waterproof varnish, enamel, or other insoluble filler. The fabric to be printed is stretched on a long table, the felt-padded top of which is covered with oilcloth; the frame is placed over it, and the paste containing the proper dyestuff is pushed over the surface with a scraper. Before the frame containing the next color design is placed on the cloth the cloth must be well dried by fans or air ducts while on the table. After steaming, followed by a thorough washing in a hot soap solution, the fabric is ready for the dryer and a final calendering.

Discharge as well as direct printing may be done by using the screen method, a discharge agent being placed in the paste instead of dyestuff.

Warp Printing. A softened effect may be given to printed designs by printing the prepared warp yarns before they are threaded into the harness of the loom. The weaving is then carried on with plain colored filling yarns, the resulting fabric having designs with irregular edges that blend softly into the background color. This method is employed on warp-printed taffetas and cretonnes as well as in tapestry carpets. *See* Carpets, p. 13.

Vigoreux Printing. Worsted fabrics of mixed colored effects have the worsted fibers printed while in the form of slivers before drawing and spinning. (*See* Wool Manufacturing Processes, p. 204.) Fluted rollers print the wool slivers, which are then drawn, thus attenuating or extending the area of the printed sections. Spinning further mixes the colored fibers so that a decidedly variegated effect is obtained on both the finished yarn and fabric.

Pure-dye Silk. The terms "pure-dye" silk and "pure" silk are now under revision. A resolution on silk weighting by the Federal Trade Commission at a Trade Practice Conference April 21, 1932, reads: Silks "shall not be designated as pure dye if they contain in the finished state more than 10 per cent of any substance other than silk and/or other fibers (except 15 per cent for black)." Goods containing in a finished state more than 10 per cent of any substance (15 per cent for black) other than fiber or fibers shall be designated as weighted.

Pure Silk. A term used to designate a fabric that contains no fiber other than silk. Sometimes used to refer to pure-dye silk.

Pyroxylin Coating. *See* Finishing of Fabrics, p. 63.

Raincoats. The fabrics most generally used for raincoats are of wool, such as covert cloth and gabardine, or of silk. The silk used is a thin, light-weight material rendered waterproof by boiling it in linseed oil. Coats of this material are light and comfortable to wear but are expensive and likely to tear easily. New synthetic rubber coatings of excellent durability have been developed recently.

Light-weight but closely woven wool gabardine and covert cloth are made water repellent by treating them chemically to resist water. They are also coated with rubber and vulcanized at high temperature; this renders the fabric impenetrable to air as well as to water, making the garment very warm to wear. To ensure complete waterproofing, coats of rubberized fabric should have the seams cemented together rather than stitched by machine. As heat causes rubber to deteriorate, raincoats of rubberized fabric should be kept in cool cupboards when not in use. *See* Finishing of Fabrics, p. 64.

Ramie. The ramie plant, grown chiefly in China, Java, Japan, and India, is a species of nettle that reaches from 4 to 8 feet in height and produces a strong bast fiber that has many of the qualities of flax. To obtain the long, silky fiber the stalks are water-retted, degummed by a chemical process, combed, then drawn and spun into yarn. The combing and drawing processes separate the long fibers, known as line, from the short ones, or noils, both of which are used for fabrics, though of different qualities. The noils are generally used for canvas, wadding, and cordage. The fibers range in length from 4 to 72 inches, bleach well, have a high luster, but like flax are difficult to dye.

Ramie cloth, known as China or Canton linen and grass cloth, has a crispness which is enduring and makes very satisfactory doilies and luncheon cloths. These are embroidered by natives in the countries that produce the fiber and who also wear it in their native costumes.

Rayon. Rayon has been defined by Committee D-13 of the American Society for Testing Materials as follows: "The generic name of filaments made from various solutions of modified cellulose by pressing and drawing the cellulose solutions through an orifice and solidifying it in the form of a filament or filaments by means of some precipitating medium." The term *rayon* was adopted by the Federal Trade Commission in 1924. The definition of this Committee is: "The generic term for manufactured textile fiber or yarn produced chemically from cellulose or with a cellulose base, and for thread, strands or fabric made therefrom, regardless of whether such fiber or yarn be made under the viscose, acetate, nitrocellulose or other process."

The word *generic*, in the sense of pertaining to classes of related things, is comprehensive for manufactured filaments, since some of these are now made not from cellulose but from protein or other nitrogenous material. *See* Nylon, p. 102 and Vinyon, p. 183. However, the vast bulk of generic filaments is still made from cellulose, either in the form of cotton linters or spruce pulp.

History. It might be said that the silkworm is responsible for the creation of its greatest rival in the textile field, because for many years experimenters tried to produce filaments which would be the counterpart of natural silk. Réaumur voiced this compelling interest in his *Histoire des insectes*: "Silk is only a liquid gum which has been dried; could we not make silk ourselves with gums and resins?" It was seventy years before this, in 1664, that Robert Hooke, in his *Micrographia*, made a similar suggestion, and prophesied unwittingly in: "This hint, therefore, may, I hope, give some Ingenious inquisitive Person an occasion of making some trials, which if successfull, I have my aim, and I suppose he will have no occasion to be displeased."

Out of a long list of early experimenters the names of Audemars and Sir Joseph Swan emerge. Audemars, in 1855, received the first patent for making artificial silk, but he met mechanical difficulties in drawing out the filaments, and his work did not become commercially important. Sir Joseph Swan, an inventor in the fields of electricity and photography, succeeded in making collodion filaments which were denitrated, woven into fabrics, and exhibited in London in 1887. But his major interest was in his production of carbon filaments for electric lights, and he did not follow up his epoch-making creation of synthetic fibers.

Contemporaneous with Swan was Hilaire de Chardonnet, a research assistant of Pasteur in the Institut des Paris. Pasteur had saved the silk industry by discovering the cause and control of a menacing disease of the silkworm; his associate was to make commercially possible a future rival of that industry.

Chardonnet at first used mulberry leaves, but later cotton linters, for his basic material. He nitrated this cellulose, then dissolved the product in alcohol and ether, passed the solution through a spinneret to form filaments, and coagulated these by evaporation of the solvent. The almost explosive inflammability of the filaments was corrected by a process of denitration.

At the Paris Exposition of 1889 Chardonnet exhibited "artificial silk" yarn and fabrics. In 1890 his factory at Besançon, France, the first of its kind in the world, produced about 30,000 pounds of artificial silk yarn. Count de Chardonnet is called the "Father of the Rayon Industry."

In its early years artificial silk, still so called, had many weaknesses and defects, and was considered by some as a "basement bargain" commodity. But in less than a generation that dubious creation of textile chemistry has outgrown many defects and has become the fifth major textile fiber, finding many uses and making fabrics of durability, interest, and beauty.

Processes for Making Rayon. The method of production followed by Chardonnet became known as the nitrocellulose process, and for some sixteen years it was the only one used. It is now almost superseded by the viscose, acetate, and cuprammonium processes, but it is included below for purposes of historical record.

Whatever the process, the basic principles in rayon manufacture are:

1. The cellulose, either cotton linters or purified wood pulp, is brought into solution.

2. This solution is extruded through openings in a spinning device, called a spinneret.

3. The emerging material is hardened into filaments.

The Nitrocellulose Process

The Tubize Company established a factory in Belgium for the making of rayon by the nitrocellulose process, and in 1920 began production at Hopewell, Va. In 1934 the company discontinued the plant, and this process is not now employed in the United States. The method was essentially that of Chardonnet's; the cotton linters were nitrated to form a nitrocellulose; this was dissolved in the solvent and spun; the filaments were denitrated with ammonium or sodium sulphide, washed, bleached, and finished. The finished filaments were regenerated cellulose.

The Viscose Process

At present this is the most extensively used process. The name "viscose" is that of the viscous solution of cellulose in the manufacture. Cross and Bevan, the well-known cellulose chemists, discovered a new means of dissolving cellulose, and covered this "viscose" solution by British patents in 1895. Further developments followed, notably the invention by Topham of the centrifugal spinning box, all of which culminated in the modern production of viscose rayon.

In spite of the fact that for the manufacture of high-grade viscose rayon some three hundred controlled steps are involved, production is economical and the method has had phenomenal success.

The raw materials for viscose rayon are spruce wood or cotton linters. From spruce wood, the purified pulp, called alpha cellulose, is converted into alkali cellulose by treatment with caustic soda, and then into cellulose xanthate by treatment with carbon disulphide. Because it is orange in color, it has been given the name xanthate from the Greek *xanthos*, meaning yellow. Cellulose xanthate, when dissolved in a dilute solution of caustic soda, forms a viscous spinning solution. This is forced through the spinnerets, which are nozzles with very fine perforations, into a coagulating bath of dilute acid. Further processes are desulphurizing, bleaching, and finishing. A regenerated cellulose yarn is the final product.

The viscose process was the first to be introduced into the United States, in 1910, by the Viscose Company of America. Their original factory is located at Marcus Hook, Pa.

The Acetate Process

Cellulose acetate was used as a "dope" or varnish for airplane wings at the time of the World War. Growing out of that use, the product has been developed until the process of making cellulose acetate filaments is extremely important, and the output is rapidly increasing. Several companies are making yarns by both the viscose and the acetate methods.

Briefly, the process consists in forming cellulose acetate by treating purified cotton linters with acetic anhydride and glacial acetic acid, with a catalyst. This acetylation must be carefully conducted in order to form the desired secondary acetate. When put in water, this acetate forms flakes, which are dried and dissolved in acetone. Dry spinning follows, the acetone evaporating in an upward current of warm air, and leaving behind the dry cellulose acetate filament.

Acetate filaments differ chemically from other rayons. They are a cellulose ester; most others are regenerated cellulose. This chemical difference places acetate rayon in a unique position in regard to certain properties, which are described later.

The Cuprammonium Process

Cotton linters are the raw material used. They are purified, then dissolved in a mixture of basic copper sulphate and ammonium hydroxide, known as the cuprammonium solution. After filtering, the solution is ready for spinning. Cuprammonium yarn as produced by the American Bemberg Corporation is spun by stretch spinning. As the filaments emerge from the spinnerets they pass into glass funnels through which water flows, the slow downward movement of which stretches the filaments to a fine, round form resembling natural silk. An acid bath finishes the coagulation of the filaments. After removal of the residual copper compounds and further finishing, the yarn is regenerated cellulose multifilament in character.

Rayon Manufacture in the United States. Manufacturing companies have increased rapidly within the last one or two decades, new geographical areas have been brought into prominence, and new names for the products have come to the notice of the consumer. Some of the leading manufacturers, with their types of rayon, follow:

Manufacturer	*Type of Product*
The Viscose Company	Viscose and acetate
Du Pont Rayon Company	Viscose and acetate
Celanese Corporation of America	Acetate
American Glanzstoff Corporation	Viscose
Industrial Rayon Corporation	Viscose
Tubize Chatillon Company	Viscose and acetate
American Bemberg Corporation	Cuprammonium
Tennessee Eastman Company	Acetate
American Enka Corporation	Viscose

From Manchester, N. H., down into Georgia, the factories engaged in rayon manufacture dot the Eastern States, following the Piedmont region because of the abundant water supply there.

In 1938, rayon filament yarn production in the United States was 257,916,000 pounds, with 29,833,000 pounds of staple yarn. (*See*

p. 121.) The estimated world production for that year was 975,000,000 pounds of filament yarn and 925,000,000 pounds of staple yarn.

About twenty countries are now producing rayon, Japan leading in output. In order of production, the United States, Germany, Great Britain, Italy, and France are the principal producers after Japan.

Characteristics of Rayon. Rayon is the only fiber, other than silk, which produces yarns without the long and expensive processes required by short fibers. It is superior to natural fibers in that filaments of any desired size, length, and luster can be produced, so that fabrics more varied in construction and use can be made from rayon than from natural fibers. Its production is not dependent upon climate or season; therefore, so far as these factors are concerned, it has stability of production and cost. If improvements in its properties continue to be made as rapidly in the future as in the past it will become still more valuable.

Luster. The early rayon yarns were distinguished by too brilliant luster. This has been controlled by mechanical and chemical means, to meet fabric requirements and the demands of good taste. Mechanically, the effect of stretch spinning is to produce fine filaments, multifilament yarns, and a breaking up of surface reflection in consequence; hence Bemberg yarns have a naturally low luster. Other mechanical means are employed, such as corrugating the filament surface. White pigments have been used, the common one being titanium dioxide, which is dispersed in the solution before spinning, and which gives a dull, chalky appearance. Several synthetic organic compounds with pigment qualities are replacing the titanium dioxide, however, because of the weight of that substance. Acetates may be delustered by boiling water or by partial saponification. *See* below.

Strength. Because, in dissolving cellulose, the molecular structure is thrown out of its natural alignment, rayon filaments do not have the native strength of cotton, silk, and other natural fibers. The filaments produced by stretch spinning gain strength by this process, because of some realignment of the molecules due to the lengthwise stretching. Since there is not this molecular cohesion in rayons as a class, they lose strength when wet, their wet strength being from 40 to 70 per cent of their dry strength. This is a drawback in manufacturing, since most rayons absorb moisture easily and are affected by the humid atmosphere which is an advantage in the spinning and weaving of other fibers. Cellulose acetate filaments are most resistant to water; therefore, their wet strength is higher in proportion to their dry strength. Bemberg yarns have the highest inherent strength because of the stretch spinning process, their multifilament yarns being stronger than those of the same denier with fewer filaments, other things being equal. With care in laundering rayon fabrics, their temporary loss of strength causes no inconvenience. The original strength is regained on drying.

Elasticity. Again, the lack of cohesive arrangement of the molecules in rayon tends to destroy even the low elasticity of natural cellulosic fibers. Rayons may be elastic up to about 2 per cent; after that they are ductile, they stretch but do not spring back. If heavy rayon garments are hung to dry, they are likely to stretch out of shape. Both stretching and wrinkling, however, are influenced by kind of weave as well as the fiber.

Effect of Perspiration. Rayons are not weakened by perspiration to the extent that silk is; therefore, they are suited to coat linings. Acetate rayon is the least affected, owing to its resistance to moisture.

Yellowing. White rayons do not turn yellow with age and laundering.

Mildew. Rayon does not easily mildew.

Warmth. Rayon is a better conductor of heat than silk is; it is cooler next the skin and feels cooler in the hand. Fibers from nitrogenous material do not show this difference. Fabrics made from staple yarn feel warmer than those from long filaments, because more air is held in the short fibers of the yarn.

Slippage. Smooth rayon filaments have little natural adherence; therefore, in some weaves there is slippage of the threads and fraying at the seams. Weaves have much to do with this, however, and staple yarns show little slippage.

Shrinkage. Shrinkage is largely a matter of cloth construction; nevertheless, rayons tend to shrink. Gentle stretching of the fabric while wet will overcome much of the difficulty.

Surface Characteristics. Acetate rayon has a harder surface than other rayons, which as a rule does not lend itself to crêping. Therefore acetate crêpes are generally acetate warp and have either silk or viscose rayon in the crêped filling. Recently an acetate staple yarn has been produced with a permanent crimp. A certain degree of heat will melt acetate rayon; therefore, by the use of hot engraved rollers it is easily pressed or surface-finished to create permanent designs. The most lasting moiré is produced on acetate fabrics in this way. In laundering, acetate weaves hold impressions made by wringing or twisting the material while wet. To avoid this, keep the material as flat as possible in washing and drying.

Ironing. Acetate rayon melts at the heat of a moderately hot iron, or at about 12° less heat than will scorch silk. An iron set at low heat control, and a pressing cloth, will enable acetates to be ironed without damage. Other rayons are ironed with the care given to any fine fabric.

Dyeing. The dyeing properties of regenerated cellulose are similar to those of cotton. These rayons have good affinity for direct cotton colors and for vat dyes, and the dyes have good permanency. The dyeing of acetate rayon is discussed under Dyes and Dyeing, p. 47. Since acetate filaments will not take the dyes used for other rayons, interesting cross-dyed effects may be produced by dyeing a fabric of mixed yarns in the same bath, or by saponifying acetate yarns in regularly recurring areas which alternate with unsaponified ones, and dyeing in one bath. The saponified sections will dye with cotton colors; the unsaponified parts remain undyed.

Saponification. This is a process applied to acetate rayon, which, as has been said, is cellulose acetate, an ester. Saponification breaks down or hydrolizes the ester and produces cellulose and acetic acid, or sodium acetate if dilute sodium hydroxide is the saponifying agent. The point is that the filament, on the surface at least, is no longer an acetate but a regenerated cellulose rayon, capable of taking the same dyes as other rayon and not susceptible to melting under heat. Hot baths of sodium hydroxide in dilute solution will saponify either lightly on the surface or deeper, according to time and other conditions. Filaments or fabrics so treated are "iron-proofed." An application of saponification to cross-dyeing is mentioned above. Saponified acetates become leathery in acetone but do not entirely dissolve.

Rayon Staple. Rayon staple fiber, cut from ½ inch to 9 inches long, constitutes another source of textile material. The short fibers can be handled on regular cotton- and wool-spinning machinery. To produce staple fibers, the threads from a number of spinning jets are collected during the spinning. This forms a heavy yarn which is cut into the desired staple lengths. By cutting the yarn while wet, the individual lengths wrinkle and curl to some extent, which is an aid in carding and spinning. Curly rayon staple may also result from treatment with resins. For cotton-spinning machinery the staple is usually just under 2 inches in length; for wool spinning it is longer. Most of the newer fibers from protein or proteinlike bases are produced as staple fiber. Fabrics from staple yarns are dull and soft, and can be made to feel and look like other materials such as wool goods. They have less slippage and more elasticity than long-filament rayon fabrics.

Spun rayon weaves include linen-type hopsacking, worsted-type hopsacking, nub sheers, herringbone novelties, and suitings, especially wool mixtures in men's suitings.

Care of Rayon. With the exception of wet strength, ironing temperature and creasing of acetates, and undue stretching of heavy garments if hung to dry, rayons offer no laundering problems, and can be washed or dry cleaned, as the case may be, with the care given to any fine fabric. The dyes are usually fast on rayons. Bleaches may be used with care, as on cottons.

Certain solvents and stain removers used formerly in dry cleaning establishments rather than in the home have the power to dissolve acetate fabrics. These cause little or no trouble at present because the professional dry cleaner understands this and can recognize such fabrics. Nail polish removers, however, usually contain acetone, and must not be brought in contact with acetates.

Rayon Fabrics. Rayon has taken over the names, weaves, and finishes, to a large extent, of the older fibers and fabrics. For example, we have rayon satin and taffeta, rayon alpaca and voile, rayon crêpe. Viscose yarns make a variety of types, from sheer to heavy fabrics, such as crêpes, twills, semi-sheers, alpacas, jerseys, velvets, brocades, nets, taffetas, and upholstery fabrics. Cuprammonium yarns (Bemberg) are found in triple sheers, chiffons, ninons, nets, satins, suitings, and in combination weaves with wool, mohair, and rabbit's hair. These yarns, because of fineness, are well adapted to very sheer fabrics. Acetate yarns, besides making moiré of permanent pattern and most of the fabrics produced from the other rayon yarns, are frequently combined with one of these rayons or with other fibers for novelty and cross-dyed effects.

The Federal Trade Commission has ruled that when names such as taffeta, crêpe, and others, heretofore recognized as silk fabric terms, are used, the word rayon must clearly appear on label and advertisement, if the fabrics are made partly or entirely of rayon.

Reclaimed or Reworked Wool. This term is defined as wool which has been reconverted into a loose fibrous state, after having been spun, woven, knitted, felted, or otherwise made into a wool product, and also wool card waste. In contradistinction, "virgin" wool has been defined as wool that has never been spun, woven, knitted, or felted or used for any other purpose, but may include soft wool yarn waste not containing reclaimed wool. These definitions are used in a Truth in Fabric Bill S 3502 which was under consideration by the Committee on Interstate Commerce in the Spring of 1938, and which was recommended for enactment by the Committee.

Up to this time, the definition of virgin wool has included wool card waste, but as this is so inferior to soft wool yarn waste it is classed, according to this Bill, as reclaimed wool.

The purpose of Bill S 3502 is to protect producers, manufacturers, and consumers from the unrevealed presence of substitutes and mixtures in fabrics. Briefly, it provides that

> misbranding goods in interstate commerce shall constitute an unfair method of competition and an unfair and deceptive act or practice. Goods would be deemed misbranded unless they were tagged, stamped, labeled, or otherwise identified to show the percentage by weight of virgin wool, reclaimed wool, and other fibers . . . and the maximum percentage by weight . . . of any matter other than fiber or dyes contained therein, if the percentage by weight of all such matter amounts to 3 per cent or more of the total weight of such wool product. . . . No product can by any device be represented as a woolen product if it contains less than 51 per cent of wool.

For many years, reclaimed wool has been used in woolens, where carding allows the use of shorter wool fibers. It has been necessary to extend the wool supply by this means, and when the reclaimed wool is of high quality, often better in many respects than some grades of virgin wool, cloth of good construction containing reclaimed and virgin wool is durable.

The best grade of reclaimed wool is from "softs," or material which has not been felted. Hosiery, blankets, sweaters, and similar fabrics yield fibers which are not necessarily broken or torn. A poorer grade consists of fibers obtained by tearing apart felted goods, since the fibers suffer some breaking and mangling in the garnetting machine. Still poorer grades may come from fabrics of mixed wool and cotton yarns, from which the cotton is first removed by acid and heat in the carbonizing process.

There is no satisfactory test for reclaimed wool as distinguished from virgin wool; the microscope may show differences, but more often does not.

Other than the shortness of fiber, which may or may not characterize reclaimed wool, the chief criticism of the product is that in the previous manufacturing processes some elasticity is destroyed, so that wool goods containing a high percentage of reclaimed wool are likely to feel harsher and wrinkle more than corresponding material from good virgin wool.

Regenerated Silk. A process has been patented recently for converting all types of raw silk waste into skein yarns by means of completely boiling off the gum, dissolving the fibroin in a chemical, permitting the solution to age, then spinning it on a spinning machine that resembles the one on which rayon is produced. When solidified in an acid bath and thoroughly washed the silk is wound into skeins.

Regenerated silk does not play an important part commercially, as the yarn resulting from the process does not possess satisfactory strength and elasticity.

Revertex. Natural milk of the rubber tree from which the water is removed, so that concentrations up to 75 per cent are obtained. It is used for non-slip rug backings, and for impregnating cottons, velvets, silk, rayon, and felt to make artificial leather and suede cloth. Combined with cement, cork or wood chips, sisal, ground rubber waste, etc., it is used in the manufacture of domestic and industrial floorings.

Ribbons. These are narrow fabrics of silk, rayon or metallic threads woven on special looms, called ribbon looms, several pieces at a time, and are made in plain, cord, satin, figured, pile, and double cloth weaves. *See* Weaves, p. 184. The edges of ribbon have a cordlike finish instead of the selvedge found on broad silks. Some cheap-quality ribbons are woven in a broad width, then cut into strips of the width desired; another type consists of two light-weight strips pasted together. With washing and dry cleaning these pasted ribbons separate. The Federal Trade Commission has promulgated a ruling that ribbons must be labeled as to their type of selvedge and whether or not they are cut or pasted ribbons.

For the best-quality ribbons reeled silk is used, spun silk for the less expensive types. Transparent velvet ribbons, like the broad transparent fabric, are made with rayon pile and silk ground. In satin ribbons, with face of one color and back of another, two sets of warps, each of a different hue, are interlaced with a single filling thread in the double cloth weave.

Taffeta ribbons are sometimes either direct or warp printed (*see* Printing of Fabrics, p. 113) with floral or geometric designs as well as given a moiré finish. Satin ribbons are frequently finished with a lacquer or wax, ciré, as are broad silks of the same weave.

Ribbons vary in width from the very narrow ⅛-inch "baby" ribbon to 10-inch-wide sash ribbon.

Laundering Ribbons. Ribbons may be successfully washed by stretching them on a table and scrubbing them with a small brush and soap until they give up all soil. They should then be rinsed in clear water without crushing them, some of the water being removed by running the ribbon between the fingers. The ribbon should then be stretched on the table and permitted to dry.

Rug Cushions. The life of a rug is prolonged by the use of a cushion between it and the floor. The best types are made of cowhair felt treated to render them mothproof.

Rugs without Pile. Inexpensive rugs for hallways, porches, and cottages are made without pile from such materials as grass, sisal, rags, hemp, flax, fiber made from wood pulp, and combinations of wool and fiber. The warps are usually of cotton tightly twisted. Such rugs are cool, easily cleaned, and made in plain colors or with designs usually stenciled on. Some fiber and grass rugs are processed to make them resistant to sunlight and water.

Grass rugs have for their filling a specially cured grass grown in part of western United States, the Philippines, and China, bound into a uniform rope with a cotton strand or twine.

Sisal rugs are made of the leaves of the sisal plant, which grows in the West Indies and Central America.

Flax rugs have coarse flax as a filling and are considered especially durable.

Fiber Rugs. Sheets of paper made from spruce or fir pulp are cut into strips and twisted to form the weft for this type of rug, which is found in plain and twill weave. For firmness and resistance to water a fiber rug is subjected to a sizing process.

Wool-texture rugs are those made with both fiber and carpet wool used as weft and fiber as the warp. These rugs naturally lack something of the harshness of the all-fiber rug, are reversible, and are woven in broadloom fabrics as well as rugs.

Rag Rugs. A very serviceable, easily washed, and light-weight rug made of a warp of cotton and a filling of strips of fast-color cotton rags. *See* Carpets and Rugs, p. 16.

Sanforizing. *See* p. 63.

Saponification. *See* p. 121.

Seconds. These are knitted or woven fabrics or articles with some imperfections in their construction. They are labeled "seconds" or "irregulars" in sheetings and sold at a lower price than perfect goods or "firsts." Frequently the slight flaw can be strengthened by the purchaser, or the imperfection, as in hosiery, may be in an inconspicuous place so that a satisfactory purchase may be made at slight cost.

Selvedge. The finished warpwise edge or narrow border of woven fabrics is known as the selvedge. It is of a plain, close weave, sometimes of heavier yarns than the body of the material, and is for the purpose of strengthening the fabric. It usually shrinks differently from the rest of the material and for this reason is removed or clipped in the making of curtains and garments.

A mock selvedge is sometimes found on inexpensive towels. Two towels are woven as one wide one with a stripe in plain weave of about ¾ inch through the center. The fabric is then cut in two through the center of this stripe and the raw edges are overcast on a special machine. This type of selvedge will not wear well.

A tape selvedge is wider than the ordinary selvedge and is reinforced to give extra strength to the edges. Tape selvedges are found on sheets of very good quality.

Sewing Silk. This is usually made of high-grade silk from Japan and China, though some cheaper spool silk is made of spun silk, which, however, does not have a high degree of elasticity.

In the manufacture of sewing silk the preparatory processes consist of sorting the raw silk for size of fiber and soaking it in warm water and soap suds to soften the sericin or gum. When dry the skeins are placed on the winding frame and wound on bobbins, which in turn are taken to the doubling frame where several threads from several bobbins are combined and wound as one on another bobbin. Still another machine, "spinner," spins these combined strands into one thread, the number of turns per inch, few or many, depending on the type of silk thread desired. On the twisting machine, two strands for sewing silk, three for machine twist, are twisted together in opposite directions. Stretching, dyeing, degumming, and the application of live steam for bringing out the luster are the finishing processes through which the skein silk must pass before being wound in 100- or 50-yard lengths on spools for retail use, or on spools or cones containing several ounces for manufacturing purposes.

Silk for use in embroidery is very slightly twisted. A number of slightly twisted singles are doubled, then given a loose twist in the opposite direction. Buttonhole twist, on the other hand, is a heavy and hard twisted silk used for the making of buttonholes on tailored cloth garments and comes on small spools holding about 10 yards.

Silk thread is made in several sizes each designated by a letter, E, D, C, B, A for the coarser sizes and 0, 00, 000 for the finer sizes. E and D indicate buttonhole twist, and A the spool silk that is most commonly used.

Sewing Threads. Thread for sewing differs from thread or yarn used for weaving in the nature of the doubling and twisting to which it is subjected to obtain the strength needed.

Shades. Before the World War most shade cloths were made of high-grade linen. Today this has been largely supplanted by cotton with cambric of varying qualities used for the base. High-count cambric, about 72 or more threads to the square inch, is used for the better qualities, while a thin, sleazy cotton with 64 threads or less per square inch is found in the cheapest qualities. Plain weave, found, of course, in cambric, is most generally used, though a twilled cotton cloth base which is suitable for shades that receive especially hard wear, as in institutions, is on the market.

Holland shade cloth, either linen or cotton, imported or domestic, is considered very durable and will not develop pinholes after it is hung and in use. It is manufactured in stripes or with a moiré design obtained by calendering over hot engraved rollers.

The wearing qualities of cambric shade cloth depend not only on the grade of the material used but also on the finish it receives. Handmade shades are carefully stretched in frames so that the threads are perfectly straight; they are glue-sized and later painted by hand with linseed oil paint. If a completely opaque shade is desired a coating of dark paint is sometimes given to one side of the cloth and a light color to the reverse side. Handmade, oil-painted shades may be washed flat on the table with soap and water. The cheap variety of shade is machine-made, treated with a filler of starch or clay to cover up the interstices of the loosely woven cambric, and painted with water-color paints. It is not washable and will crack and pinprick with use. Shades may be rendered water repellent by coating them with a thin layer of pyroxylin.

Sheeting. Unbleached, bleached muslin, fine percale, and linen may be purchased by the yard, the cotton in a variety of widths from 36 to 108 inches, the linen 72 inches, and made up into sheets of the length desired. Unbleached muslin makes a very durable, practical sheet that after several washings becomes whiter without loss of strength resulting from initial bleaching by chemicals.

Sheets and Sheeting. Although cotton sheets are more generally used in this country than any other variety, sheets made of linen and of silk are found on the market today, the silk ones coming under the classification of luxury goods and consequently sold in exceedingly small volume.

Linen sheets are hygienic, cool, and pleasant to feel, but they are not comfortable in cold weather, they muss very readily, and are very expensive, costing approximately four times as much as a muslin sheet of the same dimensions.

In purchasing cotton sheets or sheeting by the yard the housewife is beginning to find labels which give some information as to thread count and tensile strength of the sheet in question, as well as its size before hemming. Some authorities claim that further information as to the weight of the sheet in ounces per square yard, the percentage of dressing, and whether of first or second quality should also be included on a truly informative label.

Smooth, firm sheets are closely woven of well-spun, even yarns of medium- or long-staple cotton approximately 1 to 1½ inches in length. Unevenly spun yarns contain many thick and thin places and will break under strain and cause weak spots in the fabric. Such a defect should normally place a sheet in the "seconds" class, and it should cost less than a sheet of the first class. Sometimes when reinforced by the housewife with extra threads before using, such a sheet will give very satisfactory service. Extremely fine yarns, though giving the cloth a pleasing texture, do not necessarily wear well. Percale sheets have finer yarns, of long, combed staple, as well as higher thread count than the regulation muslin sheets.

The thread count of a sheet means the number of yarns or threads per inch lengthwise, warp, and crosswise, filling. The number of warp threads is stated first; for example, "68 by 72" means that there are 68 warp threads and 72 filling. Thread counts, in sheeting specifications, refer to the count of the greige goods. When the number of yarns in warp and filling are the same, the sheeting is spoken of as "square." The durability of a sheet depends on the closeness and compactness of its weave as well as on the size and twist of its yarns. The balance or the proportion of threads running each way of the material is important, as one with many more threads in the warp than in the filling, or vice versa, will probably tear under slight strain. In percale sheets the thread count averages about 100 by 100, or more, in good quality.

The tensile strength of a sheet is rarely stated on a label but is one indication of its probable wearing qualities. The Federal Government requires that the minimum tensile strength of sheets purchased for use in its hospitals and institutions shall be 70 pounds in the warp and 70 pounds in the filling for a 68 by 72 sheet. (*See* Textile Tests, p. 168.) Until this information is stated on labels about the only way in which the consumer can judge for herself something of the breaking strength of the sheet she is buying is to pull the fabric first lengthwise, then crosswise, and compare these results with those of other sheets.

Poor-quality sheets are loosely woven and then heavily sized with starch to fill in the interstices, which after a few washings give up the sizing. A slight amount, 2 per cent, is considered permissible to give a good appearance and to keep the sheet looking fresh while on the merchant's shelves. However, the amount found in a sheet may vary from about 2 per cent or less for a 68 by 72 sheet of good quality to 20 per cent in poor-quality merchandise. A 64 square may have 5 per cent of sizing. By holding the sheet to the light to see if there are patches of sizing or by rubbing the fabric briskly between the hands and over a dark fabric one can detect the presence of excess amounts of starch.

Institutions usually specify the weight or the number of ounces of cotton in a square yard of unsized sheeting, varying from 3 to 5 ounces, for their sheeting purchases and because they buy in large quantities they can readily obtain the correct information. The average consumer, however, is rarely given this information; again, she must rely on her own judgment and roughly weigh in her hands two sheets of the same size and, so far as she can tell, the same thread count. Even then she is not certain how much of the weight in each article is sizing. The heavier sheet stays in place better on the bed but on the other hand is more difficult to launder if washed at home, and more costly if done at a commercial laundry at poundage rates. Muslin sheets come in three weights: light, medium, and heavy; percale ones are light and medium weight.

Sheets of muslin, percale, or linen should be clear white. Bleaching does to some extent harm the cotton and linen fibers, but modern housewives prefer the bleached sheet to the enduring unbleached sheet of a former generation. There are many attractive colored sheets on the market, but they present a problem in laundering, as they cannot be boiled and should not be hung in the sun. Sheets dyed with vat colors (*see* p. 46) retain their color better than those dyed with other dyestuffs.

Hems and selvedges play an important part in the wearing quality of sheets. The selvedges should be firmly and closely woven and fairly wide, the tape selvedge having extra threads to ensure strength. Hems should be evenly turned after the fabric has been torn from the bolt, not cut, and securely fastened at the ends. The width of the hems is usually 1 inch at the bottom and from 2 to 3 inches at the top, though the tendency is to have the same width hem at top and bottom so that the sheet may be reversed on the bed and the strain on the sheet not placed at the same place all the time. The machine stitching should be approximately 14 to 18 stitches to the inch. Hemstitching, either by hand or by machine, makes a more decorative finish than a plain-stitched hem but does not wear so well.

For comfort, neatness, and the protection of mattress and blanket sheets should be both long and wide enough to be tucked in about 7 inches at each side, top, and bottom of the mattress. This means that the purchaser must know the length, width, and thickness of the mattress when purchasing sheets. In addition, about 5 per cent of the length of the sheet should be allowed for shrinkage.

The following table of sizes is for beds of average size:

Crib	*Single or Cot*	*Single or Twin*
45 by 64 inches	54 by 99 inches	63 by 99 inches
45 by 72 inches	54 by 108 inches	63 by 108 inches
45 by 75 inches		
50 by 72 inches		

Three-quarter	*Double*
72 by 99 inches	81 by 99 inches
72 by 108 inches	90 by 108 inches

Shirtings. As the material used in shirts for men and boys must undergo innumerable washings and is constantly subjected to severe strain, good quality is essential for satisfactory wear. The weave should be firm, the balance of the warp and filling close, the tensile strength high, the color fast to washing, and the material guaranteed not to shrink. Since the promulgation by the Federal Trade Commission of rules regarding the labeling of washable cotton fabrics, it should no longer be necessary for men to endure the discomfort of tight neckbands and short sleeves due to excessive shrinking and meaningless labels.

The materials most commonly used in shirts are percale, plain or printed, birdseye piqué, poplin, cotton broadcloth, madras, and oxford cloth; flannel, hickory, khaki, and chambray render excellent service for work shirts. Silk broadcloth, pongee, habutai, and tub silks are used for shirts of the formal type.

Knitted fabrics in cotton, rayon, or silk are very frequently used for sport shirts. The elasticity of knitted fabric makes it highly desirable for that type of shirt.

Shirts of colored and silk fabrics should be washed with care in mild soap and not too hot water and should be hung in the shade to dry. White silks will turn cream color after several washings. *See* Cotton Fabrics, p. 30; Silk Fabrics, p. 137.

Shower Curtains. A number of fabrics and treatments are found in this type of article. Closely woven cottons, treated with chemicals in the sizing to give some resistance to water, were the first fabrics of this sort. Their great disadvantage is that they do get wet, are slow to dry, and mildew easily. Rayon materials, especially cellulose acetate rayon, offer greater resistance both to water and mildew. These are attractively designed and are found with thin rubber or pyroxylin coatings but still in a low price range. New chlorinated rubber coatings are excellent. Oiled silk curtains give the highest resistance to water of the thinner fabrics; they are easy to keep clean, are very inexpensive, and come in a range of colors. *See* Oiled Silk, p. 102; Waterproofing under Finishing of Fabrics, p. 64.

Shrinkage. Shrinkage may be desired or undesired. Desired shrinkage is discussed under Fulling and Felting (p. 53) and Sanforizing (p. 63). Factors in the shrinkage of fabrics are the nature of the weave, the kind of fiber, and the temperature, detergent, and handling employed. Successful laundering of shrinkable fabrics requires considerable intelligent skill and knowledge of fiber characteristics.

Wool fibers become softened and somewhat plastic in hot water, especially in hot alkaline solutions, and tend to crawl or creep up in the mass. If rubbing or other friction is used while in this condition, the creeping tendency is increased and the plastic fibers cling together. No doubt the scales aid this felting action, because such hair fibers as mohair, having only faint scales less definitely overlapped, shrink less than wool fibers under the same conditions of laundering. To avoid shrinkage as much as possible, in washing woolens, water at about blood heat, a mild soap, and above all gentle handling, are essential.

On June 30, 1938, the Federal Trade Commission promulgated Trade Practice Rules on the subject of shrinkage of woven cotton yard goods, for the purpose of prevention of misrepresentation, deception, and other unfair practices relating to shrinkage, in the sale or distribution of such goods, and for the purpose of establishing proper designations and descriptions to be used in the marketing of such merchandise. In principle the rules are applicable to cotton garments as well as yard goods, and prohibit false or deceptive labeling of these as to shrinkage. As an instance, the terms "pre-shrunk" and "shrunk" are prohibited when the goods are likely to shrink substantially, having residual shrinkage left in the material. Nor can the product be labeled shrinkproof, "will not shrink," etc., unless it is free from residual shrinkage. Goods may be described as "Preshrunk (or shrunk) . . . [if they] will not shrink more than . . . per cent when tested by Commercial Standard Shrinking Test CS59-36 or CCC-7-191a of the National Bureau of Standards."

Not only wool and cotton, but also other fibers and their finished goods, may be laundered with a minimum of shrinkage if proper methods are followed. These are discussed under the sections on care of textiles. *See* Textile Tests, p. 168.

Silence Cloth or Table Pads. For the protection of highly polished dining tables and the lessening of noise from dishes good housekeepers use a silence cloth under the damask cloth. This is usually a soft, thick, cotton fabric made in double cloth weave and heavily napped on both sides. This should be cut to fit the table top and the edges finished with blanket stitching. Quilted cotton padding is frequently used as well as the more expensive but highly satisfactory asbestos pads that are covered with flannel or felt and made in sections for greater ease in handling and storing.

Silk. According to legend, the origin of this fiber so highly prized by Orientals and Occidentals alike for many thousands of years is ascribed to China. About 2300 B.C., Hsi-Ling-Shi, the young wife of the third Emperor of China, is said to have discovered how to reel silk from the cocoons of the silkworms, which she later wove into a robe for the emperor. For nearly two thousand years the Chinese kept secret their method of obtaining the silk fiber, selling their yarns and woven products to the Persians, through whom these valued wares became known to the peoples of the Mediterranean countries. In A.D. 555, the Roman Emperor Justinian bribed two monks to bring back from China in the hollow of their pilgrim's staves a quantity of the silkworm eggs, and with these he set up the silk industry within the eastern borders of the Roman Empire. The industry soon spread to the west into Italy, Spain, and France, sporadic attempts at silk culture being made in the United States in the seventeenth and eighteenth centuries. Today the throwsters and weavers of silk in this country obtain their raw silk from Japan, which at present heads the list of silk-producing countries. China and Italy, Bulgaria and Mexico, are constantly increasing their output.

Silk Production. Silk is the excretion from two small glands between the head and prolegs of the silkworm. The two strands of filament are ejected by the 3-inch-long worm from the tiny spinneret just below its mouth, during the three days in which the worm is spinning the cocoon within which it changes into a chrysalis. Between two and three weeks are required for the development of the moth, which breaks through one end of the cocoon and lays the many minute eggs which in turn hatch into worms and complete the life cycle.

The eggs of the cultivated silkworm, *Bombyx mori*, are laid on sheets of cloth or tissue, and sometimes placed in cold storage until the grower is assured of a plentiful supply of fresh mulberry leaves for the voracious worms. The cultivated silkworm is fed for about a month on chopped leaves of the dwarf white mulberry tree, and carefully tended during its short existence. Only the very best cocoons are permitted to be pierced, so that the best moths may lay eggs for future supplies of worms and cocoons. The wild silkworms feed upon the leaves of the white oak tree and produce a silk that is ecru in color, and coarse and irregular in texture. (*See* Wild Silk, p. 201.) It is used chiefly for making pongee, tussah, and shantung, and is rather difficult to dye.

The color of cocoons of the cultivated silkworm varies from a bright yellow to white, the pigment being derived from the gum, sericin, which holds the filaments of silk proper, fibroin, together. The sericin is boiled off in the process of manufacture, and the cultivated silk is left its natural color of white or cream. The wild silk, on the other hand, remains ecru after the partial or complete removal of the sericin.

When the silkworm pierces the cocoon and emerges the filaments of silk are cut into short lengths as a result. These, together with the filaments brushed from the outside of the cocoon during the reeling process, known as floss, are spun into yarns to be used for filling threads and the pile of some velvets. Spun silk fibers lack the strength of the continuous filament but possess the other characteristics of this highly desirable fiber. *See* Spun Silk, p. 145.

Reeled or Raw Silk. The unwinding of the silk from the cocoon is now usually done in filatures, buildings equipped with facilities for softening the sericin and winding the strands of silk into skeins. The apparatus may be driven by hand or by machine. In many sections of the Orient the reeling of silk is still done on the small farms where the worms are cultivated.

When the silkworm has finished spinning the cocoon, the living organism is killed by placing the cocoon in large drying ovens, in containers holding hot water, or by refrigeration. As a strand from a single cocoon is too fine for manufacturing processes, the filaments from several cocoons are wound together. In the process of unwinding the silk filament from the cocoon in a continuous strand, from 300 to 700 or more yards in length, the cocoons, after careful sorting, are placed in basins of hot water so that the sericin may be softened. With a small brush the reeler brushes the cocoons, unwinding the loose, fluffy silk covering, until she secures the end of the filament. This is combined with the ends of four or more cocoons and threaded through the perforated agates and guide eyes and attached to the drum of the reel. On this, operated by hand or by steam, the combined fibers are held together by the wet, gummy sericin, and wound into skeins.

The process of reeling requires great care on the part of the operator, as the uniformity of the thread depends upon the joining together of the filaments. The diameter of each filament varies throughout its length, being thin at the beginning and ending, and thicker in the center. Several filaments, therefore, must be joined in such a way as to produce an even, smooth thread. Threads of various sizes are obtained by combining the strands from four to ten cocoons. The actual size of silk threads is determined by weighting a certain standard length in grams, and is called the denier of the silk.

When removed from the reel, the silk is in the form of skeins of varying lengths, particularly when reeling is done on small farms. It is graded according to color, and is then prepared for sending out. For ease in shipment, the skeins are tightly twisted and tied into bundles called "books," each weighing from 4 to 6 pounds, and these in turn are packed as bales and wrapped in tea matting. The silk bales of the Orient weigh approximately from 140 to 145 pounds; those from Italy, 200 pounds.

The process of reeling is carried out in the countries where the silkworm is producd; the manufacture of the raw silk into yarns for different types of fabrics is done in the United States by the American purchasers of the raw silk. It is estimated that between 35 and 50 per cent of the raw silk produced in Japan and China is reserved for spinning and weaving in those countries, the rest being exported.

Tsatlees are silks reeled by Chinese peasants in their cottages on primitive machines. The product is troublesome to unwind, and the size of the filament is irregular. The name comes from a region back of Shanghai. Tsatlees have not been used in their original state to any extent in this country, although the silk is often very beautiful and white. It is rereeled in the Chinese filatures and then comes to this country cross reeled, with the irregularities removed and the skeins of standard size. The size of the thread is large; consequently it cannot be used for taffetas or other fabrics with fine warp or filling, but is used for sewing thread and floss. Tsatlee silks sell at lower prices, yet are strong, durable, and brilliant.

Marketing. On their arrival in this country, the bales of silk are taken to conditioning houses where sample skeins are tested for their moisture content, percentage of boil-off or gum, elasticity, color, grade of evenness, size, and winding strength. Silk can be made to contain 30 per cent or more of its weight in moisture, but excess moisture decreases the strength of the silk as well as adds to its elasticity and weight. For the protection of the manufacturer, the silk is sold on the "conditioned weight" basis, that is, with a moisture content of 11 per cent over its absolutely dry weight. *See* Conditioning, p. 26.

Raw silk is sold in exchanges as spot and futures, and is ever fluctuating in price, being subject to the speculative movements in other markets. Its classification and grading are complicated because of the variation in qualities due to the climate and the conditions under which it is reeled. That reeled by natives in their homes is, as has been said, frequently full of imperfections; that reeled in the steam filatures of large companies is of much better quality but not always uniform. Oriental reeled silks are listed under "chop" or trade marks such as "Gold Double Deer" or "Black Dragon" from China, and "Sinshiu" and "Kansai" from Japan.

Thrown silk, marketed in much the same manner as raw silk, is listed on exchanges as organzine: Double Extra Crack, Double Extra, and Extra; tram: Extra, Best No. 1, or according to twist, thread, and turns. Silk waste or spun silk is listed under a few grades and the names of the places in which they are produced.

Silk Manufacture. Thrown Silk. When the skein silk reaches the hands of the "throwster," it is in the form of a single, continuous strand known as a "single." For some purposes, such as the formation of warp in piece-dyed goods or as filling in very thin materials, singles are quite satisfactory, and the only preparation they require, after all foreign matter is removed by passing the strands between closely placed metal plates, is winding from the skeins to bobbins or spools, although singles are sometimes twisted. Many fabrics, however, demand skein-dyed silk and heavier yarns, so that the raw silk must be doubled and twisted in the process known as throwing, a term derived from the Saxon *prāwan*, to twist.

Thrown silks are divided into three classes: singles, tram, and organzine. The last, employed as warp, which requires considerable strength, consists of two or more well-twisted single threads combined and given a very firm twisting in the opposite direction with eight or more turns to the inch. Organzine with from forty to eighty turns to the inch is designated as crêpe yarn, and is used for the weaving of crêpe fabrics and chiffon and the knitting of dull-lustered hosiery.

Tram in its use as filling requires less strength; consequently, its two or more threads are twisted together on the spinning frame with only two, three, or four turns to the inch.

When the skeins of raw silk selected for organzine have been placed in cotton bags, they are soaked in warm water containing olive or neat's-foot oil in addition to olive oil soap to soften the sericin; they are dried, then placed on reel swifts for winding off onto bobbins, which are then taken to the first spinning frame. There a twist is inserted in the singles. On the doubling frame two or more twisted singles are wound together onto another bobbin, but receive no twisting, this being reserved for the second spinning frame which twists the combined threads in the opposite direction with as many turns to the inch as called for. If the organzine is to be used in piece-dyed fabrics the bobbins are sent directly to the warping room, where they are prepared for the looms. The thrown silk is next prepared for dyeing by being wound from bobbins into skein form and the sericin removed by boiling.

The preparation of raw silk for tram is much simpler than that for organzine. It consists of doubling two or more strands of raw silk and twisting them together with a slight twist of four to six turns to the inch.

During the soaking of the skeins to remove the sericin the silks for different grades are often tinted so that they may be quickly distinguished in the processes of throwing and weaving.

Finishing of Silk Fabrics. To improve the appearance of silk cloth as it comes from the loom it is given some type of finish. This may consist of a very simple operation as calendering, or more elaborate ones as sizing with gelatin, glue, dextrin, or wax; steaming and pressing as in velvets; gassing for the removal of protruding fibers and threads; printing or one of the special finishes as waterproofing, moiréing, etc. *See* Finishing of Fabrics, p. 57.

Silk fabrics of the type of chiffon are woven with the natural gum still in the yarns. This gives a dullness and stiff feeling to the fabric and is removed by a process known as the "boil off" or "stripping," which consists of boiling the material in a soap solution to remove all the sericin and results in the silk's becoming lustrous and creamy white.

Up to 30 per cent of the thrown weight of the silk may be lost in the removal of the sericin. Since no one wishes to pay for this loss, the manufacturer in the weighting process, which is given to some silks, has an opportunity to restore this lost weight or to give additional weight in the form of sugar of lead and salts of tin. Excess weighting is injurious to the silk fiber, so that in time on exposure to air and light a heavily weighted fabric cracks and splits. When 50 per cent or more is used in some types of silk fabrics, the consumer readily can understand why such a fabric does not give satisfactory service. She cannot, however, easily determine for herself how much weighting is present in the silk of a ready-made garment. Unless the percentage is stated on an accompanying label the best she can do is to clip off a portion of a seam and apply to it a lighted match. If the sample retains its original shape after burning, the consumer is assured that the little silk present has been consumed and the residue is entirely metallic weighting of some form. Weighted silks have a fuller, heavier feeling than those that are unweighted and for that reason are preferred by many women to the light-weight pure silks. These, in color, contain not more than 10 per cent of weighting; in black, they contain not more than 15 per cent (*see* Pure-dye Silk, p. 113) and are labeled or stamped on the selvedge according to a promulgation of the Federal Trade Commission.

Silk Fabrics. Silk is used in a large variety of weaves, knits, and textures from the sheerest of chiffons to heavy, rich pile velvets and sturdy corded silks as grosgrain. The natural strength of the fiber renders it suitable for material that is to receive hard wear; its cleanliness and coolness make it ideal for underwear and for summer wear; its natural luster fits it for fabrics that are to have rich, gleaming texture.

Many fabrics are woven entirely of silk yarns, but many also of silk in combination with yarns of another fiber, particularly today with rayon, either as the continuous-filament rayon or the staple fiber. Since rayon has characteristics that differ greatly from those of silk, such mixed goods do not always wear the same as pure silks, and require special handling in their care, cleaning, and pressing. The fact that silks and rayons do not take equally the same classes of dyestuffs makes the dyeing of mixed goods an operation requiring particular care, unless novelty color effects are desired. Interesting color effects, for example, are obtained by employing in the dyebath a silk dye only, for a fabric composed of silk and acetate rayon yarns.

Care of Silk Materials. Although silk is inherently strong and elastic, it has a smooth, delicate filament, and care must be taken in its laundering or other handling. It is susceptible to the action of both acids and alkalies. Since perspiration has at times either of these reactions, silk garments worn next the skin should not be allowed to wait long after removal before being washed. Knitted silk articles, such as hosiery, require especially gentle handling, for a silk thread, once broken, rapidly forms a "run." Strong soaps, because of excess alkali, weaken silk and will dull or cause to bleed certain dyes used for silk, particularly the acid colors. On the other hand, dyed fabrics which would commonly be dry cleaned may often be washed successfully if a mild soap or a soapless cleanser is used, tepid or cool water, and rapid, gentle handling. Do not wait until the garment is badly soiled, for speed and the minimum of handling are essential in washing fabrics which are not guaranteed to be color fast. Thorough but rapid rinsing in cool water follows, until no dye stains the rinse water. The article is then squeezed out gently, wrapped for a moment in a cloth to remove excess moisture, shaken out, and pressed while damp. Pongees and other fabrics made from wild silk, however, are pressed when nearly dry, to avoid stiffness and water spotting.

The iron for pressing silk should be only moderately heated, and a pressing cloth used, to avoid glazing. This is especially a wise precaution if acetate rayon is present in the weave, since that material takes a glaze or even melts if the iron becomes more than moderately warm.

Crêped fabrics should be gently stretched to original size and shape, while still quite wet. If ironed at all, it is when they are dry, and on the wrong side, over a blanket or terry toweling.

Weighted silks lose their body on washing, and often on dry cleaning; the heavier the weighting the more difficult their maintenance. A thin silk is sometimes given additional body before pressing by dipping or sponging with a thin solution of gum arabic. A tablespoonful of good quality gum arabic, soaked in cool water and finally dissolved by heating the soaking water, will make a solution sufficient for dipping a dress, but a piece of the dress should be tested before dipping the entire garment, to judge of the effect.

Staple Silk Fabrics

Armure. A firm, stiff silk fabric with small, pebblelike, all-over design, used for trimming and neckwear.

Bagheera. A pliable silk velvet with uncut pile, used for wraps and evening dresses.

Bedford cord. Similar to wool fabric of the same name, but made of all silk and wool yarns. Used for coats and dresses.

Bengaline. A coating and dress material made with fine silk or rayon warp and heavy worsted or cotton filling threads, and possessing a characteristic cross-ribbed appearance. Used for coats and dresses.

Bolting cloth. A crisp, sheer silk fabric of leno weave from hard spun yarns. Its chief use is for sifting flour in the mills, but it is employed also for neckwear.

Broadcloth. A somewhat lustrous, firmly woven silk shirting and dress fabric in plain weave.

Brocade. A silk fabric with rich pattern woven in color different from that of the background or foundation, the patterns having an embossed character. Frequently threads of gold or silver are woven into the pattern. Brocaded satin is made with a satin weave in the foundation and a different weave in the pattern.

Brocatelle. A heavy brocade fabric used chiefly for furniture covering and draperies. It has the pattern thrown into relief by means of extra backing yarns. The all-silk brocatelle is now largely replaced by cotton and rayon.

Canton crêpe. A silk dress fabric with heavier filling than warp threads, the alternating yarns of different twists.

Charmeuse. A soft, light-weight satin-weave material, with dull luster, suitable for afternoon and evening gowns.

Chiffon. A transparent, plain-woven fabric with either a slightly stiff or a soft feeling, woven of hard twisted singles. Crêpe chiffon has a slightly crêped surface; chiffon cloth is heavier than chiffon. It is used for evening gowns, lingerie, and blouses.

China silk. A light-weight, very soft silk of plain weave and considerable luster. It is used for curtains, lamp shades, dresses, and linings.

Crêpe de Chine. A light-weight all-silk fabric with filling of hard twisted silk, two picks of right-hand twist alternating with two picks of left-hand twist. It is used for dresses, blouses, lingerie, and linings. Plain weave.

Crêpe back satin. A silk fabric in satin weave with the back of hard twisted yarns, with alternately right- and left-hand twist. The face is like that of ordinary satin and the back like a dull crêpe fabric. It is used for dresses, lingerie, and linings.

Damask. A figured silk with large or small motifs woven with the ground in satin weave and the motifs in a contrasting weave. Heavy damasks are used for draperies and upholstery, while light-weight ones are employed in dresses, blouses, negligees, and coat linings. For satisfactory wear the floats should not be too long.

Duvetyn. A supple fabric of twill weave composed of cotton warp and filling of spun silk. In the finishing, the face of the fabric is emerized. Used for wraps, dresses, and trimmings.

Épinglé. A tie and dress silk woven with a crosswise rib.

Éponge. A loosely woven, rather open-textured fabric similar to ratiné. Used for dresses chiefly. Plain weave.

Faille. A cross-ribbed fabric of plain weave. It is very soft and supple, being suitable for dresses.

Foulard. A light-weight and soft printed silk of twill weave, used extensively for ties and dresses.

Georgette. A sheer dress fabric of plain weave with alternate right- and left-hand twists in both warp and filling. The fine crêpe surface is dull in texture.

Gloria. An umbrella fabric woven in plain weave with silk warp and cotton filling.

Glove silk. A lingerie and glove warp-knit fabric.

Grenadine. A slightly stiffened, gauzelike fabric of leno weave, used for dresses.

Grosgrain. A round, heavy-ribbed effect in a dress fabric, with filling frequently of cotton. Plain weave.

Habutai. A pure-silk, light-weight fabric made in Japan, of plain, close weave. It resembles China silk but is heavier. It is used for shirts, underwear, lamp shades, draperies, and linings.

Lamé. A silk and metal thread fabric in plain or figured weave, used for dresses, blouses, wraps, and trimmings.

Maline. A stiff, fine net similar to tulle. Used for veils, scarfs, and dress trimmings.

Matelassé. A fabric in Jacquard weave with figures in blistered or raised effect. Used for dresses and wraps.

Mogador. A corded, plain-woven fabric with silk warp and either cotton or linen filling. Used for men's ties.

Moiré. A corded silk fabric with "watered" pattern obtained by passing the fabric between heated engraved rollers. The pattern is not permanent on silk fabrics. The plain weave is most common, but some moiré silk fabrics have a satin back.

Mousseline de soie. A silk chiffon type fabric with slight stiffness. Plain weave. It is used chiefly for dresses and as lining for laces.

Ninon. A sheer silk fabric of closer texture than chiffon, used for lingerie. When of rayon, it is used for glass curtains.

Plush. A long-piled fabric similar to velvet, with the pile made from spun silk or wild silk. Pile weave. This fabric is used for trimmings and wraps when in fashion.

Pongee. A light-weight silk fabric in plain weave made from wild silk, and usually found in its natural tan color. It is used for dresses, underwear, shirts, smocks, and curtains.

Poplin. A corded dress fabric made in plain weave with silk warp and worsted filling.

Radium. A smooth-textured, soft-lustered silk in plain weave. It is used for linings, dresses, and negligees.

Satin. An all-silk material or silk combined with other fibers in satin weave. In soft and medium-weight textures satin is used for dresses; in light weights, for linings; in heavy weights, usually with cotton back, for draperies and furniture upholstery.

Shantung. A type of pongee made in Shantung province, China, from wild silk. It is heavier and rougher in texture than ordinary pongee, and is used for dresses, suits, and coats.

Spitalfields. Small all-over designs characterize this hand woven fabric of excellent durability for neckties. Manufactured in England.

Surah. A soft, supple silk of twill weave used for neckties and dresses.

Taffeta. A smooth, soft, slightly stiff silk fabric in plain weave, used for dresses, draperies, linings, and trimmings. It may be heavily weighted. Shot taffeta has the filling threads of different color from those in the warp, giving an iridescent effect. Chiffon taffeta is very light in weight and soft.

Tulle. A soft silk net with fine mesh, used for veils and trimmings.

Tussah Silk. A type of pongee or tan-colored silk made from the silk of wild silkworms. The fabric is rather rough in texture, as the silk is uneven in diameter.

Velour. A silk and mohair drapery fabric in pile weave.

Velvet. Short-pile fabric of all silk or silk combined with other fibers. Used for dresses, wraps, coats, negligees, blouses, and trimmings. *See* Velvet, p. 180.

Voile. A plain-woven, sheer fabric in all silk or all cotton. Used for dresses.

Sizing. A finishing process for the stiffening or the dressing of cotton and linen fabrics. The sizing is applied to the cloth after it leaves the loom by passing it between two rollers, one of which applies the sizing. A small amount of sizing keeps the cloth crisp and attractive in appearance while on the merchant's shelves. Sizing that is applied to material for the purpose of adding weight is usually spoken of as filling or loading.

Most warp threads before being set up in the loom are sized in a starch mixture for the purpose of increasing both the smoothness and the strength of the thread during the process of weaving. When a fabric contains only the sizing used on the warp threads it is designated as *pure-finish* cloth, but some authorities consider a pure-finish cloth to have no sizing whatever. *See* Finishing of Fabrics, p. 55.

Slip-cover Fabrics. As the chief use for slip covers is the protection of upholstered furniture from dust, soil, and sunlight they should be made of fabrics that are closely enough woven to give this protection and to withstand hard wear, as the cost of labor involved in the making of slip covers is high—irrespective of the quality of material used.

Firmly twisted yarns woven into high-count twill and plain weaves are more satisfactory than loosely twisted yarns in open or fancy weaves with long floats of yarn on the surface. To ensure perfect fitting slips, both before and after washing, preshrunk cotton or linen fabrics should be used; for good appearance the colors in the fabrics used for the body, the welting, and the trimming of the slip cover should be fast to sunlight, washing, and dry cleaning. (*See* Vat Dyes, p. 46.) Cottons and linens given a non-crush or anti-crease finish (*see* Finishing of Fabrics, p. 57) are very satisfactory for a well-tailored and non-wrinkling cover, and cost but slightly more than untreated fabrics.

Materials generally used for slip covers are: Belgian linen, hand-blocked linen, crash, denim, chintz, cretonne.

Spinning. Spinning is the drawing out or elongating and twisting of groups or bundles of fibers into a continuous thread or yarn of sufficient strength to be woven or knitted into fabric or used for embroidery or sewing threads.

Early hand spinning consisted of the drawing out of the fibers from a bundle tied to a stick known as the distaff, then twisting the strand between the fingers and finally winding the yarn on a notched stick called the spindle. During the Middle Ages wool and flax wheels were invented to facilitate the processes of twisting and winding and to increase production. The invention of the spinning jenny by James Hargreaves in 1762, of the water frame by Richard Arkwright in 1768, and of the spinning mule by Samuel Crompton in 1779 not only increased the yearly output of spun yarn but also introduced the fundamental principles of the electrically driven mules and upright frames of modern times.

On these intricately made but simply operated giant machines of today the roving of cotton, flax, or wool is drawn out into a fine strand, given twist of a specified number of turns to the inch and in the direction desired, either S twist or Z twist, and wound on bobbins. Yarn intended for warp is always given a higher twist than that to be used for filling, as the warp yarn must be stronger to withstand the strain and friction it meets during the process of weaving.

The modern spinning mule consists essentially of a stationary frame for holding the roving and sets of twin rollers, and a movable carriage containing the slanting spindles to which are attached the ends of the rovings, there being the same number of spindles as spools of roving. As the carriage, on wheels moving along grooves, draws away from the frame holding the roving the roving is drawn out and reduced in size. The spindles turn during the outward movement of the carriage and put the twist in the yarn. When the carriage reaches the end of the track the spindles reverse for a few turns, until a mechanism places the yarn in position for winding; then as the carriage moves toward the frame the yarn is wound on the revolving spindles. In the mule used for the spinning of worsted yarns the drawing is done by a set of rollers.

In the upright spinning frame sets of drawing rollers, revolving at different rates of speed, draw out or attenuate the roving as it passes between them on its way to the revolving upright spindle placed on a stationary rail in front of and below the rollers. The mechanism which inserts the twist and winds the yarn on the bobbin held on the spindle is of three types—the ring, cap, and flyer. In the first a metal ring with a wire traveler is set into a frame and encloses the spindle. As the spindle revolves rapidly, the thread coming from the drawing rollers and through the traveler is twisted and wound onto the revolving bobbin.

In the cap spinning frame the ring is replaced by a metal cap attached to the top of a stationary spindle. The bobbin on the spindle revolves rapidly up and down under the cap, twisting the yarn attached to it. In the flyer spinning frame, a flyer is attached to the moving spindle containing a bobbin that not only revolves with the spindle but also moves up and down so that the yarn may be evenly wound on it.

Yarns spun on the mule are usually finer, softer, and of greater evenness than those twisted on the upright frames, which, however, have the advantage of reduced operating costs and increased rate of production. For these reasons mule spinning is not so commonly found in larger mills at the present time.

The product of the spinning machine is always a single yarn which may be used alone or twisted with one or more yarns into what are known as two, three, four or more ply yarns. These naturally have greater strength than a single yarn.

Spool Cotton. Because of their long staple and their strength Egyptian and Sea Island cottons are used for the making of sewing threads. The usual processes of preparing the raw cotton for spinning (*see* Cotton, p. 29) are employed for spool cotton, the cotton being spun into the desired size and twist. Next the yarn is doubled and twisted, and for a six-cord thread three strands of the two-ply yarn are twisted together in opposite directions. This, known as cable construction, results in a smooth, strong thread suitable for hand and machine sewing. In three-cord spool cotton three single yarns are twisted together, giving a thread of less strength than the six-cord construction. Cotton is made in two-, three-, four-, and six-cord construction.

The skeins of thread are closely inspected, bleached, and then dyed before being wound on large bobbins from which the thread is finally rewound on spools in the desired number of yards—50, 100, 150, 200. For the use of clothing manufacturers the cotton is wound on large cones containing as much as 12,000 yards.

Spool cotton in large quantities is made of long-staple, combed, and mercerized yarn as a three-cord thread. It is sold in all standard colors and is today usually color fast. For stitching on single-thread sewing machines, cotton is sometimes given a glacé finish to make it especially smooth. Darning and embroidery cottons are softly twisted threads sometimes mercerized and sold in white and a variety of colors.

Cotton thread is made in sizes numbered from 8, the coarsest, to 200, the finest, in white; 8 to 100 in black; and other colors in 50 to 80 only. Mercerized cotton is made in sizes 50 and 60, while basting cotton, a three-ply, cheaper thread, is made in sizes 40, 50, and 60 with 250 yards on each spool.

Linen thread lacks elasticity but is best for use when great strength is necessary. It is made in sizes numbering 25 to 250 but is not commonly used.

Spray Finish. *See* p. 64.

Spun Glass. Two companies in the United States are producing spun-glass yarns in continuous filament and in staple lengths. These yarns are used for filter fabrics, for tapes and braids in the electrical industries, and for some decorative purposes and awnings.

The molten glass is forced under high pressure through revolving spinnerets. The filaments are deposited on a movable conveyer and wound on rolls as roving, which is later doubled and twisted into yarns. It is claimed that glass yarn is about one-half as strong as linen and about 50 per cent stronger than cotton. It is fireproof but low in its resistance to abrasion, and it breaks easily when the fabric is crushed in the hand.

Spun Silk. Raw silk is unwound from perfect cocoons. Spun silk, on the other hand, is made from the cocoons which have been pierced by the emerging moth, from the floss or loose silk on the outside of the cocoon and that inside the cocoon next to the chrysalis, from the frisons or waste from the reeling operation, and from the pierced as well as the unpierced cocoon of the wild silkworm or tussah. The spun-silk industry is entirely separate from that engaged in the manufacture of reeled silk, and many processes are necessary to convert the short fibers into threads suitable for weaving.

The first of these operations is the opening up of the mass of fibers tightly compressed into bales, then the removal of the natural gum by boiling, by fermentation, which produces "schappe" silk, or by means of chemicals. The tangled mass of dried fibers is next passed through rollers covered with card clothing to soften and open it into a fluffy mass. Groups of fibers of equal length, called drafts, are separated and placed together by a combing process, the very short fibers, noils, being reserved for fancy yarns. The combed silk is subjected to the drawing, spinning, and doubling operations used in the preparation of other short fibers (*see* Spinning, p. 142) and finally singed in a gas flame to render it smooth, clean, and lustrous, ready for dyeing and weaving.

Spun silk is used for warp, filling, or both in a great variety of fabrics, which include velvet, crêpe, plush, satin, shirting fabrics, ribbons, lace, and knit goods.

Stains and Stain Removal. Such excellent bulletins are available on stain removal that the subject needs only brief attention here, with some directions for the removal of common stains such as grease and oil, ink, fruit, tea and coffee, blood, rust, mildew, scorch, and dye stains.

General Rules. For most stains it is better to let a professional do the work. But if it must be done at home, know the nature of the fabric and of the stain if possible, use the mildest treatment first, and act promptly. Stains become "set" and are difficult of removal after time has elapsed.

As to the fabric, wool and silk cannot be treated with the familiar household chlorine bleach, nor can dyed material, as a rule. White cotton, linen, and rayon may be so treated, with caution.

Acetate rayon is destroyed by chloroform, strong acetic acid, acetone, and nail-polish remover. It can be cleaned with gasoline or naphtha, and with carbon tetrachloride.

Concentrated mineral acids are particularly harmful to silk and vegetable fibers. Battery acids come under this class. Acetic acid, except as noted above, does not harm fabrics. If an acid is used to counteract an alkali in stain removal, follow it by thorough rinsing or by neutralization with borax, sodium bicarbonate, or other mild alkali.

As to the stain, the principal removal agent for a water-borne stain, as fruit, is water.

Water-insoluble stains, such as grease or iron rust, require a solvent suited to the stain.

Dye stains, tannins in some fruits, and stubborn tea and coffee stains require a bleach.

Albumin stains, such as egg, blood, meat juices, require cool water. Hot water cooks the stain.

Useful Stain Removers

A certain shelf should be set apart for some first aids in stain removal, including:

1. *Absorbents.* These are first aids of the mildest kind in stain removal. Blotting paper, absorbent cotton, starch, fuller's earth, etc., will make further removal less difficult and are useful for stains on non-washable articles.

2. *Grease Solvents.* At least three types may be noted: (*a*) carbon tetrachloride, trichlorethylene, and similar chlorine-containing, non-inflammable liquids. They are excellent for removing oils, greases, resins, and tar, but if used in quantity, good ventilation of the room is essential. Inhalation of the fumes may have a poisonous effect, or at least cause headache or nausea.

(*b*) Benzene, gasoline, and other inflammable hydrocarbons, carrying a fire hazard. No open flame should be in the room. Sometimes these are ignited by a spark of static electricity. Benzene is superior to gasoline in removing oils and greases, and it dries more rapidly.

(*c*) Mixtures of the above types are found, which carry the non-inflammability label, but may become inflammable with use, owing to the more rapid evaporation of carbon tetrachloride or similar chlorinated liquids over the slower gasoline. Garments so cleaned may become highly inflammable when partly dry.

3. *Acid Solvents.* An acid is required to dissolve iron rust and the iron base in some inks. Oxalic acid (a poison) is safe on fabrics in dilution and if properly neutralized after use. Dilute hydrochloric (muriatic) acid serves the same purpose but is more destructive to silk and vegetable fibers. Lemon juice and salt has less effectiveness but also less deteriorating action.

4. *Bleaches.* Sodium hypochlorite is the most effective household bleach, and also the most destructive if carelessly used. It is known as Javelle water and as a chlorine bleach under various trade names. It bleaches because of release of oxygen, as:

$$NaOCl + H_2O = HOCl + NaOH$$
$$HOCl = HCl + O$$

As noted above, chlorine bleaches cannot be used on wool and silk because of the attack of the chlorine ion and of free caustic alkali on both fibers. Excess caustic is found in these bleaches, acting as a stabilizer.

Sodium perborate, or $NaBO_3$, releases oxygen in bleaching, and becomes sodium metaborate or essentially borax. With ordinary care it may be used on any white fabric. It is a component of many mouth washes.

Hydrogen peroxide, or H_2O_2. In action, this is converted into water and oxygen. It is usually stabilized in the manufacture with dilute sulphuric or phosphoric acid; hence a mild alkali such as household ammonia or borax should be used with it. The alkali aids in the release of oxygen and protects the fabric from the acid.

Oxalic acid, or $(COOH)_2$. This is a reducing rather than an oxidizing bleach. In use, it breaks down to carbon dioxide, water, and carbon monoxide. The last takes oxygen from the stain and reduces the color. Because of release of carbon monoxide, oxalic acid is poisonous if vapors are breathed, as if hot acid is used. Salts of lemon, or potassium bioxalate, is less acid than oxalic acid but equally effective in removing iron rust and ink, for cleaning straw hats, and for other appropriate uses.

Potassium permanganate, or $KMnO_4$. This can be used safely to remove stains from white fabrics and from some dyed materials if the dye is first tested. It is an oxidizing bleach, and the brown stain of manganese hydroxide which forms may be removed by a follow-up treatment with an acid such as oxalic. The reactions are:

$$2KMnO_4 + 5H_2O = 2Mn(OH)_4 + 2KOH + 3O$$
$$Mn(OH)_4 + 2(COOH)_2 + Mn(C_2O_4)_2 + 4H_2O$$

Color removers in packages accompanying household dyes are the mildest of the bleaches in their effect on fabrics. The active bleach, which may be formaldehyde sodium sulphoxylate, or $HCHO{\cdot}NaHSO_2$, and a soluble zinc salt, is analogous to the color remover in discharge printing, in which process polka dots or other patterns are produced on piece-dyed material. These are reducing bleaches and are particularly used to strip colors preliminary to redyeing.

Specific Treatments

Ink. There are so many kinds of writing ink that it is impossible to use a single method of removal. Inks with an iron base require an acid to dissolve the iron compound, together with a bleach to remove the residual dye stain. This is the principle of the two-bottle ink eradicator—an acid in one bottle, a bleach in the other—but such eradicators should not be used on wool and silk without first testing their effect, because of the presence in some of a chlorine bleach. Safer for fabric and dye, as a rule, is an alternating treatment with a solution of oxalic acid and of dilute household ammonia, or still safer for some dyes, the substitution of vinegar for the oxalic acid. This treatment requires patience, and care in applying so that the threads are not slipped or abraded by rubbing. On white goods a paste of hydrogen peroxide and baking soda, or of sodium perborate, with steam applied, is effective. Potassium permanganate with oxalic acid may be used, the permanganate being diluted in the proportion of 1 teaspoonful of crystals to 1 pint of water, and the solution of oxalic acid half saturated. Another treatment for ink stains on cotton goods is soaking for a half hour in a solution of 1 tablespoonful of table salt and ½ cup of vinegar in a quart of water. Follow by washing with warm water and soap. Special inks require special treatments, which are described in the available bulletins.

Rust. Use oxalic acid in the half-saturated solution. Apply for a few minutes, rinse, repeat if necessary. Finish by thorough rinsing. Or use cold hydrochloric acid, 1 part of the concentrated acid to 9 parts of water. Or lemon juice and salt, in repeated applications, are more effective than one long contact.

Mildew, Scorch, Dye Spots. Where the growth of the mildew is severe, or the scorch is deep, the fibers are damaged too much for removal of the cause. Prevention is better than cure. If mildew is not deep-seated, try a chlorine bleach in the dilution of 1 part to about 25 parts of water, and alternate with acetic acid or vinegar. Apply cold for not more than 5-minute contacts. For deep-seated mildew, use oxalic acid in alternation with the chlorine bleach. Light scorch stains may require a bleach, but often exposing the wet spot to sunlight is sufficient. If a bleach is needed for any of this group of stains on wool or silk, use hydrogen peroxide with dilute ammonia. These bleaches may remove color. Treat dye stains in the same way.

Tea, Coffee. When fresh, these stains can be removed with water. The brown coloring matter in tea becomes persistent on standing and may succumb to boiling water, but if not, a mild bleach is needed. Residual tannin stains, if any, are removed by soaking in warm glycerin, or by a paste of borax. Coffee stains which do not yield to boiling water may be removed in the same way.

Grease or Oil. On non-washable fabrics, apply the solvent in small quantities at a time, on successive bits of clean cheesecloth, letting the solvent be drawn in from the outer part of the stain to avoid spreading. Work with light strokes, and make frequent renewals of blotting paper or absorbent cotton below the spot, and tampings above. After the grease is removed a ring may be left, due to the building up of sizings around the treated portion. To "feather out" this ring, a fine spray of water may be blown on the fabric and brushed lightly with soft cheesecloth, or a piece of cheesecloth may be dampened with alcohol and lightly brushed over the spot from the circumference toward the center.

Paint. Use a grease solvent, or ammonia and turpentine in equal amounts. Paint is difficult to remove when old; it oxidizes to more insoluble compounds.

Milk, Blood, Eggs, Meat Juices. Use lukewarm water and soap. If a stain lingers, use a bleach.

Fruit. Cooked fruits stain less than raw, because cooking coagulates some of the substances which otherwise act as binders of the stain. Hot water applied with some force, or a dilute bleach if necessary, are the remedies. Do not use soap, especially on fruits containing tannin compounds, such as peach. Use warm glycerin as for tea and coffee stains, or a bleach.

If the stain is unknown, first use an absorbent; second, try cold or lukewarm water if water can be applied to the fabric; third, use a solvent as the case may indicate; fourth, and finally, use a bleach if this cannot be avoided. This is the general path from the mildest to the most drastic treatment.

Staple Fiber. *See* p. 121.

Starches. *See* p. 20.

Stenciling. This is a hand process for the direct printing of designs on cloth or paper and is an art highly perfected by the Japanese who decorate their kimono fabrics in this manner and export large quantities of stencil-dyed luncheon cloths of cotton to the United States.

The design is traced on specially treated heavy paper and cut out with a sharp knife. The stencil is then laid on the cloth to be decorated and the dye applied to the exposed portions of the cloth. If several colors are desired in the design several stencils must be cut and used. In order to set the colors the stenciled material must be steamed thoroughly.

Stockings. *See* Hosiery, p. 70.

Suitings. Worsted fabrics such as serge, gabardine, unfinished and finished worsteds play an important rôle in the field of men's suitings because they are very durable, outwearing woolens several times, hold their shape, and tailor well. They do, however, tend to shine more than woolen materials such as tweed, wool cheviot, homespun, cassimere, and flannel. Suits of these last-mentioned fabrics do not retain their shape well, and if rayon or cotton is present in large quantities they wrinkle badly.

Wool broadcloth is generally used for men's dress suits and tuxedos; Palm Beach cloth, French serge, tropical worsted, alpaca, mohair, linen crash, and seersucker give satisfaction for summer wear. Non-crush linen and spun rayon fabrics will undoubtedly find increasing use for summer suitings. Many wool suitings are now being moth-proofed.

For women's suits the above-mentioned fabrics are in general use, the sturdy worsteds being found in strictly tailored suits.

Table Linens. This term, very descriptively used by older generations of housewives, is today something of a misnomer, at least so far as the word linen goes. Today the materials which are used for formal as well as general home use are made of the attractive new member of the family of fibers, rayon, and of the less costly cotton in addition to the enduring, highly satisfactory flax. The figured or damask weave is most generally used, though in modern table linens the plain weave predominates, especially for luncheon, breakfast, and tea services.

Rayon Damask. Rayon combined with cotton or linen in white or pastel colors lends luster as well as style appearance to cloths for small and large formal tables. The figures in the Jacquard weave stand out prominently because of the difference in luster of the rayon and the cotton thread. Because rayon crushes badly, cloths of this type are likely to muss readily and require care in laundering as rayon fibers lose some natural strength when wet.

Cotton Damask. Inexpensive but durable damask is made of cotton, either plain or mercerized. In general, such cloths, owing to inherent characteristics of the fiber, lack beauty of luster, they muss and stain readily, the spots being difficult to remove, and because of the shortness of the cotton fiber, they lint decidedly. Cotton cloths are frequently given a linenized finish, and when well woven render excellent service.

Union Linen. A damask with a warp of cotton and a filling of linen thread is considered by many a better-wearing and generally more satisfactory material than one of all linen yarns of poor quality.

Linen damask is a fabric more costly for the consumer to purchase than that made of other fibers, because of the expense involved in the production and manufacture of flax and its importation into the United States, but it is renowned for its beauty and satisfactory wearing qualities. The higher grades of cloth are made of line, the longer, finer flax that results from the process of scutching, while tow, the shorter, coarser fibers are reserved for the less expensive fabrics. High-grade linen damasks have beautiful, enduring luster because of the reflection of light by the smooth, even fibers; they do not stain or soil easily, as the fibers are smooth, and the length of the fibers prevents linting.

Weave and Count. Linen damasks are woven in figured weave with the Jacquard attachment, the warp-face satin forming the background and the filling-face satin the design or pattern on the right side of the fabric. Double damask is the term ascribed to the heavier and better grades made with an eight-shaft satin weave in both the ground and the pattern; that is, the filling thread passes over seven threads and under one in its progress across the width of the fabric. In this type of damask the design shows more clearly on the wrong side than in single damask, as there are many more filling threads which throw the design in relief. Such a cloth is reversible, the pattern being equally attractive on both sides. Very long floats, while adding to the beauty of the cloth, tend to be caught and worn by friction, so for hard general wear should be avoided. In single damask a filling thread passes over four and under one warp in both the ground and the pattern, or in the ground only, and is known technically as "five-shaft satin." This is a lighter-weight fabric than double damask, lacks its luster, and is woven of either linen or cotton yarns, while double damask is woven of linen threads only.

Weight. The weight of damask, a partial indication of durability, varies from 4½ to 7 ounces per square yard. A small percentage of sizing is permissible, but a loosely woven cloth receiving its weight from sizing rather than the amount of the fiber present is certainly a poor purchase, as the sizing is removed by washing and a poorly constructed and poor-wearing fabric is left. *See* Sizing, p. 166, for method of detection.

Count in damask is the total number of both warp and filling threads in a square inch of cloth. In single damask a count of 162 should mean that there are 81 warp threads and 81 filling threads to the square inch. This method of stating the count does not help the purchaser to judge the balance of the weave. Damask of either type with fine yarns and consequently high thread count is not suitable for everyday hard wear, as the fineness of the threads does not necessarily indicate their ability to wear.

Color. In rayon damask cloths, colored yarns are to be found in warp or filling and, combined with white yarns of cotton or linen, give an interesting color and texture to the cloth. With linen damask, however, white is the rule, though the degree of whiteness varies with the bleach. Today chemical bleaching has to some extent supplanted the crofting or grass bleaching which to an older generation signified quality and endurance. Tan, brownish fabrics stretched on hedges or spread over the meadow were heretofore subjected to the gentle but firm process of bleaching from sun and dew; now many fine linens are given a slight bleach with chemicals then finished by being placed on the grass in the sun. In general, modern damasks are bleached with some chemical. Unless chemical bleaching is done with great care, considerable loss of strength of the linen results. The unbleached naturally gives the best service, but is rarely seen in American homes today, preference being given to full bleach or one of the degrees of "silver bleach": ¼, ½, or ¾ bleach.

Pattern. While plain, satin-weave tablecloths are classified under table damasks, the presence of some pattern, floral or geometric, is understood. Most cloths now come with all-around borders making a unit of design in the cloth though the material without the border may still be purchased by the yard in widths of 58, 64, and 72 inches.

Size. The sizes of tablecloths of damask have become standardized in the measurements: 72 by 72 inches; 72 by 90; 72 by 108; banquet cloths usually measure 72 by 126 or 72 by 144 inches; luncheon cloths 54 inches; breakfast cloths 45, 54, or 63 inches square.

Napkins. Tablecloths are accompanied by napkins of the same design and in sizes appropriate to the type of service.

Dinner napkins	22, 24 inches square
Tea napkins	13, 14, 16, 17, 18 inches square
Breakfast	14, 19, 20, 21 inches square
Luncheon	14, 16, 18, 20 inches square
Bridge	12, 13 inches
Cocktail	5 by 7; or 7 by 7 inches

Non-damask Table Linens. Fashions in luncheon, breakfast, and tea cloths change somewhat, but whatever the design or decoration a plain woven, round-thread linen (not beetled) is always on the market, recommended by its quality, satisfactory wear, and appearance. This as well as a finer linen furnishes the base for embroidery of various types, Madeira, Spanish, Italian, Puerto Rican, mosaic. Linen cloths with lace inserts or edges are attractive but expensive both in initial cost and in upkeep. The gaily patterned and colored peasant linens now on the market are in general made of short-fiber linen or of cotton. Like the stenciled Japanese cotton cloths, when well cared for, these breakfast and luncheon sets give satisfactory service.

Among the novelty tablecloths on the market today are those of lace—either hand or machine-made, with the machine-made predominating, and chiefly of cotton. Linen threads are used for the expensive handmade filet laces that may be distinguished by the knots tied at each of the four corners of the square mesh, and for the heavy, compact point de Venise.

Care of Table Linens. *See* Linen, p. 95.

Tapestry. Textiles with interwoven pictorial patterns were made by the Copts of Egypt in the fifth, sixth, and seventh centuries, and by the Incas of Peru before the Spanish Conquest in 1531, and they played an important rôle in the textile industry of France and Flanders from the fourteenth to the latter part of the eighteenth century. In Europe these large and heavy fabrics were used at first in the churches; later they hung on the walls or lay on the floors of the cold castles and châteaux of the wealthy. In the eighteenth century the large-scaled patterns were modified to suit the needs of furniture coverings.

Two types of looms are used in the weaving of handmade tapestries, the same today as centuries ago—the low warp loom in which the linen or cotton warp threads are placed in the horizontal position of the loom itself; and the high warp loom, the threads of which are vertical, facing the weaver as he works. In the low warp loom the cartoon or paper on which the design is drawn in full size and is the reverse of the finished tapestry is placed underneath the warp, so that the weaver may follow it through the horizontal threads. He works on the wrong side of the fabric and cannot see the right side until the piece is completed and removed from the loom. A small mirror placed between the cartoon and the warp enables the worker to see the right side of a small section only. The weaver who uses the high warp loom has the cartoon placed at his back and follows the pattern through a mirror. He has the added advantage of being able to walk around to the other side of the loom and follow the progress of the pattern on the right side.

Controls attached to alternate warps open the sheds through which is passed the small bobbin containing the wool filling yarn. This bobbin is carried not across the entire width of the loom but only across that space where its particular colored yarn is called for in the design. When not in use the bobbin hangs free on its thread. This type of construction results in small slits between the sections of different color, and when the weaving has been completed the slits are usually sewn up. The wrong side of handmade tapestry is rough with floats and short ends of yarn.

Arras, Brussels, Aubusson, and Beauvais are towns whose names are inextricably interwoven with the history of tapestry, as fabrics of the best workmanship and greatest renown were manufactured there; the name of the Gobelin family, so famous for the weaving of this type of textile, is carried on today in the well-known ateliers in Paris.

Machine-made tapestries are imitations of the old hand-loomed fabrics and are woven in double cloth weave on the Jacquard loom of wool, cotton, silk, rayon, or combinations of these fibers. The fabric lacks the clear-cut ribs and the small slits so characteristic of the hand-woven tapestry.

Tarnish-prevention Fabrics. *See* Finishing of Fabrics, p. 64.

Tensile Strength. *See* Textile Tests, p. 168.

Terry Cloth. This is a cotton, linen, silk, or wool fabric with a looped or uncut pile on both sides, either covering the entire surface solidly, or in stripes. When made of cotton or linen it is called Turkish toweling, and is used particularly for bath towels, washcloths, and bath or beach robes, though it is now entering the decorating field and is being used as drapery material.

Terry is made with two sets of warp threads wound on separate beams. One set is held taut to form the ground warp, the other loosely. Several picks are woven in, then beaten up together, and the backward and forward motion of the reed pushes up the slack threads into pile loops. The number of filling threads inserted between each row of loops determines the quality of the fabric, which is spoken of as 1, 3, 4, 5, or 6 thread terry, according to the number of picks or filling threads inserted.

Textile Tests. *Microscopical.* The compound microscope reveals the structure of textile fibers and is often the best means of identifying them, as for cotton and linen. A magnification of at least 250 times is desirable.

The compound microscope is a delicate instrument, and a few directions for its care and use may not be amiss.

Study the parts of the microscope and their functions, first learning to focus with the low-power objective before attempting to use the high power.

In focusing with the high power, the objective usually has to be lowered almost to touching distance of the microscope slide; therefore, for the safety of the lens, the operator should always watch from the side of the instrument while lowering the objective.

Use only lens paper for cleaning the optical parts of the microscope, and be careful to let no liquid penetrate the lens.

After the object has been brought into focus under high power, study the effect of the fine adjustment in sharpening or deepening the focus.

Learn to move the slide while under observation, so that all parts of the object are seen and studied.

To mount a specimen of fibers, place a drop of mounting medium in the center of the glass slide, and in this a very few—six or less—of the fibers to be studied. Use a dissecting needle to separate the fibers. Bring down the cover glass in such a way that the mounting medium is pressed outward, to eliminate bubbles. Wipe from the slide any surface wetness. The mounting medium may be water or, better, a mixture of 2 parts glycerol and 1 part alcohol.

Work with known fibers first, before trying to identify unknown.

Wool and Hair Fibers. Morphologically, wool and hair fibers are alike; the microscope shows external differences in structure. Wool fibers are crimpy, comparatively short, with an average length of 1 to 8 inches, and have pronounced epidermal scales. Hair fibers, from goats, camels, and allied species, vary considerably in texture and length, may be fine and silky to coarse and harsh, but as a class do not have the crimpiness of wool or the clearly defined epidermal scales.

Wool fibers are easily recognized by their definite surface scales, characteristic of this fiber alone. These overlapping scales form the epidermis of the fiber. Underneath can be seen fine longitudinal markings or striations which are the spindle-shaped cells forming the cortical

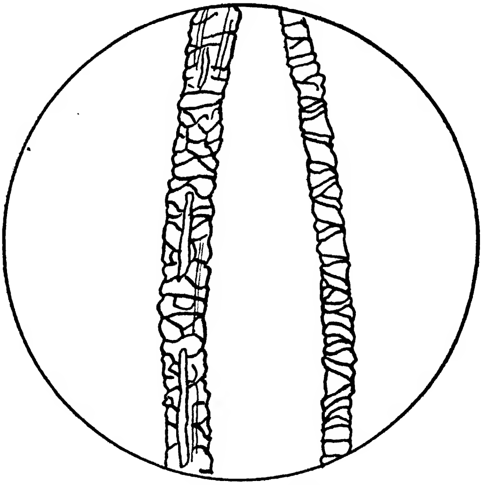

FIG. 7. Wool fibers.

layer or main body of the fiber. In medium and coarse wools there usually appears a third division of the fiber, called the medulla or medullary canal. Porous channels pass through the medulla. These are commonly filled with air, but sometimes with pigment, showing as dark, more or less continuous areas. Fur fibers often show regular patterns of discontinuous medullas. Fig. 7.

In fine wool fibers, such as the merino, there may be a succession of single epidermal scales overlapping and forming the circumference, like a series of funnels. Coarser fibers require more scales to cover their circumference, and the arrangement suggests the shingles on a house. In the laundering of wool goods, consideration must be given to these scales, although the older theory that shrinkage is due to the interlocking of softened and expanded scales is no longer given as the entire explanation. *See* Shrinkage, page 131.

Mohair. This is the hair fiber in most common use. It is obtained from the long, lustrous fleece of the Angora goat, which is named from the province in Turkey where it originated. In the United States herds of these animals are found in Texas, and in other western states. The fiber may be 12 or more inches in length. Under the microscope the epidermal scales are scarcely visible, being very thin and flat. A single scale often surrounds the entire fiber. Definite striations indicate the cortical region, as in wool. Except in coarse fibers, the medulla is seldom visible. Mohair fibers do not felt or shrink to any extent, because they are straighter and more silky than wool, without prominent scales.

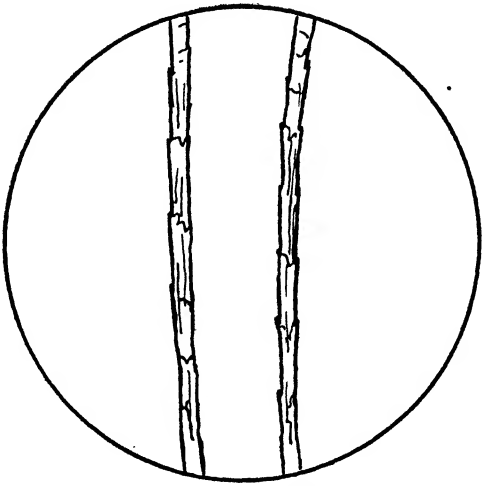

FIG. 8. Vicuña fibers.

Vicuña. This fiber is conceded to be the world's rarest and finest. The vicuña is the smallest member of the South American camel family. The animals live untamed in the high Cordilleras of Peru, and their rarity has led to their protection by the Peruvian government. Since they are so wild, it is necessary to kill them in order to obtain the hair, and as the government allows only a certain number of the herd to be killed, the amount of fiber available each year is small.

The natural color of the fiber is a deep fawn shading to a golden chestnut, and coats and suitings made from vicuña fibers are usually left undyed.

The fiber is about half the diameter of fine sheep wool; the scales are regular and can be distinguished; the striations are fine and definite; the medulla is seldom seen in the fine, silky fibers. Fig. 8.

Cashmere. The fiber of the cashmere goat, an animal whose habitat is the high Himalaya plateaus of Tibet and northern India, ranks next to the vicuña in fineness and rarity. Only the soft under hairs of the fleece are used in fabric manufacture. They are separated from the larger, coarser hairs by combing. It is said that this selection of the choicest hairs necessitates as many as forty fleeces for a single coat.

The fine fibers show visible scales with serrated edges, but no marked medulla. The cortical layer is strongly striated.

Camel. The Bactrian camel, or two-humped species, is found in most parts of Asia, and is the source of the camel hair of commerce.

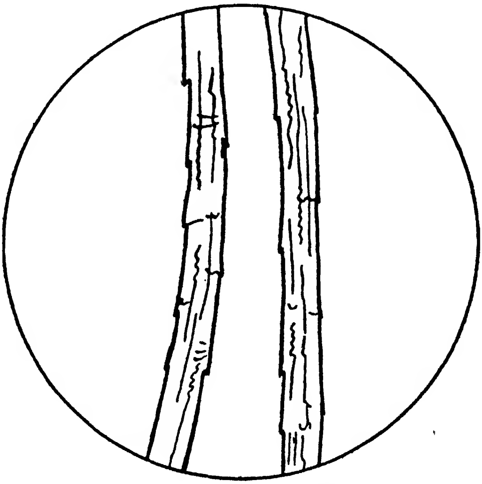

Fig. 9. Camel-hair fibers.

The outer hair is coarse, and is used for ropes, tenting, and sometimes for blankets. Next to the outer hair is a grade of fiber less coarse, but not suited to fine camel-hair fabrics. It is, however, used as a cheapener in garments of poorer quality. Next the hide is a short, soft, silky fiber of a tan color. It is the choice fiber from which the best camel-hair fabrics are made. Under the microscope this fiber shows faint epidermal scales and definite striations, but not always a medulla. The coarser camel hairs have a well-defined medulla showing pigmentation. Fig. 9.

Llama. The llama is the South American camel, with one hump. It is found chiefly in Peru and Bolivia. The fiber of the under coat is coarser than the best grade of Bactrian camel hair; nevertheless, it is soft, from 7 to 12 inches long, strong, and lustrous. The color in one fleece may vary from white to tan, brown, gray, or black, and when these colors are blended without dyeing a soft, mixed effect is given to the weave. The fibers are similar to camel hair in appearance, with usually an irregularly pigmented medulla and faint scales.

Alpaca. This valuable animal is also indigenous to South America, and is found at high altitudes in the Andes. The soft hair fibers of the under coat are long, glossy, and uniformly fine. The scales are

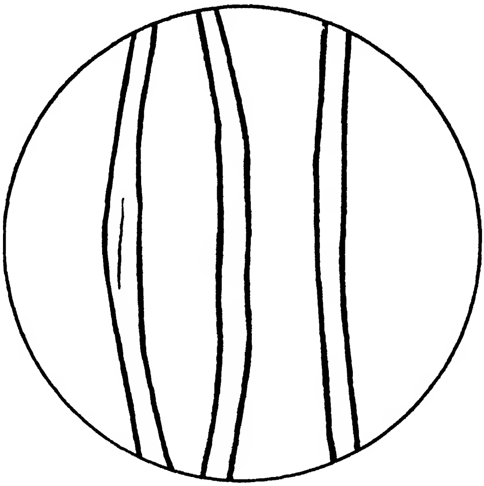

Fig. 10, Cultivated silk fibers.

indistinct, the striations well marked, the medulla usually absent except in the beard hairs.

Huarizo. The huarizo is a cross between a llama and an alpaca. The coarse outer hair of the fleece is used for cordage; the soft, silky, lustrous under coat is prized for fabric purposes.

Silk. The silk filament as reeled from the cocoon has an almost transparent outer coating of silk gum or sericin, which performs the function of holding together the two parallel filaments of the real silk or fibroin. This coating is allowed to remain through the reeling and throwing processes, and is a part of the raw silk received by the manufacturer. Until it is removed, silk is stiff, harsh, and lusterless. Under the microscope, raw silk shows the gum as a series of patches, since it is hard and brittle and develops cracks on bending. After the boiling-off process, in which the soluble gum is removed, the single filaments of fibroin appear as smooth, transparent, cylindrical threads.

Under high magnification (600×) faint longitudinal striations may be seen. Constrictions and small swellings are found at times, especially in the sections of the filament which have been under greater pressure in the cocoon. The length of the filament may be from 1200 to 1500 meters, and the average diameter is 0.00119 cm. Fig. 10.

Wild or Uncultivated Silk. These filaments are distinctly different from those of the *Bombyx mori,* which are the cultivated silk of commerce. Wild-silk moths are of several species, and their food is seldom the mulberry but white oak shrubs and other vegetation. The cocoons are gathered wherever found, and the silk ranges in color from yellowish to brown, gray, or even green. The term *tussah* is applied to wild silks in general, although strictly speaking it refers to an Indian variety. The wild-silk filament is easily recognized under the microscope by its irregular diameter, regular longitudinal lines or striations indicating a complex structure, and a flattened shape with cross-markings. These are probably due to pressure on the coarse filament while still plastic in the cocoon. Fig. 11.

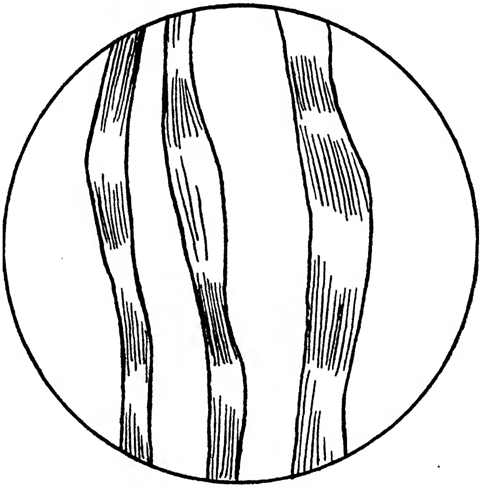

FIG. 11. Wild silk fibers.

Cotton. Researches of Farr at the Boyce Thompson Institute (*see American Dyestuffs Reporter* of March 22, 1937) indicate that cotton has a dual structure, rather than the simple, unicellular fiber that it was formerly considered to be. It is made up of a central chain of true cellulose particles cemented with pectinlike matter. The central chain spirals around the axis of the fiber. Under magnification, cotton fibers are easily recognized by the flat, ribbonlike shape, with thickened edges, and a definite and frequently recurring twist. It is this twist, in a fiber of such shortness of staple (½ inch to 2 inches), which makes possible the strong yarn which can be produced. Fig. 12.

Cotton fibers are outgrowths of the cotton seed and are called seed hairs, as distinguished from stem or bast fibers, such as flax and hemp. In the early stages of growth the fibers are cylindrical or tubular, with a lumen or interior canal carrying moisture and other liquid nutriment. As growth continues, there is a chemical as well as physical change; the juices are being absorbed and synthesized to form pure cellulose; the ripe fiber gradually collapses and twists.

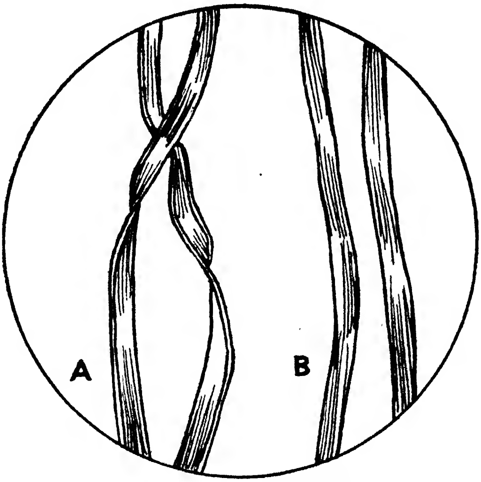

FIG. 12. A. Cotton. B. Mercerized cotton.

Cotton linters are the short down fibers clinging to the seed after the ginning of the longer fibers. These linters furnish valuable raw material for the manufacture of rayon, photographic films, celluloid, explosives, paper, and many other products.

Flax. Flax fibers are the source of linen, a word related to "line," line being the longer and finer flax fiber which separates from tow, the coarser flax residue. Flax fibers are long, averaging 18 or 20 inches as they lie in the stalk, just under the bark. They are cemented together by pectinlike matter which is dissolved in the retting (rotting) operation. Purified flax fibers appear under the microscope as straight, stiff, stemlike fibers with pointed ends. It is important to be able to recognize flax by its microscopic appearance, as no other means of identification is so conclusive. Therefore the observer should watch for the distinguishing characteristic of nodes or swellings which appear at intervals, and which, if they could be sufficiently magnified, would resemble the joints in a cornstalk or bamboo. If the fibers are stained with iodine the nodes are more easily distinguished. A line down the center of the fiber indicates the interior canal or lumen. The stiff inelastic nature of the fiber indicates that it will crush and wrinkle, and will break under habitual pressure applied to a fold. Fig. 13.

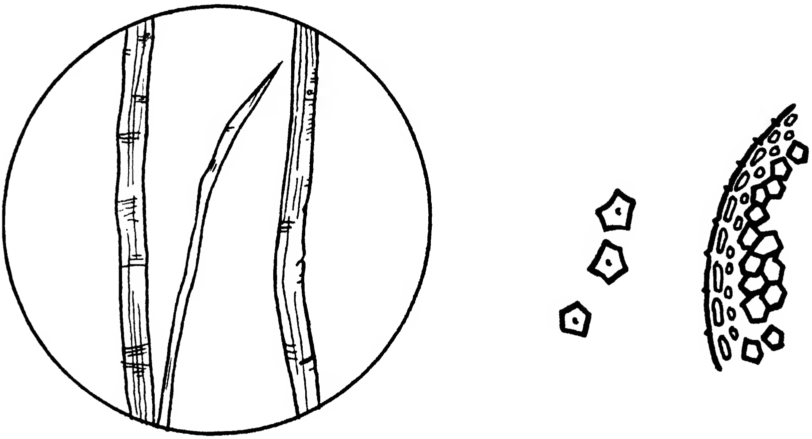

FIG. 13. Flax fibers and cross sections of fiber and stem.

Created or Altered Fibers. Mercerized Cotton. In the mercerizing process the cotton fiber swells to a cylindrical form, and the twist mostly disappears. However, there is enough evidence of a twist or a tendency to twist, now and then, to identify mercerized cotton. Otherwise, the fiber would resemble silk. Fig. 12.

Rayon. The microscope is not so reliable a means of identifying rayon filaments as some chemical tests are. In general, evenness of diameter, lack of twist, cylindrical form, and a mechanical aspect can be noted. But it is not always possible to distinguish one kind of rayon from another by specific structural differences; therefore the illustrations given here are subject to variation. The student will find it interesting, however, to study known varieties of synthetic filaments, and in particular to observe their cross-sectional appearance. Figs. 14, 15, 16.

Minor Fibers. Ramie. Ramie has never been developed successfully in the United States, because of the difficulties and expense incident to the purification of the fibers. Ramie, and the similar China grass, can be found in fabrics imported from the Orient as doilies, luncheon cloths, etc.

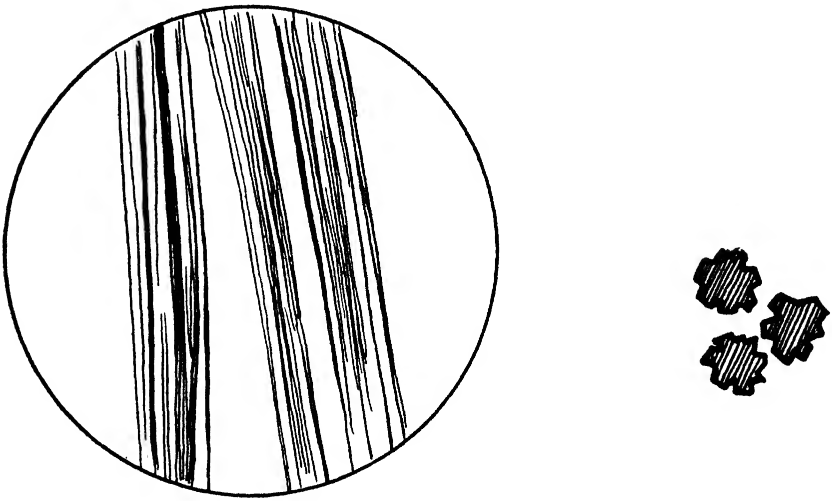

FIG. 14. Viscose rayon with cross sections.

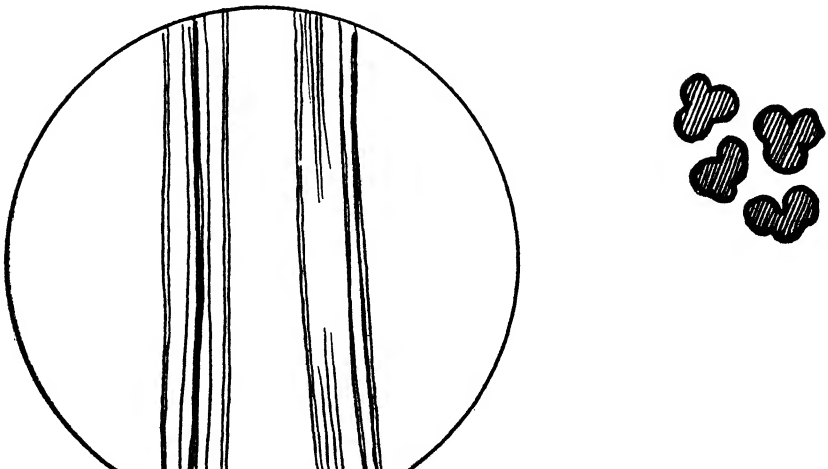

FIG. 15. Acetate rayon with cross sections.

Hemp is of many varieties. The fiber is strong, and is commonly used for ropes, cordage, burlap, and backs of rugs and carpets. It is not weakened by salt water. Hemp fibers often resemble flax, but the striations and nodes are more pronounced, the fiber is less transparent, and the interior canal or lumen less visible.

Jute is a bast fiber obtained from several species of mallow. It is fine, somewhat silky, but relatively weak and unsuited to cordage, as it is weakened by salt water. It is used for bagging, twine, sometimes for the backs of carpets and rugs, or as the pile of inexpensive upholstery fabrics.

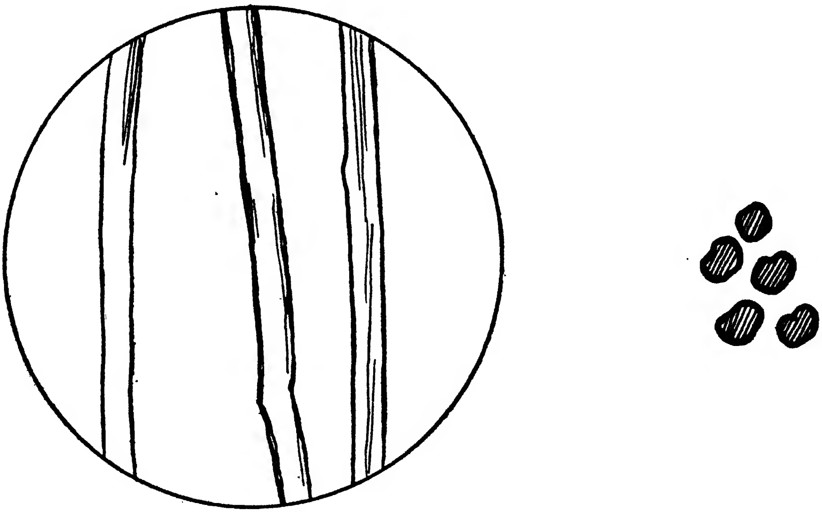

FIG. 16. Cuprammonium rayon with cross sections.

Pineapple fiber is obtained from the leaf of the pineapple plant. It is extremely fine, highly lustrous, white, and flexible. It is used in the making of the piña cloth of the Philippines.

Kapok is a weak, brittle fiber, but of considerable interest nevertheless. It is obtained from a pod of a tree found in semi-tropical countries, and is sometimes called tree cotton. Its interest lies in the fact that the fibers are used for mattresses and, because of their extreme lightness and resistance to water absorption, are particularly adapted to mattresses for vessels, or for life preservers other than cork on small water craft. In mattresses kapok is also claimed to have resiliency, so that the mattress regains shape on exposure to sun and wind, and to be repellent to vermin. It is too weak and brittle a fiber to be spun, unless mixed with cotton.

Fiber Structure in General. X-ray investigations have thrown light on the molecular structure of fibers. Protein fibers—wool and silk—are complexes of amino-acid groups. X-ray patterns tend to show a difference between the molecular arrangements of the two. Silk has comparatively long chains of amino-acid groupings and relatively short side groups; wool shows chains contracted into loops, with interlocking side groups. Elasticity is a function of these looped chains and of the interaction of the side groups, because the tendency of the arrangement is to straighten under tension but to resume the looped pattern and side-group cohesions when tension is released.

Vegetable fibers have cellulose molecules in straight rather than looped arrangement, but carrying a natural alignment and cohesion. This arrangement gives strength in either dry or wet condition, but not much elasticity.

In a rayon filament the chain particles of the cellulose raw material have been thrown out of natural arrangement by the dissolving of the cellulose, and in the succeeding coagulation of the regenerated cellulose they are arranged at random. Such an arrangement allows for stretching but not for elasticity, and rayon filaments have therefore high elongation, loss of strength when wet, and relatively low elasticity. If stretching accompanies spinning of the filament, as in one type of rayon, there is a tendency for alignment to take place before coagulation occurs, thus more nearly reproducing the original alignment and increasing strength and elasticity.

Tests Not Requiring Laboratory Equipment

Feel. The hand can be trained to recognize differences in the nature of fabrics. Good wool feels warm, soft, and when crushed in the hand springs back without holding wrinkles. If mixed with cotton or rayon these qualities are lessened, and wrinkling increases with the proportion of cotton or rayon.

Silk also feels warm and is smooth and pliable. If weighted, it feels less pliable and elasticity diminishes. Rayon feels cooler and heavier than silk in fabrics of comparable weave, and is less elastic. Otherwise, there is enough similarity to make recognition difficult.

Good linen feels cool, firm, leathery, in fabrics such as table damask. Cotton feels limp rather than firm and is warmer to the hand. Both crush easily, but linen tends to hold sharp creases; cotton is less definitely creased.

The Weave. Weaves should be examined for evenness of thread and count, held against the light to detect thick and thin places, rated according to whether there are construction features which may affect durability. Some of these may be too long floats in a damask; heavy cords against soft, fine threads; open weaves which lack strength, the yarns of which are easily pushed apart if the finger nail is scraped over the cloth. Strength of weave may also be tested by running a tuck in the cloth with a pin, and pulling away from the pin on both sides of the tuck. The threads should not separate easily if the weave is strong. Or grasp the cloth between the thumb and finger of each hand, with about an inch of space between the thumbs. Press downward and outward, and note whether the cloth tears easily, or stretches out of shape, or is firm.

Thread Count. A pick glass or thread counter is easily obtainable. The threads are counted for 1 inch in both warp and filling directions, taking an average of five counts in each direction, and placing the thread counter at least 2 inches from the selvedge. Staple goods are often labeled nowadays as to their thread count, and a study of the count of grades of sheeting muslin and table damask, for example, will be a guide to the student in understanding the meaning and value of these labels.

Sizing or Dressing. Cottons and linens may be too heavily sized by starches or other substances, in order to give them fictitious body and appearance of quality. Rubbing or tearing, over a dark cloth, will show the loosened sizing if this is the case. Holding against the light may reveal filled-in spaces in the weave. Laundering a sample will show how the fabric may appear after using.

The Fiber. Fibers have characteristics which the eye can recognize. Wool fibers are crimpy; the serrated edges can be felt by the fingers when the fiber is rubbed against the serrations. Cotton fibers are short, opaque rather than translucent, and their twist can be seen. Flax fibers of good quality are longer than cotton, translucent, stiff, and straight. If the parted ends of a yarn are observed against the light, flax fibers if present will point out in parallel arrangement; cotton fibers will curl back in many directions. Silk filaments are fine, smooth, lustrous, unless weighted; rayon filaments are cooler, less pliable, more slippery in feel than silk.

Burning Test. This is one of the most valuable of textile tests. To perform it, bring a flame to the edge of a sample of the fabric, or to separate bunches of warp and filling threads.

Wool burns slowly, with an odor of burning hair, and leaves a crisp black residue.

Silk also burns slowly, forming black bubbles or beads along the edge of the fabric. The odor is similar to that of wool, but less suggestive of burning hair. Weighted silk is easily recognized by this test. It chars and holds the shape of the weave.

Cotton and linen burn rapidly, with an odor of burning paper. After the flame is removed, the ignition creeps along the threads until they are reduced to papery ash.

Viscose and cuprammonium rayon burn rapidly, with the odor and ash of cotton. Acetate rayon fuses or melts in the flame, and often drips like melted black sealing wax. The difference between this fiber and silk is in the odor, which is pungent from the rayon, and in the nature of the ash. Pure silk forms crisp black balls; the black residue from the acetate rayon is flatter and more brittle.

Fastness of Dye. To Light. An exposure to 20 days of sunshine is considered adequate. If the exposed sample does not then show an appreciable alteration of color when compared with the original, it is rated "good." Other ratings are "fair" and "poor." The specimen should be covered with glass, with a space of about ½ inch between the glass and the sample, and with openings at the side for ventilation. It is set facing the south, at an angle of 45 degrees from the horizontal.

If a Fade-Ometer is available, the test can be completed within 48 hours.

To Washing. Standard specifications for this test are given in Federal Specifications for Textile Test Methods CCC-T-191a, in the A.S.T.M. Standards on Textile Materials or in the yearbook of the American Association of Textile Chemists and Colorists. But for most purposes, the material may be washed as in the home by the method suited to the fabric, and the process repeated as necessary. A piece of white goods of cotton, rayon, or whatever the test material may be, is sewed to the specimen before running the test.

To Perspiration. The solutions required for the perspiration test may be prepared without difficulty.

For acid perspiration:

10 grams sodium chloride
1 gram lactic acid, U.S.P. 85%
1 gram disodium orthophosphate, anhydrous
Make up to 1 liter with water.

For alkaline perspiration:

10 grams sodium chloride
4 grams ammonium carbonate, U.S.P.
1 gram disodium orthophosphate, anhydrous
Make up to 1 liter with water.

Pieces of the dyed material and similar pieces of white goods, each about 2 by 4 inches, are rolled together and thoroughly wet in the respective solutions. The rolls are placed in test tubes, with about one-third of the roll exposed, and allowed to stand in a dry place, at about body heat if possible, for 48 hours. The appearance of the white sample as well as the condition of the dyed fabric is considered. Alkaline perspiration usually has more effect on silk dyes than acid perspiration. If silk has become discolored by continued exposure to perspiration, sponging with vinegar may help to restore the color. Similarly, a change brought about by acid perspiration may be remedied by sponging with dilute ammonia.

Shrinkage. The standard method of estimating shrinkage, for woven cotton goods, is the Commercial Standard Shrinking Test CS59-36 or CCC-T-91a of the Bureau of Standards, Washington, D. C. Other procedures are given in the test methods referred to above under Washing. For practical purposes, and when material is limited, a 10-inch square may be accurately measured and marked, within an outer square. This outer square is the border which prevents raveling. The sample is washed at least five times according to the method suited to it, and handled without wringing or otherwise distorting the material. After each washing it is dried flat, and ironed with a moderate iron. The iron is placed flat on successive surfaces; never pushed along. Duplicate or triplicate tests are made if possible. From the final measurement of the inner square the percentage of shrinkage is computed.

Laboratory Tests

Tensile Strength. A standard type of tensile-strength machine is required. The breaking strength of the cloth may be determined by either the grab or the strip method. For accurate determinations, the fabrics should be brought under standard temperature and humidity control, of 72° F. and 65 per cent relative humidity.

By the grab method, specimens 4 inches wide and not less than 6 inches long are stamped out or cut. At least five tests should be made in each direction of the weave. The pieces should not include the same set of threads, nor be cut nearer the selvedge than one-tenth the width of the material. The front jaws are 1 inch by 1 inch; the back jaws are 1 inch by 2 or more inches. The distance between the jaws at the start is 3 inches. The speed of separation of the jaws should be about 12 inches per minute. In placing the specimen in the jaws, care must be taken that the vertical threads are parallel with the direction of the pull; otherwise the sample will break on the bias. Another source of error is slipping in the jaws; these must be screwed as tightly as possible over the specimen.

By the strip method, two sets of specimens are cut as before. Each strip is cut at least 6 inches long, and a little more than an inch wide. Just before putting in the machine, the surplus width is raveled on each side to give the exact width and two lines of straight threads. Both front and back jaws are 1 inch by at least 1½ inches, the long dimension as before being perpendicular to the direction of the pull.

Weight per Square Yard. For accuracy, the samples should be brought to standard moisture conditions. A convenient method of taking the weight per square yard is with a steel die exactly 2 by 2 inches. The weight of the square cut out by the die, multiplied by 324, gives the weight per square yard. It is much better to weigh the entire square yard, of course, if sufficient material is available.

Moisture Content. When necessary, the moisture content may be determined by placing a weighed sample in a glass weighing bottle and drying to constant weight in a heat-controlled oven at 105° to 110° C.

Determination of Sizing in Cotton or Linen. Starch, and the other substances which may be incorporated with the starch, are difficult to remove by boiling. The starch and other organic sizing may be digested to maltose or glucose by starch- and protein-digesting enzymes, and its removal in this soluble form carries with it considerable other sizing material. For the full method, consult the references given above under Washing. A time-saving method of approximate accuracy is the use of boiling solutions of organic acids, such as oxalic or tartaric, using a reflux condenser. The acid hydrolyzes the starch to glucose. Boiling should not continue for longer than 10 or 12 minutes, if a 5 per cent solution of oxalic acid is used.

Previous to the above treatments, fatty and waxy finishes may be extracted with chloroform.

Burning Test. The destructive distillation of dry textile material is a guide to elemental composition and identification. A sample of the material is put in a dry test tube and strongly heated until fumes arise. Wool and silk, being protein, give off ammonia. A piece of moistened red litmus paper held in the mouth of the test tube will therefore turn blue. Vegetable fibers, including rayon, decompose with the formation of impure acetic acid; therefore a strip of moistened blue litmus paper is turned red. This distinguishes all types of rayon from silk, except the newer synthetic fibers from a casein or other nitrogenous base, which would react like wool, but under the microscope would not, of course, show scales. Another exception to the litmus test is those crease-resisting cottons or rayons which have been treated with a formaldehyde-urea or other nitrogenous resin. These fabrics will respond to blue litmus with an acid reaction, but will also give off enough ammonia to affect red litmus, and so the burning test provides a means of identifying this type of finish.

Wool and silk, again, are different in elemental composition: wool contains sulphur; pure dye silk does not. A roll of filter paper moistened in a solution of lead acetate turns black in the hydrogen sulphide emitted from wool and to a certain extent from viscose rayon; silk does not give this reaction. The casein type of rayon would give only a trace of sulphide, since less than 1 per cent of sulphur is present in it, as compared with nearly 4 per cent in wool.

Weighting of Silk. The method of determining weighting in silk, which is of general acceptance, is published as Research Paper 498 of the Bureau of Standards at Washington, D. C., under the title "Analysis of Weighted Silk," and in the yearbook of the A.A.T.C.C.

Identification of Animal-Vegetable Mixtures

Millon's. This reagent colors animal fibers red, including any synthetic fibers made from a protein base. It leaves uncolored any fibers of vegetable origin. White or light-colored materials respond best to the test. The fabric should be prepared by fringing, or threads of the material taken and opened out; enough of the reagent applied to moisten thoroughly, and the whole warmed gently until the test is definite. If the fabric or thread is then placed under the low power of the microscope the method of combination is more clearly seen, especially if the amount of animal fiber in the mixture is so small as to make its presence uncertain.

Acid dyes dye wool and silk; vegetable fibers are only stained. Rayon from a protein base is said to take a wool dye more brilliantly than wool does.

All-fabric dyes dye all materials except acetate rayon. Special dyes are required for this type.

Picric and nitric acid color animal fibers; they have little color effect on fibers of purely vegetable origin, except acetate rayon, which is stained.

Animal and Vegetable Fiber Admixtures. 1. Animal fibers (wool, silk, protein type of rayon) are destroyed by boiling in dilute solutions of caustic alkali. Vegetable fibers are not destroyed, although rayon of the ordinary types is much softened. A weighed specimen of the material is boiled for at least 10 minutes in 100 times its weight of a 5 per cent solution of sodium hydroxide, using a reflux condenser. The residue, if any, is vegetable material. It is washed with water and a 1 per cent solution of acetic acid, finally with water, and dried to either air-dry or bone-dry condition, to correspond to the condition of the original sample. An allowance of 3 per cent is usually made for loss of weight of vegetable fibers in this test. The test may be simplified by boiling out an unweighed specimen in a solution of household lye.

2. Silk-acetate rayon mixtures can be separated by acetone, provided that the rayon is of the acetone-soluble type. Agitate the weighed sample for 15 minutes in about 50 times its weight of acetone at room temperature. (*Caution:* acetone is highly inflammable.) Squeeze out and repeat with two or three fresh applications of acetone, until it is evident that nothing but silk remains. Dry and weigh.

3. Silk-regenerated cellulose mixtures may be treated with calcium thiocyanate, according to the method outlined in A.S.T.M. Standards on Textile Materials. Silk is destroyed. Admixtures of other fibers may also be determined by carrying out the complete method as given in this pamphlet.

Specific Tests for Rayons. 1. The burning test differentiates between the acetate and the regenerated cellulose rayons. The tip of a hot iron placed on a portion of the fabric will melt acetate rayon but merely scorch the viscose and cuprammonium types. (If the acetate rayon has been "iron-proofed," i.e., has had a saponification treatment which has changed the outer surface of the filament to regenerated cellulose, it will not fuse with heat applied to the surface.)

2. Acetone dissolves untreated acetate rayon almost instantly; if the rayon has been partially saponified, the change is slow or incomplete. There are a number of organic solvents for this type of rayon, including glacial acetic acid, chloroform, and chloroform-alcohol mixtures.

3. Neocarmin W, a dye, is useful in identifying viscose and cuprammonium filaments, if they are white or light colored. Immerse a few threads or a piece of the fabric in the cold dye for about 3 minutes. Remove, rinse in running water, draw through slightly ammoniated water, and rinse again. Cuprammonium fibers become a clear, dark blue; viscose turns violet; cellulose acetate becomes greenish-yellow.

4. Dyed samples of viscose and cuprammonium rayon may be differentiated as follows: Place a small sample in a test tube, cover with a

3 per cent solution of sulphuric acid, close the mouth of the test tube with a filter cap wet with a 10 per cent solution of lead acetate, and place the test tube in a boiling water bath for 4 hours, keeping the water boiling moderately. If a small glass funnel is inverted over the test tube the lead acetate paper will be better protected from any sulphide which may be in the air. If the sample is viscose, the lead acetate paper will be stained brown or black, owing to the formation of lead sulphide.

5. Strongly concentrated solutions of calcium thiocyanate dissolve regenerated cellulose, but not cotton and wool. The method is described in A.S.T.M. Standards, referred to above.

Recognition of Mercerized Cotton. The specimen, freed from starchy dressing, is moistened with a solution of 20 grams of iodine in 100 cc. of a saturated solution of potassium iodide. Remove and rinse well; lay in clear water. Mercerized cotton will be blue-black; unmercerized cotton brownish-yellow.

Recognition of Chlorinated Wool. Moisten a light-colored sample with Neocarmin W, warm gently, rinse. Chlorinated wool becomes dark green or black; unchlorinated will be yellow or olive-tan.

Recognition of Cotton and Linen. The microscope is the most certain means of recognition.

If a yarn is gently pulled apart and the broken ends examined, flax fibers appear stiff, pointed, parallel, translucent. Cotton fibers curl back in several directions and have an opaque appearance in white goods.

The ink spot or oil test is serviceable only if dressing or sizing is removed. Ink will form a clean-cut, round spot on linen; on cotton it radiates out along the threads. A spot of thin oil on linen will look translucent against the light; on cotton it will be opaque.

All tests except the microscope are of little value on mixed weaves, where the linen and cotton fibers are frequently combined in one yarn.

Silk and Wild (Tussah) Silk. Again, the microscope furnishes the best test. Wild silk dissolves slowly in cold concentrated hydrochloric acid; cultivated silk in less than 2 minutes, unless heavily weighted. Hot solutions of caustic alkalies destroy cultivated silk in 10 to 15 minutes; wild silk is destroyed much more slowly.

Thread Count. The number of warp and filling yarns per inch in a cloth, as 60 by 45. A form of measure to designate the quality of a fabric. A small instrument, pick glass or thread-counting micrometer, with a lens is used to magnify the yarn in a given space. When the yarns in two examples of cloth are exactly the same in size and quality, the piece having the higher thread count, or the greater number of warp and filling threads to the inch, is considered the better quality.

In linen damasks for table use the thread count consists of the total or combined number of warp and filling threads per inch. In knitted fabrics the count is the number of wales and courses per inch. *See* Knitting, p. 78.

Ticking. The covering of bed pillows and mattresses is usually a firmly woven cotton material known as ticking. The older twill and herringbone weaves, yarn-dyed blue and white stripe ticking are being replaced somewhat by the more attractive, likewise more expensive, new tickings of sateen weave, and printed floral or stripe designs in pastel colorings. The important factors to considered are the strength of the yarns and the compactness of the weave as necessary to prevent the tiny quills of the feathers from working through the covering. A type of ticking especially used for mattresses is of damask weave, either in all-over designs or in panels designed for the dimensions and shape of the mattress. Cotton is the chief fiber used, though sometimes rayon cross threads are employed.

Tie Fabrics. In the selection of men's ties not only the design and color of the material should be considered but also its tendency to wrinkle. That made of fibers with considerable elasticity and resiliency, silk and wool, wrinkles less than that made from cotton and linen, both of which lack these properties. Cotton, linen, and rayon may, of course, be treated with a synthetic resin to make them crush less when used in ties. *See* Finishing of Fabrics, p. 57. Ties lined with light-weight wool fabric wrinkle less than unlined ties, the "seven-fold" tie, folded seven times so that it is virtually self-lined, being equally satisfactory. Fabric ties knot and hold their shape better when cut on the bias than when cut along the straight of the material. Ties knitted of silk or rayon thread wrinkle less than those made of woven material.

The following woven fabrics are used in ties:

Silk	*Silk*	*Wool*
Armure	Mogador	Cashmere
Barathea	Moiré	Challis
Brocade	Pongee	Flannel
Crêpe	Rep	Palm Beach cloth
Faille	Satin	
Foulard	Spitalfields silk	
Grenadine	Taffeta	

(*Continued on next page*)

Woven Fabrics Used in Ties (*Continued*)

Rayon	*Cotton*
Brocade	Broadcloth
Crêpe	Madras
Moiré	Oxford
Satin	Piqué
Taffeta	Poplin

Tie-dye Work. This is a form of resist dyeing that has been practiced by the Japanese, the Chinese, and the East Indians for centuries, and is said to have been employed by the early Peruvians. It is popular today as a craft in the schools and camps of America. *See* Dyes and Dyeing, p. 49.

Toiles de Jouy. These were high-grade cotton stuffs of Indian or Swiss origin printed at first with wood blocks; later, in 1780, with copper plates, and in 1797 by cylinders at the printing and dyeing establishment founded at Jouy-en-Josas, near Versailles, by Christophe Philippe Oberkampf in 1758. Small designs of scattered bouquets of flowers and of Persian and Indian motifs in polychrome were the bases of the earlier prints, but later landscapes, either pastoral or classical, sometimes Chinese in character, in red or blue scattered over a cream ground, and larger patterns reflecting political events of significance were designed by such artists as Huet, Vernet, Prod'hon, Lebas, and Pillement.

Printed cottons were manufactured at Nantes, Angers, Bordeaux, Beutron, and Mulhouse, but those made at Jouy were especially renowned for their fine quality of fabric, design, and dyes.

These toiles were tremendously popular in France, England, and the United States during the late eighteenth and early nineteenth centuries for use as bed valances and covers, for tables, and for wall hangings as well as for dressing gowns and sacques. Today excellent machine reproductions of these famous cottons, as well as some reprints from the original blocks, are used very extensively for wall panels and furniture coverings.

Toweling and Towels. Desirable characteristics in materials used for towels are as follows: good powers of absorption and evaporation; absence of lint; smoothness or roughness of texture; durability and laundering qualities; ability to hold color; beauty of luster and design. These characteristics are determined largely by the type and quality of the fibers used in the yarns, the type and quality of the construction or weave, and the finish.

Fibers in Towels. Towels made of linen yarns absorb moisture readily and dry quickly; if of good-quality flax (line), they will not lint, i.e., leave white flecks of fiber on glass, china, or the skin, will not soil readily because of the smoothness of the flax fiber (*see* p. 161), and will maintain a good color. Linen towels, however, are comparatively expensive. When composed of cotton warp and linen filling (union linen) they possess some of the qualities of an all-linen towel and are considered better than those entirely of cotton. All cotton towels, owing to the shortness of the cotton fiber, will lint easily unless specially treated. The fuzziness of the yarn causes the towel to soil quickly and to be difficult to keep a good color. Because of the low powers of absorption and evaporation possessed by cotton, towels made of this fiber do not absorb moisture from the skin, glass, or china very readily.

The finer the yarns in the toweling the greater the beauty of texture, but usually the durability of the towel is affected. Medium size yarns are stronger if less beautiful than the finer ones, and two-ply stronger than singles. Cotton yarns that are loosely spun will absorb moisture more readily than those with a higher degree of twist.

Weaves Used in Toweling. A rough weave is desirable in body towels, first because it increases friction, thus stimulating circulation of the blood within the body; and secondly because owing to greater exposure of the yarn in a rough weave the absorptive and evaporative powers of the yarn are increased. A compact weave with a well-balanced thread count is necessary for strength and durability.

The following types of materials are generally found in towels:

Crash. A material made of linen, cotton, or a mixture of cotton and linen, in either plain or twill weave. It is partially bleached and when of light weight, of plain weave with a check design made in colored cotton yarns, is known as glass toweling. Ordinary dish toweling is of slightly heavier crash than glass toweling. Roller toweling is still heavier and of closer weave, either plain or twill. Linen crash frequently has a colored stripe of cotton parallel to the selvedge.

Birdseye. This is a small, geometric, and all-over patterned material of considerable beauty when made of high-grade linen yarns.

Damask. Damask towels, like linen damask used for table linen, are soft and beautiful but expensive. Damask is found only in face and hand towels.

Honeycomb. Towels woven in a geometric pattern of small squares resembling a waffle-iron surface are called honeycomb. Because of the rough surface this fabric is highly absorptive and desirable for towels.

Huckaback. This is a towel fabric characterized by a small figure that somewhat resembles birdseye, except that the figure in birdseye is diamond shape and that in huck is square. This is a very generally used material and is made in different degrees of coarseness.

Terry Cloth or Turkish Toweling. Used chiefly in bath towels because of its roughness of surface, Turkish toweling is found in small towels for hand and face as well as washcloths. It is distinguished by a loop pile on both sides of the cloth. The ends are generally woven plain with at times a border in Jacquard weave. Cotton is generally used but linen is sometimes employed in the warp pile.

For satisfactory wear, Turkish towels should have strong ground warps and a sufficient number of filling threads between the rows of pile loops to hold them in place. Good-quality fabric has from four to six picks or filling threads between the rows of loops, medium quality three, and poor quality only one, thus permitting the loops to pull out easily along the length of the fabric. Double loop pile warps add to the desirability of the towel.

All toweling should have firm, strong selvedges, but they are particularly necessary in bath towels to prevent the cloth's tearing under strain. Some poor qualities are woven as one towel then cut in two lengthwise. The edges are overcast by machine. If this thread breaks, the entire edge finish ravels and the towel is practically destroyed.

High-grade glass and face towelings do not require sizing. Cotton fabric may be made to resemble linen by being beetled (*see* Flax, p. 68) to obtain luster, and by having the yarns spun unevenly.

Edge Finish. Towels may be bought by the yard or with the ends finished with scallops, hemstitching, or plain hems, the last being more enduring than the other finishes.

Sizes. Towels vary considerably in size from the tiny finger-tip style to the generous-sized bath towel 26 by 52 inches; huckaback yard goods varies from 15 to 24 inches in width and crash from 15 to 20 inches.

Care of Towels. Embroidered and monogrammed towels should be ironed over a folded Turkish towel in order to throw the embroidery into high relief. Colored towels should never be boiled or hung in the sun to dry. Turkish towels should have only the hems pressed, the towel being shaken to make the loops fluffy.

Trubenizing. *See* p. 64.

Umbrella Fabrics. The cloth used for the covering of umbrellas is made of long-stapled cotton, carded or combed or both, and frequently mercerized; of silk, either alone or in combination as in the fabric known as gloria; or of all rayon or combinations of rayon and silk. Popular today is the pure-silk covering treated with boiled linseed oil and chinawood oil to make it transparent and waterproof.

Umbrella fabrics should be closely woven, fast color, and treated to render them showerproof.

Underwear Fabrics. It is highly desirable that the materials used for underwear possess certain characteristics such as: washability; colors that are fast to washing and perspiration; yarns strong enough to withstand considerable strain, particularly in men's and boys' wear; a thread count high enough to prevent slippage at seams; small percentage of shrinkage; the ability to absorb perspiration and to allow it to evaporate quickly; the ability to keep the body either cool or warm as needed in different climates and seasons of the year. *See* Hygiene, p. 76. Water-repellent finishes on fabrics for underwear are undesirable.

It is claimed that woven cotton cloth, especially of the nainsook type, is the coolest for underwear. Cotton and linen absorb perspiration more rapidly than rayon or silk; bleached cotton, from which all fatty and waxy substances have been removed, possesses this characteristic to a higher degree than unbleached cotton.

Wool underwear, today almost invariably of the knitted rather than woven type of cloth, feels warm because still air, a poor conductor of heat, is held in the meshes of the fibers and yarns. Wool, however, readily catches and holds soil and is difficult to wash because of its tendency to felt. Wool mixed with cotton, silk, or rayon is more desirable than all wool for many persons and for use in some climates. It is not only less expensive but also easier to launder.

Rayon is being used in underwear in constantly increasing amounts. Its ability to conduct heat better than silk, therefore feeling cooler, not to be appreciably weakened by perspiration, to resist soil because of the smoothness of the fiber, and the fact that white rayon does not become yellow after repeated washings as does silk, are all factors that make for the use of rayon rather than silk in undergarments. Its comparatively low cost is also a factor. Rayon does, however, stretch and shrink, loses strength when wet, and requires considerable care in washing as well as ironing.

Linen makes especially cool underwear because of the rapidity with which it both takes and gives up moisture, and because it does not hold a layer of warm air next to the body. It is expensive and not in general use for this purpose.

For some types of undergarments knitted fabric is more common than woven. Some of its many advantages may be stated as follows: it stretches and contracts readily, making for comfort and freedom of bodily movements; it is light in weight; it is easily laundered; it is cool because of its porosity, which permits of ventilation of the body; and it is warm when made of wool or softly spun cotton yarns, which hold still air in the looped construction of the fabric.

Knitted underwear is made from all types of textile yarns, wool, silk, cotton, rayon, as well as mixtures of these in a variety of types of knitting, of weights, and of styles for men, women, and children. (*See* Knitting and Knitted Fabrics, p. 78.) The garments are fashioned to shape on the knitting frame or made from cut goods and sewn to the shape and size desired.

The following are the varieties of woven materials used in undergarments:

Women's Undergarments

	Slips, Petticoats	*Panties, Step-ins*	*Chemises, Nightgowns*	*Pajamas*
Cotton	Sateen	Crêpe	Cambric	Batiste
		Nainsook	Flannelette	Broadcloth
			Nainsook	Crêpe
			Voile	Flannelette
				Pongee
				Seersucker
Silk or rayon	Canton crêpe	Crêpe de Chine	Crêpe de Chine	Crêpe de Chine
	Crêpe de Chine	Flat crêpe	Chiffon	Brocade
	Flat crêpe	Satin	Georgette	Damask
	Habutai		Satin	Pongee
	Radium			Satin
	Satin			
	Taffeta			
	Brassières			
Cotton	Coutil			
	Poplin			
	Lace			
	Net			
	Sateen			
Silk	Satin			
	Crêpe de Chine			

MEN'S AND BOYS' UNDERGARMENTS

	Shorts, Drawers	*Pajamas, Night Shirts*	
Cotton	Broadcloth	Broadcloth	Nainsook
	Chambray	Cambric	Poplin
	Madras	Crêpe	Sateen
	Nainsook	Dimity	Soiesette
	Percale	Flannelette	Outing flannel
	Soiesette	Madras	Oxford cloth
Silk	Broadcloth	Broadcloth	Pajama check
	Radium	Crêpe de Chine	
		Pongee	
		Radium	

CHILDREN AND INFANTS' WEAR

Gowns	*Gertrudes, Petticoats*	*Diapers*	*Drawers, Bloomers*	*Bands*
Crêpe	Batiste	Birdseye	Cambric	Woven or knitted all-cotton, all-wool mixtures
Flannelette	Lawn	Canton flannel	Crêpe	
Longcloth	Muslin	Cheesecloth	Muslin	
Muslin	Flannel	Flannelette	Nainsook	
Nainsook	Flannelette			
Plissé				

"Unshrinkable" Wool. *Chlorination.* Wool is seldom if ever unshrinkable, but when wool fibers are treated with a dilute solution of calcium or sodium hypochlorite the scales are either removed or fused with the cortical region, hence shrinkage is decreased. Luster and affinity for dyes are increased, but strength is diminished.

An English process for making wool unshrinkable uses a solution of sulphuryl chloride, SO_2Cl_2, in any of several organic solvents such as a petroleum white oil. The wool material is steeped in the sulphuryl chloride-white-spirit solution at room temperature, and is then washed and hydroextracted, after which it is neutralized in dilute alkaline solutions of sodium carbonate or bicarbonate. The fiber, it is claimed, is not appreciably changed in appearance, as the scales are left intact, and the strength is about the same. There is less luster than when the chlorination process is used.

A new process for rendering wool unshrinkable has been developed by three chemists connected with the United States War Department, and patents have been secured. The process consists of treating the wool with tertiary amyl or butyl hypochlorite at 104° F. for a short period of time, the time depending upon the moisture content of the wool. The inventors claim that the treatment does not damage the wool.

Upholstery Fabrics. Material for the covering of furniture not only must be beautiful in design, color, and texture, in harmony with the decorative features of the room, but from the practical side must also be strong enough to withstand the strain to which it is subjected during the process of upholstering, as well as the weight of many occupants of the chair or couch it covers. It should be of heavy enough yarns and closely enough woven to keep its shape and not stretch; it must resist abrasion, have a non-roughing surface and not cling to the clothing of the sitter.

Pile fabrics of mohair do not crush as those of rayon pile do unless they have been processed to withstand crushing, but they do not always slip easily on the clothes of the sitters. All pile fabrics, of course, including velveteen now so frequently used for chair covering, catch dust and need constant brushing. Those of mohair or wool pile must be carefully watched to prevent attack by moths. Many wool upholstery materials, as well as the hair filling, are now mothproofed and guaranteed for a stated number of years. The slightly added cost of this treatment is well worth while to the purchaser. Satin, brocade, and damask fabrics are perishable and should be used only on furniture not to be subjected to hard usage. The floats in the weave should not be very long.

The materials listed below are employed for the covering of upholstered furniture or seats of chairs: antique satin, brocade, chintz, corduroy, cretonne, damask, frisé, rep, sateen, satin, tapestry, velveteen, and velour.

Care of Upholstered Furniture. Wet cleansing of upholstered articles is seldom a job for an amateur. Light colored and delicate fabrics require dry cleaning by experts. If home washing is considered feasible use the soapless cleansers, such as Dreft or Vel, which have no alkaline reaction to harm the fabric if, as is the case, they cannot be thoroughly rinsed out. Care should be taken to prevent soaking the stuffing or the woodwork. Therefore work with the foam rather than the liquid of the cleanser, applying it to small overlapping patches in succession. *See* Moths and Moth Control, p. 99.

Velvet. This rich, lustrous-appearing fabric is presumed to have been first developed on the shuttle loom by the Chinese. It was used by the Persians about 2000 B.C., and woven in exquisite designs by the Italians during the fourteenth and fifteenth centuries. Today it is made in pile weave entirely of silk yarn, either organzine or spun silk, as in all-silk velvet; of silk warp and pile with a cotton filling thread; with a ground, both warp and filling, of silk and a rayon pile as in transparent velvet. Some novelty velvets have a pile of Cellophane. If made entirely of cotton this pile fabric is known as velveteen. The denseness of the pile indicates the quality of the velvet.

Formerly velvets were woven over fine wires which raised the extra pile warp slightly above the ground warp, as is still done in the making of Brussels and Wilton carpet. After the weaving the wires were pulled out, thus leaving loops in what is termed "uncut velvet." If a cut pile was desired the loops were slit open by means of a knife on the end of the wires. In some types of velvet, particularly in ciselé, which has both cut and uncut pile, two sizes of wires are used in forming the pile, the larger wire having the blade with which to cut the loops for the cut pile, that is later sheared to the same height as the uncut pile. *See* Carpets and Rugs, p. 11; and Weaves, p. 189.

Most modern velvets are made by weaving two cloths with a short space between, across which an extra warp passes from one to the other. A small knife following the same movements as the shuttle cuts through this common warp, separating the two fabrics, and causing the short ends of the cut warp to form the pile on each of the two fabrics. In such fabrics as velveteen and corduroy a weft pile is formed by an extra set of filling threads which intertwine at intervals with the ground warp and form floats across the width of the fabric. When cut the ends of these floats form the pile. In all good velvets the pile is originally erect but during the finishing processes it may be flattened to obtain certain desired effects.

In brocaded velvet the figure is in pile with the ground in plain or satin weave. Formerly of all silk and woven on looms with Jacquard attachment, this velvet today is made with a rayon pile and silk ground, the pattern being printed on the all-over pile fabric with engraved copper rollers carrying a chemical which destroys the rayon pile where necessary for the design without affecting the silk ground.

Velvets are woven in the gum, which in the first of the finishing processes is removed by boiling. The fabric is then dyed, and when under tension live steam is forced through it for several minutes, and at the same time the pile is brushed first with hand cards then by rotating brushes. It is then beaten by revolving wooden blades, and to insure a pile of uniform height the velvet fabric next passes through the process of shearing. Velvets with the pile longer than 1/7 inch are known as plush.

In the finishing of panne velvet the pile is usually brushed in one direction, set by steam and pressure, then run between a heated cylinder and a metal plate, so that the luster of the material may be fully brought out.

To make them less perishable modern velvets are subjected to special processes. They are frequently showerproofed to make them water repellent, but with one or two exceptions they lose this finish in dry cleaning. To an ever-increasing degree velvets are impregnated with a synthetic resin to make them more resistant to crushing and creasing. *See* Finishing of Fabrics, p. 57.

The following are varieties of velvet found in general use today:

Brocaded Velvet. The erect pile or the pressed rayon pile in this type of fabric is formed in designs on a ground of chiffon, taffeta, crêpe, or metal.

Chiffon Velvet. An extremely light-weight dress velvet made with an erect pile in either silk or spun silk with either a silk or cotton back.

Coating Velvet. A silk or rayon pile velvet with cotton back. It is very closely woven and rather heavy in weight.

Lyons Velvet. A crisp velvet with short silk pile and back of either silk or cotton, used chiefly for millinery and garments. Lyons-type velvet has a rayon pile and a ground of cotton or silk; it is stiffened after weaving to simulate the costlier Lyons velvet.

Panne Velvet. A light-weight velvet with its pile pressed flat in one direction. It has a decided luster and is used chiefly for millinery.

Shoe Velvet. An erect, short-pile fabric especially constructed for shoes.

Transparent Velvet. A light-weight, thin-textured velvet which in the better grades is made with a warp and filling of organzine and an erect pile of rayon. The cheaper grades in general have a spun silk or organzine ground warp, cotton filling, and rayon pile.

Uncut Velvet. The pile loops in this type of velvet are left uncut.

Upholstery Velvet. A heavy, wide velvet with either an uncut or a cut pile used for draperies and upholstery.

Washable Velvet. This type will wash without losing its original appearance.

Care of Velvets. Velvet is a delicate material and should receive special care whether in ribbon, trimming, wraps, or gowns. To keep the pile erect or to raise it when it has become flattened or crushed, a velvet garment should be steamed over a kettle of boiling water, the steam being forced through from the wrong side of the fabric; hung in a bathroom over a tub filled with steaming water; or pressed with a warm iron over a needle or velvet board with the pile against the erect wires. In place of a needle board use a hot iron turned up and covered with a wet cloth; draw the wrong side of the velvet tightly over the steaming cloth. Velvet articles should always be well and frequently brushed to prevent the collection of dust in the pile.

When cutting garments of velvet care should be taken to place the pattern on the material so that the pile runs from the bottom toward the top of each piece. This ensures richness and depth of texture and color.

Velveteen. Made in imitation of the costlier silk velvet, velveteen is woven entirely of cotton yarns. The pile is made by extra filling threads bound into the ground texture and carried as floats over the regular warp, then slit by specially constructed knives after the material is woven. It is finished by operations similar to those employed on velvets.

Velveteen is used not only for dresses and coats but for draperies and upholstery as well. It may be laundered successfully by washing in a rich suds, rinsed, and hung up without wringing.

Vicuña. A small, wild, goatlike animal of the cameloid family whose habitat is the high plateau region of the Andes. The inner hair of the vicuña fleece, exceedingly soft and fine in texture, furnishes fibers for very rare and beautiful fabrics. *See* Fibers, under Textile Tests, p. 157.

Vinyon. A new synthetic filament produced by the Union Carbide and Carbon Corporation. Report says that Vinyon is a vinyl resin (a polymerization product) dispersed in acetone and spun. It is claimed to have resiliency, mildew repellency, and resistance to acids and alkalies.

Virgin Wool. This is new fleece wool obtained from live sheep. The term is used to designate wool that has not been subjected to any of the manufacturing processes, in contrast to remanufactured or reclaimed wool. (*See* Reclaimed Wool, p. 122.) It varies in quality according to different breeds of sheep and to its position on the fleece, whether on the head, back, legs, etc.

Warp-print Fabrics. These are usually silk ribbons or silk or cotton fabrics in which the design is printed on the warp threads before weaving takes place. Tapestry carpets also have the warp yarns printed while wound on huge drums, before being threaded into the loom. The blurred, softened edge of the design characterizes all warp-printed or chiné materials. *See* Printing of Fabrics, p. 113.

Waterproofing. *See* p. 64.

Weaves. The interlacing of at least two sets of threads at right angles to each other to form a woven cloth may be so manipulated on the loom as to produce a variety of surfaces or types of cloth. The three fundamental weaves on which others are based are plain, twill, and satin. Those which are modifications or combinations of these are known as figure, pile, double, gauze, leno, extra thread, and novelty weaves.

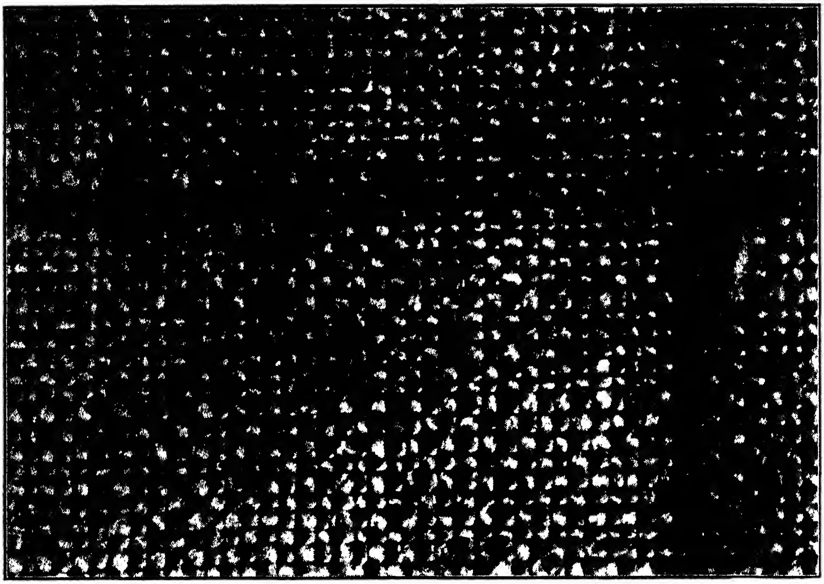

FIG. 17. Plain weave.

Plain Weave. The simplest type of weave is made by interlacing the filling or crosswise threads with the warp or lengthwise threads alternately under and over one, as in simple basketry. The result is a strong, firm cloth, both sides exactly the same in appearance and the basis of practically all printed fabrics. Examples of this weave are found in the following fabrics: in cottons—sheeting, organdie, gingham, and voile; in linens—crash, handkerchief, and suiting linen; in wool—challis, homespun, flannel, and crêpe; in silk—chiffon, taffeta, crêpe de Chine, and habutai. Fig. 17.

Variations of Plain Weave. By using a heavier thread in the warp than in the filling an interesting simple pattern may be made with the plain weave. This may be reversed, the heavier threads being in the filling. This is known as the cord or rib weave and is to be seen

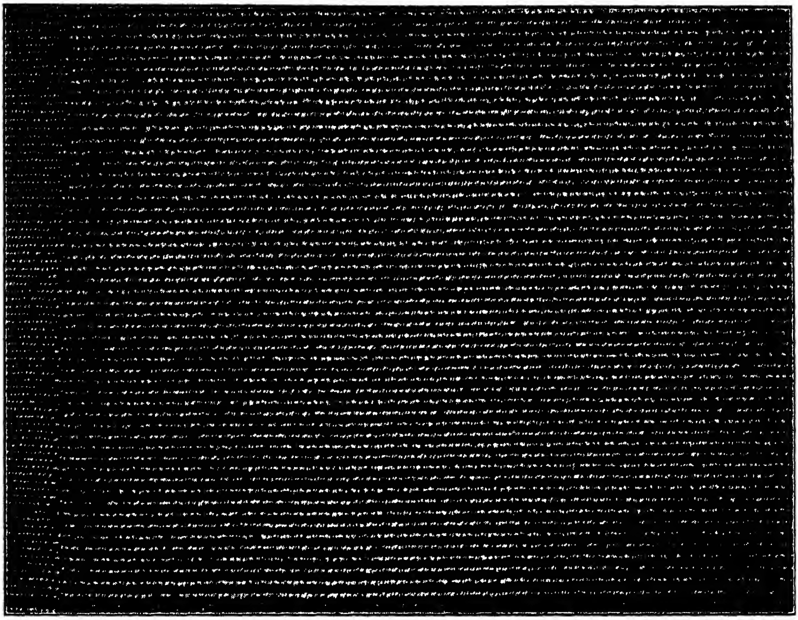

FIG. 18. Plain weave variation: rib weave.

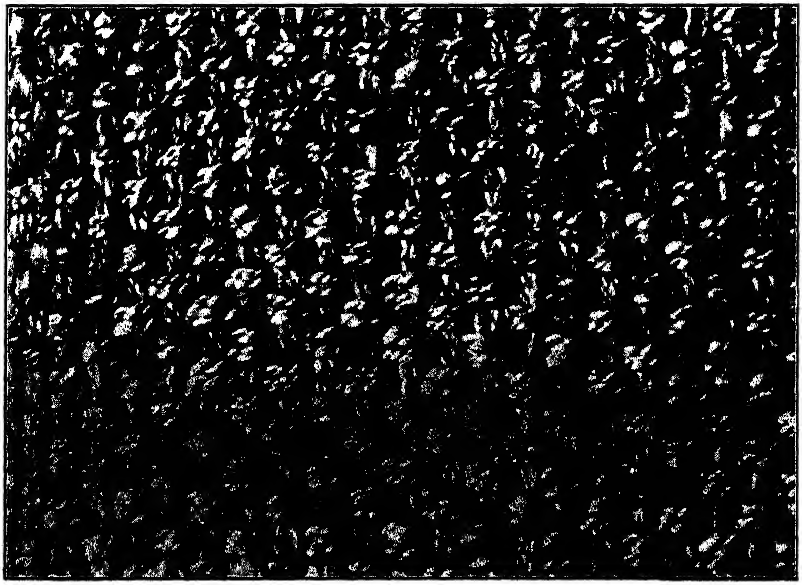

FIG. 19. Plain weave variation: basket weave.

in rep and poplin. Fig. 18. By passing two or more filling threads under and over two or more warp threads the basket-weave variation is obtained, as is found in monk's cloth and oxford shirting. Fig. 19.

Twill Weave. If the warp and filling threads are interlaced so that the filling passes under two and over two warp yarns, then in being carried back by the shuttle splits, every group continuing to pass regularly under two and over two warp threads, a diagonal line is produced across the surface of the cloth. Fig. 20. On the wrong side the

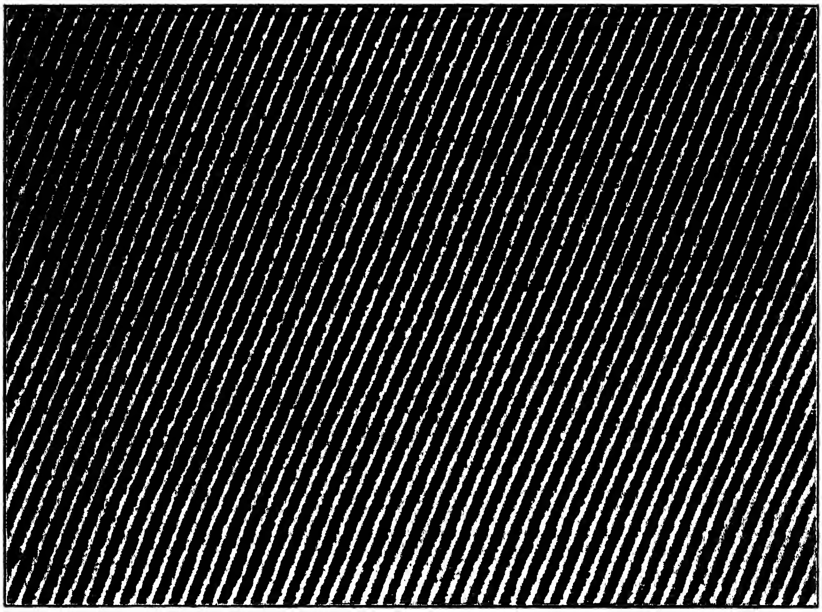

FIG. 20. Twill weave.

diagonal line runs in the opposite direction. There are many forms of twill weave. Twills may run to the right or to the left or in both directions, the last forming the design known as the chevron, herringbone, or broken twill. They may also be made so that either filling or warp threads are thrown on the face. In one type of four-shaft twill the filling goes under one and over three warp yarns in one row of weaving and in the next row continues to go under one and over three but in such a manner that the warp passed over is always one thread to the left of the warp passed over in the row above. This makes for a filling-faced twill.

Fabrics woven with the twill weave are generally quite compact and may contain heavy or fine yarns; tightly twisted yarns increase the clear-cut effect of the diagonal ridges. This type of construction is used for serge, whipcord, some tweeds, drilling, and surah.

Satin. By an irregular interlacing of warp and filling yarns with a regular progression of one or more threads at the point of interlacing, a smooth, lustrous-surfaced fabric results. This weave, known as satin weave, is in reality a form of broken twill and is quite different on the two sides.

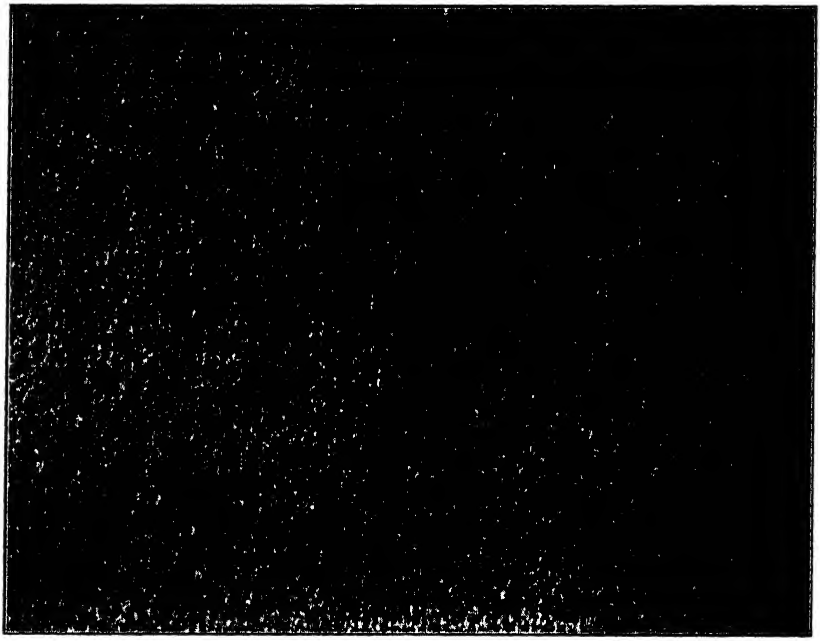

FIG. 21. Satin weave.

When the filling passes several times under an individual warp thread the warp thread is thrown to the face of the cloth, is unattached for a short space, and is known as a "float." This same thing happens when the filling thread passes over or under several adjacent warp ends, only in this instance the filling thread is thrown to the face and becomes the float. In the first case, when the float is warpwise we have what is considered by some the true satin weave; the filling-wise float forms the so-called "sateen" weave, usually found in cotton fabrics. Damasks are often woven with the background in sateen weave and the figure in satin weave. The length of the float in satin weave is important inasmuch as it governs the luster of the surface and its

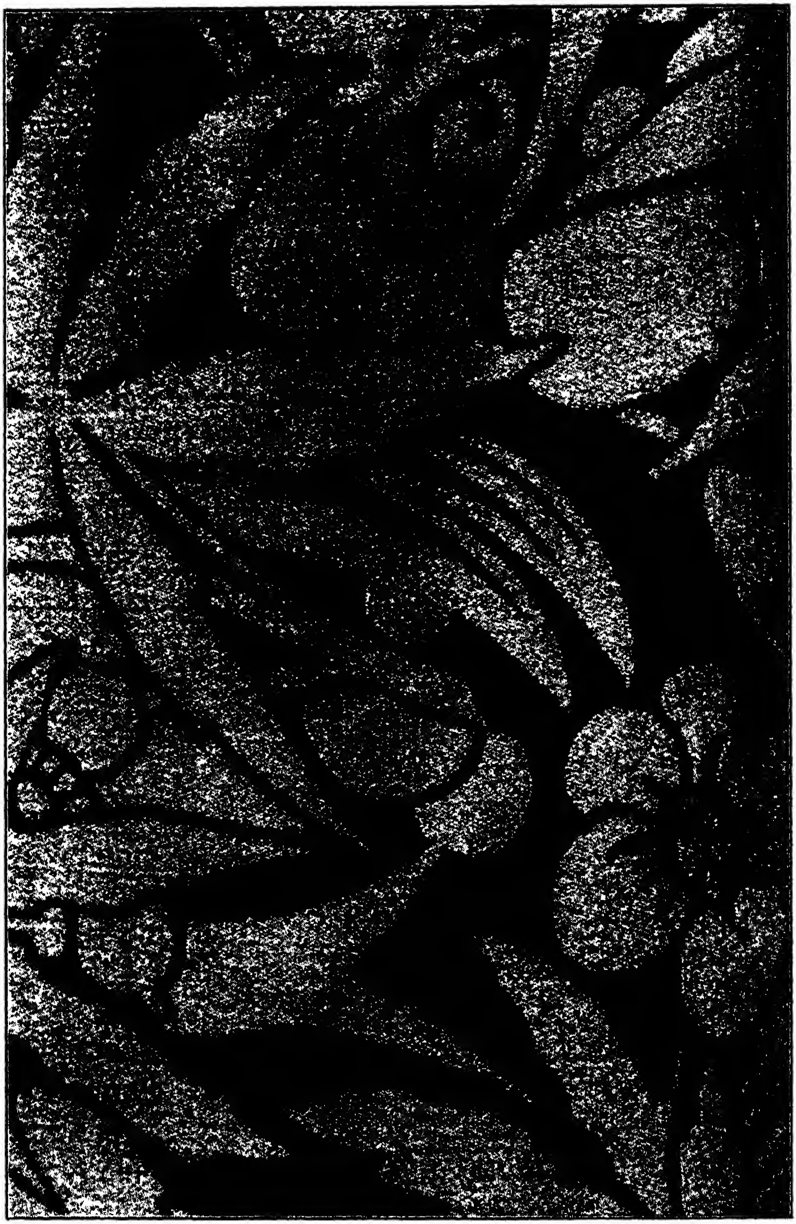

Fig. 22. Figured weave.

wearing quality. A very long float will catch quickly, pull, and damage the cloth. For this reason materials made in this construction should not be subjected to hard usage.

The satin weave is used in the manufacture of satin, Venetian, and the now seldom made but excellent-wearing prunella.

Figure Weaves. Many fabrics have designs large or small, geometric or floral, woven directly into them by means of combining two or more of the fundamental weaves, plain, twill, or satin or their variations. The face and back of the cloth may show the same design as in huckaback, or in the reverse as in damask, or be totally different as in brocade. The correct interlacing of the threads becomes a somewhat complicated matter when the designs are elaborate and the repeats cover a large area. Consequently intricate weaves are constructed on a loom with the Jacquard mechanism (*see* p. 199); attachments such as the cam or dobby may be used on the ordinary loom to weave simple figures as in birdseye, huckaback, or other small geometric arrangements. Fig. 22.

Examples of Jacquard or elaborate figure weaving are found in brocade, brocatel, damask, and tapestry; simple figure weaving is shown in huck toweling and some madras shirting. Fig. 23.

Pile Weave. In the pile weave there are certain additional threads, either warp or filling, so interlaced with the ground threads as to form loops on one or both surfaces of the fabric. If the loops are uncut and on both sides, terry cloth results (Fig. 24); if uncut and on one side only, the face of the cloth, uncut velvet may be made; in floor coverings this would be found in Brussels carpet. When the loops are cut, tufts of yarn stand erect from the body of the cloth, giving it a "cut pile." This occurs in velvet, velveteen, and corduroy.

In cut-pile carpets the pile warp is looped over wires which have a razor blade at one end. As the wire is withdrawn from the loom after a few picks have been shot across, the blade cuts the loops open. In such fabrics as velveteen and corduroy a weft pile is formed by an extra set of filling threads which, intertwined at intervals with the ground warp, form floats across the width of the fabric. When cut, the ends of these floats form the pile. Fig. 25.

Another method of producing pile fabrics is to weave two cloths face together on the loom with the pile warp interlacing between the two cloths and to cut them apart while still on the loom. *See* Velvet, p. 181.

Some fabrics have pile of different depths, forming patterns with long pile on a background of short pile. When the weaving is done

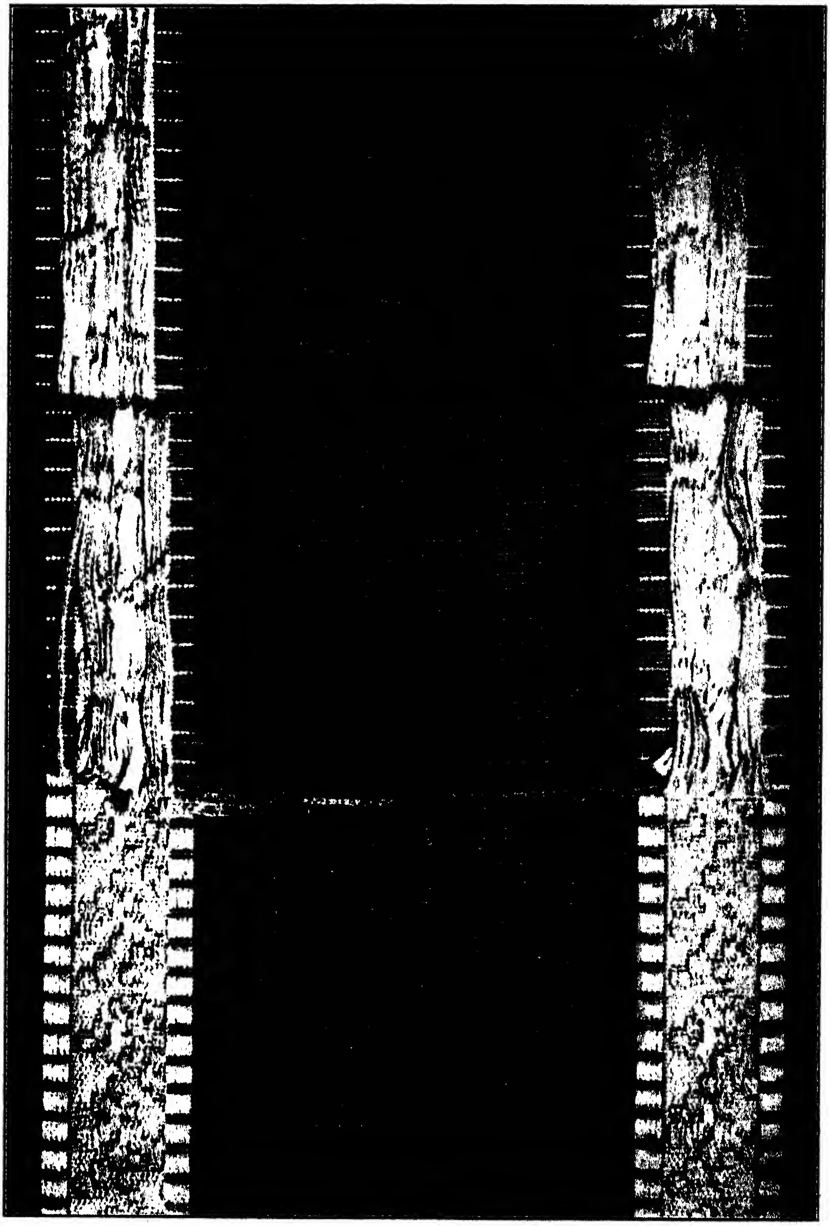

FIG. 23. Figured weave. Brocade, showing right and wrong sides. Moiré pattern on right side.

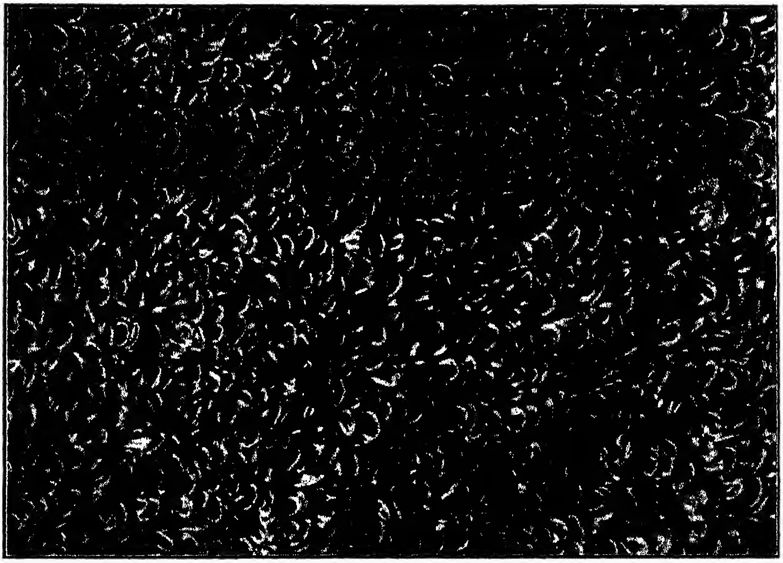

FIG. 24. Uncut or looped pile; terry cloth.

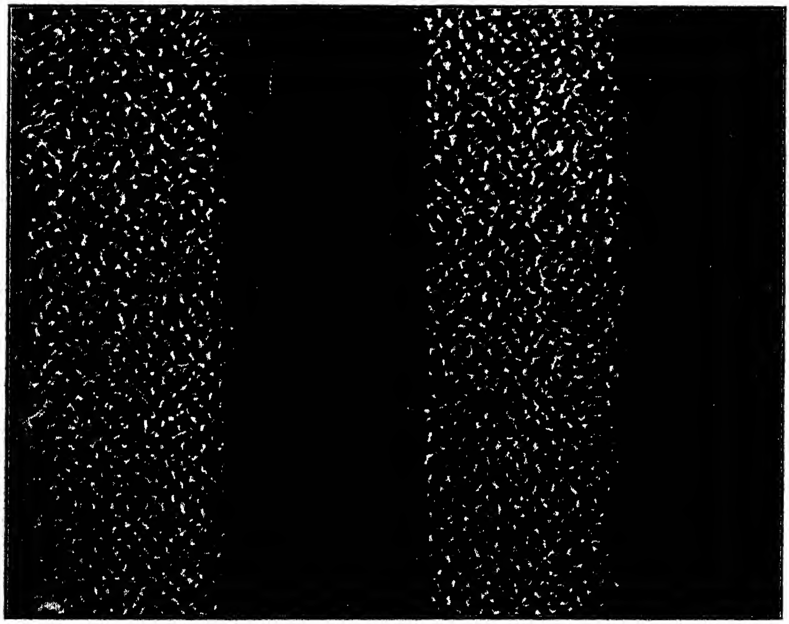

FIG. 25. Cut and uncut pile weave.

with a warp pile, wires of varying thickness along their length are used; if the filling forms the pile the floats are made of different lengths. Still another method in common use consists of pressing part of the evenly woven pile flat, then cutting short the erect pile. When the pressed parts are brushed up, a design in two lengths of pile is formed.

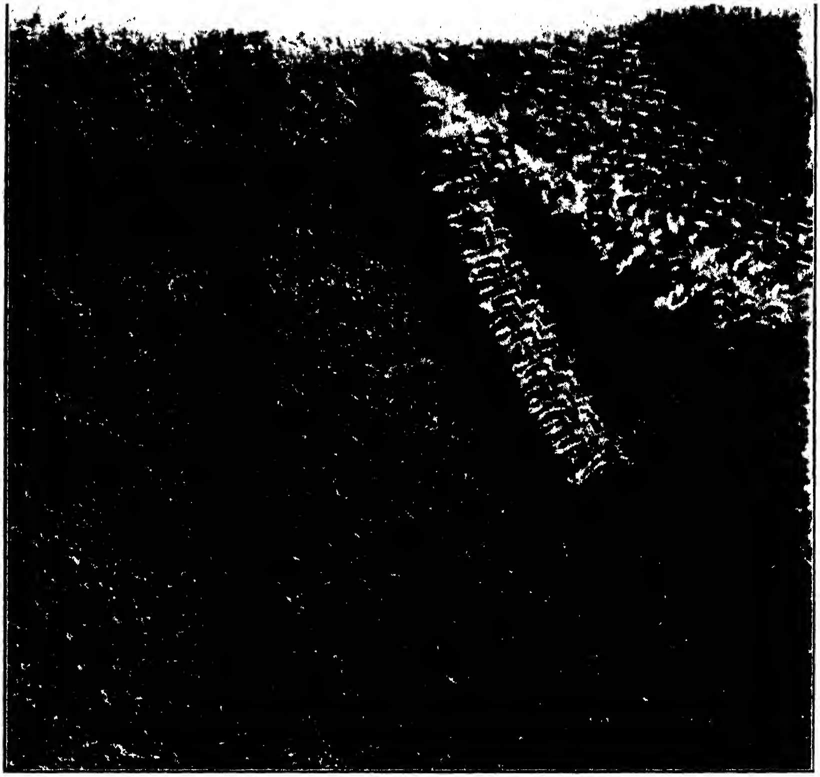

FIG. 26. Double cloth weave.

Double Cloth Weave. The name of the weave is practically self-explanatory, as literally two cloths are made on the loom at the same time, each with its own set of warp and of filling but joined invisibly by extra warp or filling threads interlacing them together. In some cloths the filling yarns of one cloth interlace with the warp yarns of the other set. Frequently the two sets of yarns weave separately to form the figure, then combine to make the background. In making seamless pillowcases two sets of warp are placed in the loom, then the one filling thread interlaces first with the upper set of warps then with the second or lower set, making a tubular fabric.

Gauze Weave. A lacy, open effect in woven fabrics is obtained by means of the gauze weave, wherein two sets of warp threads are used. One in every pair of warps is half twisted about the other, then a filling is shot through to keep the threads from untwisting before the same movable warp is again half twisted about the other stationary

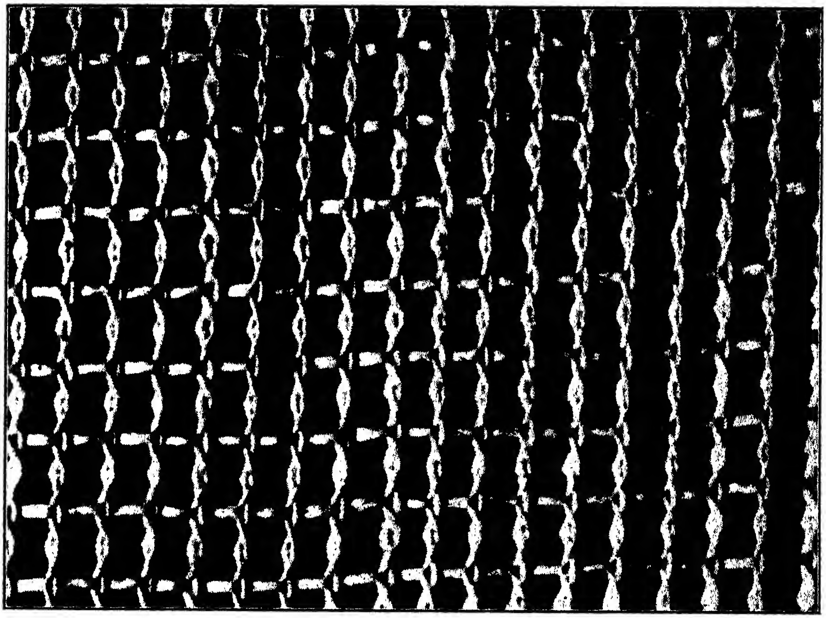

FIG. 27. Gauze weave.

and standard yarn. This twisting movement is made possible by means of a doup or movable heddle connected with a regular heddle in the harness of the loom. The doup is moved to right or left as the warp which it contains is required to twist in first one or the other direction. Fig. 27.

The leno weave frequently used synonymously with gauze under the generic term of crossweaving, is a combination of gauze and plain cloth and produces an open, lacy effect. These openwork weaves are found in such cotton and rayon fabrics as marquisette and madras as well as in some dishcloths.

Lappet Weave. The term "extra thread" is sometimes applied to both lappet and swivel weaves because in addition to the regular

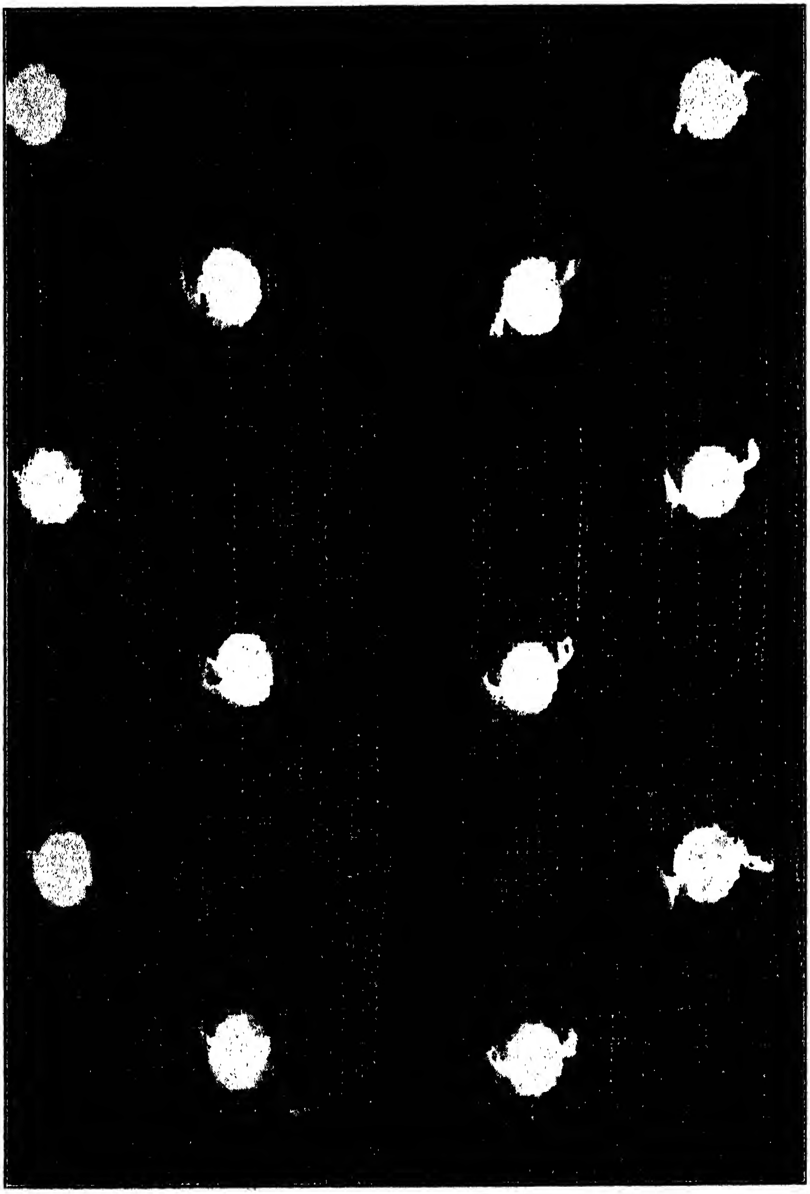

FIG. 28. Lappet weave, right and wrong sides.

ground warp and filling threads extra threads are necessary to embroider or weave in the spot designs. In the lappet weave a frame holding needles is fastened to the loom near the reed, so that the needles are at right angles to the woven cloth through which they work up and down as the weaving takes place. Each needle carries the "whip" thread which it stitches into the web, thus forming a solid dot or figure with exactly the same appearance on both sides of the cloth with the exception of the thread that is carried by the needle from one spot to another on the next row along the back of the cloth. These floating threads must be cut away when the fabric is being finished. The lappet-made figure is always securely held in place and is found in high-grade swisses, muslins, and voiles. Fig. 28.

Swivel Weave. The figures in curtain and dress fabrics, of either plain or gauze background weave, may be obtained by the swivel weave. Each figure across the material from selvedge to selvedge is woven by means of a tiny shuttle carrying the necessary extra filling thread, which is woven in after the regular shuttle has been thrown across the shed. As many shuttles are essential as there are figures across the width of the cloth, and the yarn from each shuttle is automatically cut off as soon as it is interlaced with the warps. This gives a rough effect to the figure on the wrong side of the cloth and in fabrics of low thread count may readily be pulled out. Fig. 29.

Novelty or Fancy Weaves. In general these weaves may be classified as two or more of the standard weaves combined to produce effects which are unusual but do not become accepted as staple materials. Each season several novelties are offered, in cotton materials particularly.

Weaving. This is the interlacing of two or more sets of threads crossing each other at right angles. One set, the warp or ends, is placed in the loom first, stretched between two beams; the other, termed the weft, filling, or pick, is interlaced at right angles with the stretched warps. Unlike those of looped or twisted construction, woven fabrics are firm, lacking the elasticity of fabrics of the former type. They also do not pull apart as readily as felted materials. Woven cloth is constructed from a variety of yarns in many designs and in many textures and weights, from the sheerest chiffons to heavy carpetings.

Different classes of fabrics are woven on different looms, of which there are a great variety, such as carpet, narrow fabric, blanket, velvet, plain cotton, silk, woolen and worsted looms. When intricate designs are desired special attachments are employed in conjunction with the loom.

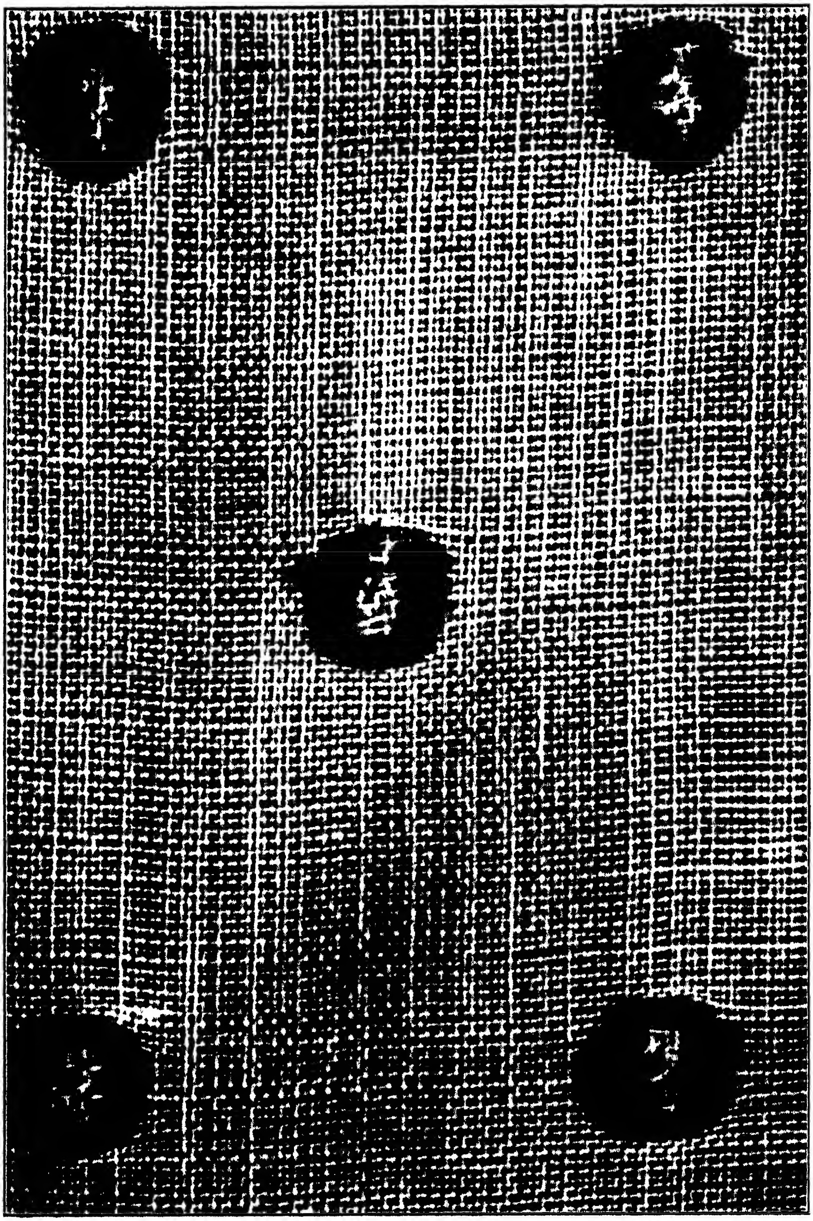

FIG. 29. Swivel weave, showing ends of threads on the wrong side.

However simple or intricate the loom may be, whether operated by hand or by electric power, the essential parts and operations are the same. All looms require warp threads which are generally stronger than the filling threads and which are specially prepared in an operation known as warping. Some types of warp yarns must be sized.

Preparations of the Threads for Weaving. Warping. Bobbins on which are wound the threads to form the warp are placed in upright frames or creels. As the threads must be of sufficient length to run the entire yardage of the cloth they are wound on a huge drum into the number of yards required, and a crossing or lease made so that the threads can be kept in perfect order. The ends, of the number necessary for the count and width of the particular cloth to be constructed, are passed through a reed to prevent entanglement, distributed evenly, and wound on a wooden cylinder known as the warp beam. Before this beam is placed in the frame of the loom the warp is passed over a roller and through a preparation of tallow mixed with starch size for the purpose of increasing the smoothness and the strength of the yarn so that it may withstand the friction and strain of the weaving process.

The weft or filling is not sized, but wound from the cops on which it was placed during frame spinning onto small bobbins, which, in turn, are inserted into a boat-shaped contrivance called the shuttle, that carries it back and forth through the sheds during weaving. Filling yarn is sometimes spun directly onto the bobbins.

Threading the Loom. In the center of the loom between the beam at the back, holding the warp, and that at the front on which the cloth is wound as the weaving progresses, are (*a*) the harnesses or shafts holding (*b*) the heddles, and (*c*) the reed. There may be as few as two harnesses for a plain weave or more than twenty for intricate patterns. Each harness consists of a rectangular metal frame to which are attached at top and bottom the required number of fine metal strips (heddles), with an opening or eye in the center of each. Every warp thread must pass through the eye of one of the heddles on one of the harnesses in the order designated by the pattern draft. Each harness as it is lifted or lowered by the automatic controls of the power machine carries up or down with it the threads passing through the eyes in its heddles; forming a shed with the other warp threads in the other harnesses that have not been moved.

A few inches in front of the harnesses, and parallel to them, the reed extends across the loom. This is a narrow rectangular frame holding a great number of fine vertical wires set rather close together, their distance apart being dependent on the desired distance between the warp threads. In these dents of the reed one or more warp ends are passed on their way to the cloth beam at the front of the loom. The reed is capable of a backward and forward movement, while the harnesses move up and down. The reed serves several functions: it helps control the width of the cloth, keeps the warps parallel as they come from the heddles, and battens or presses together the filling threads after they have been inserted in the shed. When the warp ends are finally fastened to the cloth beam at a proper and even tension throughout, the operation of weaving is ready to be started.

The threading of a loom is a painstaking, slow process necessitating days of labor on the part of skilled workers, particularly for elaborate patterns requiring many harnesses. For fabrics of the same design, time and expense can be saved by tying the ends of the new warp to those already in the loom before the ends of the finished cloth have been drawn through the reed and heddles.

The Process of Weaving. The essential mechanical processes of weaving, whether on a hand- or power-driven machine, consist of (*a*) letting out the warp threads and winding the cloth as finished on the cloth beam; (*b*) shedding, or the raising and lowering of specified harnesses and the thread they control so that the shuttle may be passed back and forth in the operation of (*c*) picking; and (*d*) the battening or beating together by the reed of the filling threads after they have passed through the shed, to make the cloth firm and compact.

Loom Attachments. More intricately designed fabrics than the plain loom is capable of weaving necessitate some attachment or mechanical device for controlling the shedding. In patterns requiring eight or more harnesses the dobby attachment is applied to the cotton or the rayon loom, while the head motion attachment is applied to the woolen or the worsted loom. With the lappet attached to the regulation loom, designs resembling hand embroidery are woven on the surface of the cloth. A bar across the loom near the reed contains a series of needles which stitch the dot or other small motif into the fabric during the process of weaving.

Another attachment for the construction of small, all-over designs is the swivel. Numerous tiny shuttles above the loom carry the extra yarns back and forth in the shed between the regular picking as far as called for by the pattern. Special attachments controlling the extra half heddles or doups cause the doups to be drawn first to one side then to the other of the standard heddles after the filling has been thrown across the shed. This creates a crossing of the warps one around the other to form open, lacy fabrics of the gauze or leno weaves.

For extremely elaborate designs calling for a great number of harnesses an intricate mechanism known as the Jacquard attachment, invented by Jacques Marie Jacquard of France in 1801, is employed. In the Jacquard harness each warp thread, including each of its repeats crosswise of the pattern, is controlled individually; consequently it can be raised or lowered as called for in intricate designs where the repeats are several inches in length. To the heddle carrying the warp is attached at the lower end a weight which causes the warp to drop; at the upper end is a wire hook controlled by horizontally placed needles at the top of the attachment, high above the loom and directly over the warp threads. These needles are in turn controlled by the perforations in a series of narrow cards attached in endless-chain formation. Each card with its perforations represents one pick, and as the cards revolve over a cylinder the needles that enter the holes in the cards carry up with them the hooks and warp threads to which they are attached. The needles that do not meet perforations to penetrate permit the warps which they control to drop, pulled down by the weights. Thus a shed is formed by some warps being lifted, some being dropped, and the shuttle carrying the filling thread is shot through.

This intricate device, a veritable maze of cords, cards, and needles, is employed on many types of machines for making many varieties of woven and knitted fabrics as well as laces and carpets.

Weighted Silk. Raw silk contains on an average 25 per cent by weight of silk gum or sericin. This is usually removed before dyeing, although sometimes the degumming and dyeing are carried on simultaneously. This loss of weight, silk being bought and sold by the pound, is partly responsible for the practice of adding metallic salts and other weighting substances to silk in the dyeing and finishing operations.

This practice has its advantages and disadvantages, from the standpoint of the silk itself. When silk was a luxury fabric, weighting brought it within the reach of modest incomes. An otherwise sleazy weave, being weighted to a proper degree, became firm, drapable, lustrous, without losing softness, and reasonable in price. But with no restrictions on the amount of weighting, or the method used, some weighted silks were so shortlived that their purchase was a lottery and a disappointment. In extreme cases weighted silks have been known to split to shreds on one wearing. Such instances belong to the past rather than the present; less weighting is practiced on the whole, and better methods are employed. The increase in the use of rayon has made cheap silks less popular, and labels indicating pure-dye silks safeguard the consumer.

The usual weighting materials for silks other than blacks are combinations of stannic chloride, disodium phosphate, sodium silicate, with other chemicals. In common terms, this is referred to as tin weighting. Silk has considerable affinity for metallic salts, and can take up by absorption and adsorption increasing amounts of these by repeated immersions.

Iron salts are sometimes used for weighting blacks. Weighting materials are red iron, or so-called copperas nitrate of iron, and black iron, called pyrolignite of iron. The black iron gives a bluer black than the red iron. With tannic acid, iron tannate is formed. These iron salts, as when used with logwood, are mordants as well as weighting substances, and necessary to the process. Other chemicals may be used for increased weight.

There is no one process for tin weighting. One method, which might be followed in the classroom for the sake of illustration, using a thin, unweighted silk for the foundation material, is:

1. Soak the silk in a solution of stannic chloride of about 25° Baumé strength for 1 hour at room temperature, or better, 60° F.

2. Hydroextract and wash thoroughly.

3. Soak 1 hour in a 6° Baumé solution of disodium hydrogen phosphate at 130° to 140° F. This causes a fixation of the tin salt as tin phosphate:

$$SnCl_4 + 2\ Na_2HPO_4 = Sn(HPO_4)_2 + 4\ NaCl$$

4. Hydroextract and wash thoroughly.

5. Soak in a solution of sodium silicate 3° Baumé for 1 hour at 140° F. This fixes the tin as the very insoluble tin-phosphate-silicate:

$$Sn(HPO_4)_2 + Na_2Si_3O_7 = Sn(Si_3O_7)(HPO_4) + Na_2HPO_4$$

6. Hydroextract, wash thoroughly, and dry.

Lead weighting of silk has been practiced to a limited extent. The process for tin weighting is made to include a treatment with a solution of lead acetate. This fixes the lead in insoluble form as a phosphate or silicate with the tin, and is said to add considerably to the weight of the silk without giving it increased harshness. Opinions on lead weighting seem to be mainly on the side that it should not be encouraged, at least in fabrics to be worn next to the skin, because of the possible solvent effect of perspiration on the lead salts. Lead salts can be absorbed through the skin.

Weighted silks dry-clean and redye less well than pure-dye silks. No one needs to purchase weighted silks in yard goods unaware, for the burning test given under Textile Tests, p. 167, is conclusive and easily performed on a sample of the material.

Wild Silk. Several varieties of silkworms are impossible of domestication in the same way as the mulberry-eating silkworms, and the white to brownish silk they produce is called wild silk. The term tussah has been generally applied to all wild silks of China and India, but specifically it is the name of a variety produced in India that is gray or brown in color.

Wild silks are uneven in diameter, coarser, and greater in tensile strength and elasticity than the cultivated variety but are more difficult to degum, bleach, and dye. The silk from some of the tussah cocoons is reeled, but great quantities have to be treated as spun silk. (*See* p. 145.) Pongee is one of the best-known and most commonly used silk fabrics woven from wild silks. *See* Textile Tests, p. 172.

Wool. Generically, wool is the outer hairy covering of a number of animals—goats, camels, the llama, sheep, etc. *See* Fibers, p. 155. Many of the processes through which this hairy covering must pass in order to be made up into fabric are similar for all. Here, however, the discussion will be limited to a consideration of the wool from sheep.

Sources and Varieties. Sheep-raising for wool is a large and important industry in many countries. China, Turkey, and Siberia produce sheep the wool of which is coarse as well as very long, two characteristics which make it desirable for yarns used in the manufacture of carpets, while England, Australia, the United States, Germany, South Africa, and South America concentrate on breeds of sheep producing softer and finer wool. These are the Merino, first developed in Spain between the fifteenth and seventeenth centuries, and various cross breeds produced by crossing the fine-wool Merino with long-wool sheep of native stock. Australia, South Africa, South America, and New Zealand are famed for their fine Merino flocks; Germany for its Saxony; France for its Rambouillet; and England for its Down breeds which produce mutton as well as long wool. The Spanish Merino, the French Merino or Rambouillet, and the many English breeds have all contributed to the upbuilding of the flocks in the United States, which produces only a part of all the wool that it uses. The best grades of merino wools are grown in the eastern and middle western states and are known as domestic; from Idaho, Nevada, Montana, Wyoming, Texas, and California come high-grade products designated as territory wools. Climatic conditions, pasturage, and care as well as type of breed are important in determining the quality of wool and in turn the type of cloth into which it is to be made.

Shearing. On the large sheep ranches the wool is sheared from the sheep in one piece (fleece) by power-driven clippers; on small farms shearing with hand clippers is customary. In the northern hemisphere shearing is done in the spring of the year, though in some localities, as in California and Texas, it is done twice a year. From the pelts of slaughtered sheep is obtained pulled wool used chiefly for felts and fabrics of soft-twist yarns. The hide may be sweated, its flesh side painted with lime or a depilatory preparation, and the wool simply pulled out; this in no way damages the hide for other purposes.

Grading and Marketing. The quality of wool depends in large measure upon the breed of the sheep producing it, but it varies greatly also within the breed itself. Consequently before it is sold to the manufacturer the fleece is graded and classed according to its fineness or diameter of fiber and its length. Its fineness is designated by such terms as "half-blood," "three-eighths blood," and "quarter blood," or by numbers, as 70's or 58's, according to the fineness of count into which it can be spun; its length is described in such terms as "combing," "French combing," and "clothing" wools. Combing wools, usually 2½ or more inches in length, must be sufficiently long to undergo the process of combing; those fine wools classed as "French combing" are shorter, 1½ to 2½ inches, but of sufficient length to be handled in the French or Heilman comb. Clothing wools are those under 1¼ inches in staple, and because they are suitable for carding only they are frequently designated as "carding" wools.

The grading of wool is done in different places in different countries, either on the ranches or in warehouses. Wool is marketed in a variety of ways: in England and the dominions it is sold through auctions; in the United States it may be sold (*a*) directly to the mills, (*b*) to local dealers, (*c*) through farmers' cooperative sale agencies, (*d*) to visiting buyers for middlemen or mills, or (*e*) to commission houses. The chief world marketing centers for wool are Sydney, Boston, Buenos Aires, and London; Boston, Philadelphia, Chicago, and St. Louis handle the buying and selling of this product in this country.

The Manufacture of Wool. Processes Preparatory to Spinning. As the fineness, staple, strength, softness, color, and felting qualities of wool determine its suitability for certain yarns and cloths, and as each fleece contains wool of varying quality on the different sections, the wool must be sorted in the mill as the first step in the manufacturing process. The sorter first skirts the fleece, removes the most soiled and matted parts, then places in separate bins the wool from the different parts of the animal—shoulders, sides, back, thighs, and finally britch and belly, the last yielding the poorest wool on the fleece. The short-staple wool, clothing wool, is reserved for the making of woolens; the long-staple, combing wool, ranging from 2 to 8 inches in length, for worsteds.

Scouring. The sorted wool is a product anything but clean, containing as it does dust, vegetable matter, natural grease (yolk), and dried perspiration known as suint. The finer wools contain more grease than the coarser ones and consequently shrink more in the removal of all foreign matter. This wool "in the grease" must be thoroughly dusted, then washed or scoured in a series of alkaline soap and water baths, in high-test gasoline, or in one of the new detergents, such as Gardinol. When well rinsed the wool is carried on a moving belt through a dryer, but for ease in later milling operations about 20 per cent of moisture must remain in the wool.

Two other methods of cleansing the sorted wool are being adopted in this country, the solvent and the freezing or frosted wool methods. In the solvent method the grease is removed from the wool by means of high-test gasoline; in the frosted wool process the wool is placed in a freezing chamber where the grease is thoroughly frozen and reduced to a state of extreme brittleness. This, together with the dust, vegetable and other foreign matter adhering to it is next beaten off the wool fiber, leaving it ready for a light scouring and drying.

All wool must be scoured or cleaned before the actual manufacturing processes begin, but the time when it is done depends on whether the wool is to be spun into woolen or worsted yarns. In the manufacture of the woolen yarns the wool may be scoured many months before it enters on the subsequent processes; in the manufacture of worsted yarns the combing wool is blended with other types of wool before it is scoured and is taken immediately after drying to the card. As there are other very important differences in the manufacture of the yarn for these two large classifications of wool cloth, and the two industries are quite distinct, the discussion of each will be taken up separately.

The Manufacture of Woolen Yarns. Burrs and other vegetable matter are removed from the scoured wool either by a chemical process known as carbonizing or by burr-picking machines where by means of toothed, wire-covered cylinders and strong air currents the vegetable matter is removed. In the carbonizing process, which is considered preferable as it removes every trace of vegetable matter, the wool is immersed and soaked in a bath containing dilute sulphuric or hydrochloric acid and thoroughly dried at a high temperature. The charred vegetable matter is later pulverized and beaten out of the wool.

After scouring, the wool may be dyed in the raw stock—a highly desirable procedure as the dyestuff penetrates the fiber more thoroughly than when it is in either the skein or the piece.

Blending and Mixing. Wool of various grades is then mixed or blended together, and as woolen fabrics may contain in addition to virgin wool the fibers of either cotton, silk, or rayon, sometimes of shoddy or reclaimed wool (*see* p. 122), the blending of the raw materials is an important step in woolen manufacturing. Alternate layers of the different stocks are built up and put through the mixing picker, a machine which opens and mixes the stock ready for carding. If hard-twisted threads of any kind are to be combined with the virgin wool they are first subjected to the process of garnetting, in which they are broken up and returned to their fibrous state.

Carding. The number and kind of the processes by which woolen yarns are produced differ somewhat from those employed in the manufacture of worsted yarns, but the chief difference lies in the elimination of combing and the sort of carding which is given to woolens. Three successive machines (*see* Carding, p. 7) open the wool, disentangle the bunches, clean and mix the stock, and finally deliver it in the form of uniform roving. These soft strands of carded yarn are next drawn out and twisted into a yarn on either the spinning frame or the more commonly used woolen mule. *See* Spinning, p. 142. Twisting it into two or more ply yarn, winding it into skeins for dyeing or onto bobbins preparatory to warping, complete the steps in the preparation of the loosely spun and fuzzy yarns that are woven into cloth that has an obscure weave, frequently a napped surface, and consequently soft, fluffy texture.

The Manufacture of Worsted Yarns. From the scouring room the clean, dried, and warm combing wool is blown through tubes to the floor containing the worsted carding machines. In these the fibers are opened, separated, and laid as parallel as possible, and are taken from the last roller in the form of a filmy sheet which by passing through a funnel is condensed into a thick but untwisted sliver or continuous strand and wound into huge balls or into deep cans.

After passing through several baths to insure still greater cleanliness, the sliver is removed from the back-wash machine, dried, oiled, and made ready for the gill box, which consists of several pairs of revolving rollers moving at different rates of speed. Between the two rollers, which are from 10 to 20 inches apart, is a set of toothed and moving bars which grasp the wool from below as it comes from between the first set of rollers, and carry it to the second set of rollers which move at a greater rate of speed. These fallers, as the bars are called, open and straighten the wool as they carry it to the second rollers. Several slivers are fed into the rollers, are drawn out, continuing the paralleling of the fibers, made into the form of a sheet, and again condensed into thinner slivers. For high-quality yarn the gilling operation may be repeated as many as four times; for coarse wool several gilling operations may replace carding.

The slightly oiled wool sliver is next placed in the comb (*see* Combing, p. 24), where the shorter fibers (noils) are removed, leaving the longer ones clean, parallel, and in the form of a continuous, untwisted strand called the "top." The passage of the top through several more gill boxes precedes the doubling and drawing processes wherein several slivers of the top are combined and passed through sets of rollers of varying speeds which draw it out into one of smaller diameter and further straighten and parallel the fibers. The drawing and doubling are repeated until the degree of fineness for specified counts of yarn is obtained. *See* Counts, p. 38. The product of the last drawing process is called the roving and, according to the French spinning system, used for yarns of considerable softness, has no twist put into it before it is taken to the spinning mule. According to the English system the last drawing process, or the roving box, gives to the roving a small amount of twist. This is accomplished by winding the roving onto vertically placed spindles from horizontally placed spools.

Worsted yarns may be spun on the worsted mule or on the spinning frame, by either the cap, which is most commonly employed, or the ring method. *See* Spinning, p. 143.

From the spinning frame the yarn may be taken to the twisting machine, where two or more yarns are twisted together into ply yarns for greater strength in weaving, or where worsted yarns are combined with yarns of other fibers or colors for certain weaves or types of fabric. If desired the yarn may be dyed in skein form before being sent to the weaving room.

Worsted yarns are lustrous, round, tightly spun, and without fuzz, lending themselves to types of fabrics that are characterized by clearness of construction in weave and have little if any finishing after leaving the loom. Because of the high-quality fiber, its length of staple, and the numerous processes connected with its manufacture, worsted yarn is more expensive to produce than woolen yarn and is consequently used in high-priced but very enduring materials.

Finishing of Wool Fabrics. Worsted materials are so designed that but few finishing operations are necessary after the cloth is removed from the loom. It is carefully examined (perching) for knots and imperfections, which are removed by burling and mending; it is singed, sometimes crabbed, wherein the warp and filling threads are permanently fixed in regular manner, and occasionally it is raised or brushed; when pressed it is ready for shipping. The fabric known as unfinished worsted is given a nap to give it the appearance of a woolen cloth.

Woolens, on the other hand, must pass through many operations, depending on the type of fabric desired, before they are presentable for sale. Inspecting and mending precede a thorough scouring in which all oils collected in the various machines are removed. In the succeeding process of fulling the cloth is well shrunk by means of moisture, friction, and heat, until the desired amount of shrinkage takes place with a resulting tightening up of the weave. The cloth may next be napped to raise the short fibers to make the entire surface fuzzy and the weave concealed. *See* Napping under Finishing of Fabrics, p. 53. This is usually done when the woolen fabric is wet in order to obtain a thicker nap, and may be repeated several times. Cropping, the process by which the nap is sheared or cut to the required uniform height, and pressing between rollers complete the finishing of a woolen fabric unless it is to receive one or more of the so-called special finishes for certain textures and purposes.

Wool Fabrics. Fabrics composed chiefly or wholly of wool fiber are classified into two important divisions—woolen and worsted. Woolen material is made of short-staple, carded wools. It may contain reworked as well as virgin wool and is generally a cheaper fabric than worsted, usually rather loosely woven and given a finish to enhance its softness and fluffiness. Examples of woolen fabric are: blankets, overcoatings, broadcloth, kersey, some tweeds and Jerseys, flannel, suede cloth, and velour.

Worsted fabrics are closely constructed of long-staple, virgin-wool fibers in smooth yarns that have a pronounced weave as well as a wiry, hard texture. Their hard-twisted yarns give strength and good wearing quality so desirable in suitings. Typical worsted materials are serge, tropical worsted, crêpe, gabardine, covert, and Bedford cord.

Wool in clothing materials is strong and durable; it wrinkles but little because of its elasticity and resiliency; it is fire resistant, absorbent of body moisture but not clammy in feeling, and warm, as it ranks high as a non-conductor. Wool is woven and knitted in a great variety of weights and thicknesses, from sheer dress fabrics to thick and heavy overcoatings and blankets.

As has been seen, wool fabrics may contain fibers other than wool, so that unless definitely labeled as to content it is impossible for the consumer to know how much or what quality wool is present when the material is being purchased. According to the National Bureau of Standards, Federal Trade Commission, fabrics containing 100 per cent wool, with a tolerance of 2 per cent, may be designated as all or pure wool; those containing 95 per cent, as wool, but those described as wool and containing less than 95 per cent of that fiber must indicate the guaranteed minimum percentage.

Not for all purposes is it considered desirable to have an all-wool fabric. The presence of some cotton or rayon causes the material to shrink less when washed than it would if it were composed entirely of wool. The mixture of cotton, rayon, and silk with wool gives the cloth a softer feeling, reduces its cost per yard, and frequently adds to the attractiveness of its appearance and texture. Spun rayon is now being used with wool in large amounts, particularly in men's suitings and overcoatings.

Care of Wool Fabrics. Special care must be taken in washing either knitted or woven wool fabrics, to prevent undue shrinking or felting. Wool, being protein in nature, and distantly related to gelatin, will become softened and plastic in hot alkaline solutions, as of strong soaps, and if under such conditions the fabric is rubbed, the plastic fibers fuse into a felted mass. To avoid this, the water should be as cool, in washing wools, as is consistent with cleanliness. Body oils will be fluid at body heat; a temperature of about 100° F., therefore, seems adequate. Rinse waters should be at the same temperature as the wash water—certainly not colder. Rich suds of a mild soap are made before the article enters the water, and rubbing soap into the fabric should be avoided if possible. Handling is of major importance; a gentle cupping action, to squeeze the suds lightly through the meshes, will prevent the felting which rubbing or twisting would produce. While the article is still damp, it may be stretched back to original shape and size. If pressing is done, a thick pressing cloth and a moderately heated iron are recommended.

The new soapless cleansers on the market are very desirable for washing wool fabrics in general, and especially good for blankets; because they are neutral in solution, they seem to have an affinity for greasy soil, and they leave the blanket soft, fluffy, and unshrunken.

No wool article should be dried over direct heat, as a radiator, or outdoors on a cold day.

Chlorine bleaches and strong alkalies, such as caustic soda solutions, cannot be used on wool. *See* Textile Tests, p. 170.

Staple Wool Fabrics

Albatross. A light-weight fabric in plain weave with the warp of wool or cotton and the filling of worsted yarns. A difference in the twist of the yarns gives a rather rough crêpy surface. It is used for children's coats and sacques and for kimonos.

Alpaca. A smooth, wiry, lustrous, and light-weight fabric of plain or twill weave composed of a cotton warp and a filling of yarn made from the hair of the alpaca. It is used for linings in men's coats and summer suits.

Astrakhan. A coating fabric made with wool or cotton in the foundation cloth and a mohair pile, curled before weaving, in imitation of caracul fur. It is used as coating and trimming material.

Batiste. A light-weight, smooth worsted fabric in plain weave used for negligees, children's dresses, and infants' coats.

Beaver. A napped, heavy woolen fabric woven to imitate beaver fur. Used for coats.

Bedford Cord. A woolen material with wales or ridges running lengthwise of the fabric. A type of double cloth weave with extra filling or backing picks. Used for riding breeches, chauffeurs' uniforms, women's and children's coats, and upholstery.

Bolivia. A coating material containing wool mixed with mohair or alpaca.

Bouclé. A heavy overcoating fabric woven with a novelty wool yarn with a decided curl or loop. The bouclé yarn may be in both warp and filling or in the filling only with the warp of cotton.

Brilliantine. A fabric woven in plain or twill weave with cotton warp and mohair or worsted filling very similar to alpaca. Its wiry, slippery surface makes it suitable for linings and office coats.

Broadcloth. A soft, lustrous, napped woolen fabric in plain or twill weave used for coats and dresses. Broadcloth of very light weight is known as chiffon broadcloth.

Bunting. A plain woven worsted fabric used for flags.

Camel's-hair Cloth. A very soft, silky, woolen coating fabric in twill weave usually, made from the silky down hair of the camel. The outer, coarse hairs are frequently combined with wool and used in cheap qualities of this type of fabric.

Cashmere. An extremely soft, light-weight woolen fabric in twill weave used for infants' coats, negligees, and dresses. Cashmere wool, from the cashmere goat of Thibet, is scarce and expensive.

Cassimere. A soft woolen or mixed yarn fabric in twill or plain weave, fulled, used chiefly for men's wear. A rather general term for woolen cloths not falling into other specific classifications.

Challis. A light-weight worsted fabric in plain weave usually with small, printed designs. Used for dresses and negligees.

Cheviot. A medium-weight woolen or worsted fabric similar to serge, but with a rough, slightly napped surface. It is made in twill weave and is used for coats and suits.

Chinchilla. A heavy woolen, or wool and cotton mixture, coating fabric usually in double cloth weave with a plain colored face and plaid back. The surface nap is rolled into small tufts on a rotary motion cylinder.

Covert. A light- or medium-weight fabric made from either woolen, worsted, or all-cotton yarns. It is characterized by white flecks throughout. This effect is obtained by using a wool warp twisted with cotton. The weave is either a twill or a warp face satin. The material is usually waterproofed and used for suits, raincoats, riding habits, and topcoats.

Doeskin. A fine woolen cloth somewhat similar to broadcloth but with a short nap. A very smooth finish conceals the satin weave.

Éponge. A spongy, loosely woven fabric made in plain weave from novelty wool yarns. Similar to cotton ratiné. Used for dresses and suits.

Felt. A wool felt is usually a material, heavy or light in weight, made by matting the fibers of wool or the hair of certain furs. It is sometimes woven with a plain or twill weave from woolen yarns and shrunk to the desired texture. It is used for hats, table covers, etc.

Flannel. A term that applies generally to a light-weight, all-wool, or wool combined with cotton or silk material of plain or twill weave with a slightly napped surface. Specific types are used for infants' garments, men's trousers, and dresses. Viyella flannel is made in England from equal amounts of cotton and wool, the cotton forming the core, the wool the covering of the yarn.

Frieze. A rough, heavy woolen fabric with napped surface in plain or twill weave used for men's overcoating. Coarse wool yarns and shoddy are used in this fabric, which is frequently of mixed colors as well as plain.

Gabardine. A twill-weave, strong worsted fabric showing a fine diagonal cord running from left to right on the right side. It is used for dresses, suits, coats, riding habits, and shoe uppers.

Granite cloth. A worsted fabric made in irregular twill weave that gives a pebbly surface to the cloth. Used for dresses when in fashion.

Homespun. A soft but rough woolen material loosely woven in twill or plain weave to simulate a handloomed fabric. The yarns are usually of mixed colors. It is used for skirts, coats, and sport suits.

Kersey. A thick woolen fabric somewhat similar to heavy broadcloth in the polished finish of its compact nap. The weave is twill, and the material is suitable for overcoats.

Mackinaw. A twill or double-cloth-woven heavy woolen fabric with a nap on both sides. It is frequently in plaids as well as plain, dark colors, and is used for coats and men's jackets.

Melton. A heavily felted, short-napped woolen fabric of considerable thickness and little pliability used for overcoats. It is woven with a twill weave.

Mohair. A plain-weave dress fabric made with cotton warp and filling of yarns made from the long, silky hair of the Angora goat. This name is given also to a pile material used for upholstery and fur fabrics. The pile is made of mohair and the back of wool or cotton.

Montagnac. An overcoating fabric of soft, fleecy texture with soft, curly nap woven in twill weave.

Palm Beach Cloth. A light-weight suiting fabric of cotton warp and mohair filling woven in plain or twill weave. It is used for men's summer suits.

Polo Cloth. A heavy coating fabric of softly spun wool and camel's hair, usually in tan color. The weave is twill, and usually both surfaces of the cloth are napped.

Poplin. A dress and suiting material with heavy filling threads forming crosswise ribs in the plain weave. It may be constructed of all worsted or of silk or cotton yarns combined with the worsted.

Ratiné. Similar to cotton ratiné but composed of wool novelty yarns.

Serge. A twill-weave fabric made from worsted yarns, sometimes with cotton warp, in a variety of weights and finishes. It is characterized by a prominent diagonal effect on both sides of the cloth. French serge is very soft, fine, and light in weight, and used for dresses and suits; storm serge is heavier, coarser, and more wiry than the usual worsted serge; all-mohair or mohair filling with cotton warp comprises the dress and coating fabric known as mohair serge.

Shepherd's Check. This is an all-worsted, woolen or wool mixed with cotton or silk fabric in small check design, most commonly black and white, used for children's as well as adults' dresses, coats, and suits.

Tropical or Summer-weight Worsted. A plain-woven, light-weight men's suiting made of tightly spun worsted yarn, two-ply in the warp, and either two-ply or single in the filling. Australian wool is chiefly used in this fabric.

Tweed. A rough type of wool fabric, all wool or combined with cotton, in plain or twill weave with an unfinished surface appearance. The two-ply yarn composing the warp is generally of two colors, giving a pleasing tone to the soft colorings of tweed. Harris tweed, made on the Isle of Lewis off the west coast of Scotland, is one of the well-known, sturdy tweeds for which Scotland is famous. Originally all the processes of manufacturing this material were done by hand; today only the weaving is done at home by the cottagers, the preparation of the yarn and the finishing of the cloth being carried out in mills on modern machinery. The name is protected by patent and stamped on each piece of the cloth. Tweeds make excellent suiting and coating fabrics for rough, strenuous wear.

Velour. A type of soft woolen fabric with napped surface used for coats and dresses; plain or twill weave.

Venetian. A woolen or worsted fabric, the latter with worsted warp and woolen filling, woven in sateen weave and made in both light and medium weight. Similar to covert cloth and used for coatings.

Voile. A plain-woven worsted dress fabric woven of hard-twisted yarns and given a clear finish.

Whipcord. A worsted fabric in twill weave with a diagonal effect on the face more pronounced than that found in gabardine. It is used for riding habits, suits, and coats.

Yarn. This term designates the fibers spun together into a continuous strand and used for weaving and knitting. Two or more of these single strands when twisted together form ply yarns, spoken of as two-ply, three-ply, etc., and are naturally stronger than the singles.

Yarns may be given few or many twists per inch as well as be twisted to the right or to the left; both the number and the direction of twists determine to a large degree the characteristics of the cloth into which they are woven. Yarns of high twist, up to a certain degree, are very strong and of a dull luster. Single yarns of two different fibers are frequently twisted together as found in some union fabrics. Yarns in cotton and wool blankets are sometimes of this type, the soft wool being spun around a fine and tightly twisted core of cotton yarn.

Novelty Yarns. Especially spun yarns are necessary to give the effect of irregularity or roughness of surface found in certain novelty materials that are fashionable from time to time. These so-called novelty yarns are obtained by twisting the "effect" yarn about the "base" or "core" yarn at a different tension or rate of delivery. Effect and base yarns, each usually single, may be of totally different fibers, sizes, colors, or twists. The rate of speed with which each is delivered to the spindle may vary, causing the effect yarn to be wound around the base in a variety of ways. With some types of novelty yarns a third yarn known as the "tie" is required to hold together the base and the effect yarns.

The variety of novelty yarns is fairly large, consisting of flake, spiral, knot, or spot and loop yarns. Flake yarns are formed by enlarging or coarsening the size of a single yarn so as to make lumps at intervals; in knot yarn the effect is wound around the base at more or less regular intervals. In loop yarns the effect is so wound or twisted on the base that small loops result at definite intervals; this type is also known as bouclé and is very extensively used for knitted rayon dresses. Chenille yarn is fuzzy with a core of cotton covered with a fringe or pile. Unlike other novelty yarns it is made by a weaving process in which cotton warps are placed in groups on the loom with short spaces between groups. The filling yarns, of wool, rayon, silk, or cotton, are bound into the warps in a manner similar to that used in the construction of the gauze weave. *See* Weaves, p. 193. After weaving, the filling threads of the "fabric" are cut between each two groups of warp threads, and the short filling threads twist about the cotton warp, completely hiding it.

Chenille yarn receives its name from the French word for caterpillar which it so strongly resembles, and is used for drapery fabrics and in chenille carpeting. *See* Carpets and Rugs, p. 13.

Ondé yarns are heavy, have a decidedly spiral effect, and are used chiefly on the back of gloves.

Fabrics woven of novelty yarns are attractive in texture but some types should not be subjected to rough usage, as the effect yarns tend to catch on rough surfaces and pull the cloth.

Carded yarns are those of cotton or wool that have been subjected to the carding process; combed yarns, either cotton or wool of long staple, are those that have been not only carded but also combed. *See* Combing, p. 24. Combed yarns are both smoother and stronger than carded yarns and are found in merchandise of better quality.

Knitting yarns are especially spun for that purpose. They are softer than those used for weaving.

FURS AND LEATHERS

Although the subject matter of this book is concerned primarily with textiles, their selection, use, and care, the fact is recognized that furs and leathers play an exceedingly important rôle in the wardrobes of all consumers. Fur- or leather-trimmed garments as well as articles of attire made exclusively of one or the other of these non-textiles are to be found in the wardrobes of practically everyone at some time or other. As the majority of consumers are even less well informed on the subjects of furs and leathers than they are on textile fabrics the following pages contain non-technical information on the types, qualities, and care of these articles.

FURS

Fur-bearing animals of many varieties, both domesticated and wild, and from many countries, supply the fur so largely used today for trimming and garments. Though in general the animals are trapped and hunted, within recent years farms for the breeding of fur-bearing animals have been developed. In either case the mature animals should be killed when the weather is coldest as then the fur is longest and thickest, or the skin is said to be in prime condition.

The transformation of raw pelts into fur suitable for a garment or piece of trimming is termed *dressing*; it consists of many important processes. The first is that of scraping the surplus fat from the pelts with a dull-edged knife. This is followed by wetting the pelts with water and softening them in a kicker machine under moving wooden blocks. The skins are scoured and the fur cleaned in slowly revolving drums containing sawdust which, with all adhering dirt and fat, is removed in a quickly revolving cage of wire netting. After a few minutes in this cage the pelts are ready for the fleshing operation, which consists of removing the remaining flesh membrane by means of a sharp knife.

Fur pelts are dressed in a manner similar to that used for the tanning of leather, the alum and chrome processes being most commonly employed today although animal oils, such as whale oil and neat's-foot oil, and various vegetable oils and fats are used to some extent, as are the formaldehyde and salt-acid tans. The tanning substance is usually brushed on the flesh side and allowed to remain until complete tannage has taken place. In order to increase the softness and flexibility of the pelts, oils are rubbed into the flesh and the pelt is then stretched and tacked to a board for drying. Excess oils and grease are removed by a second drumming in sawdust, and caging.

Many furs are ready for the manufacturer after they have been dressed, as briefly outlined above; others must be subjected to further processes to improve their general appearance, to emphasize certain characteristics, or to simulate more expensive furs. Among these processes are unhairing or plucking, pointing, dyeing, and stenciling.

Dyeing. The dyeing of furs is an intricate process requiring a very considerable knowledge of dyes and the chemical and physical differences of various skins. Great care must be used to have the temperature of the dyestuff such that it will not shrivel the skin. Two methods of dyeing are employed: (1) dipping, or complete saturation of the pelt in the dye solution; and (2) brushing a paste substance containing the dye on the fur, and after the paste is completely dry beating or whipping it out of the fur.

With some furs only top blending or tipping is necessary. For pale-colored furs the dye is brushed with a goose feather, after the application of the proper mordant, over the top of the fur. This process is used to bring out the beauty of the fur by giving it a darker shade, and in mink to match the skins. Occasionally inexpensive, pale mink pelts are blended to make them resemble the darker, finer mink. Blending is used on such furs as marten, mink, fitch, fisher, sable, otter, beaver, and muskrat. Blended furs are likely to fade unevenly.

In the preparation of white furs, bleaching with hydrogen peroxide or sulphurous acid is essential to remove stains and any cream or yellow streaks. Ermine, white fox, kid, and lamb skins are subjected to bleaching.

After they have been dyed, fur pelts are washed, dried, drummed in sawdust, screened, and whipped before they are ready for the manufacturer, who fashions them into coats, capes, neckpieces, muffs, and trimming.

Plucking. The coarse top or guard hairs of such furs as beaver, nutria, seal, and otter, which detract from the beauty of the soft, fine, body fur, are plucked out by hand or cut close to the skin by the rotating blades of an ingenious machine.

Pointing. This process consists of adding hairs to a fur to simulate a more expensive one. This is practiced for pointed fox, which is either a red or a white fox dyed black, to make it resemble the more expensive and desirable silver fox. Inferior natural silver fox skins may also be made to appear like first-class ones by means of pointing. In this process the end of a white badger hair is dipped into cement, then carefully inserted into the fur as near the skin as possible. These inserted hairs are generally securely held and do not drop out when the fur is cleaned or subjected to hard wear.

Shearing. In order to bring out the moiré or wavy effect of the wool or hair of some pelts the tips of the hairs are sheared off. American broadtail, the pelt of South American lamb, is treated in this manner, as is beaver-dyed coney to imitate the fur of natural beaver.

Varieties of Furs

Badger. Most of the badgers used for fur purposes, chiefly trimmings and pointing, come from Canada and the United States. The better fur is creamy white in color with silver-tipped guard hairs; the inferior quality has reddish under fur and dark top hair, and is obtained from China and Japan. This is a long-haired fur of considerable durability.

Beaver. Canada, Labrador, Alaska, and the United States furnish this strong, short-haired brown fur that has such excellent wearing qualities in both coats and trimmings. The guard hairs are plucked from all beavers; some skins are sheared to make them less bulky. The hair of sheared beaver does not mat or curl; the unsheared variety does, but it may be easily restored to its original appearance by electrifying. Beaver is never dyed and holds its color well, the darker furs being considered most desirable.

Broadtail. See Lamb.

Caracul. See Lamb.

Chipmunk. This small rodent furnishes a short-haired brown and yellow fur with light and dark stripes down the center back. It is used chiefly for trimmings, only occasionally for short coats, as it is not a serviceable or warmth-giving fur. The Russian chipmunk, known as Burunduki, is used more generally than the American rodent.

Chinchilla. One of the most expensive as well as the least serviceable of furs comes from the region of the Andes Mountains in South America. Chinchilla fur is blue-gray along the back, shading to cream or light gray underneath, and averages in length about 1½ inches. Gray squirrel and rabbit are dyed and sheared to imitate chinchilla.

Civet Cat. The member of the skunk family with white stripes in its black coat, and obtained chiefly from the states in the Mississippi Valley, is designated by the trade name of civet cat. Southern China furnishes the true species of civet. Long guard hairs protect a wooly type of fur that renders fair service when used in coats and as trimming.

Coney. See Rabbit.

Ermine. This small member of the weasel family, found in northern

Europe, Asia, and America, provides one of the most luxurious and perishable of furs. The best ermine is caught in the winter when its coat is white, the color changing to gray in the summer. White pelts slightly tinged with yellow are bleached; those not suitable for bleaching are dyed a beige or cocoa color to resemble the natural color of ermine during the summer months. The fur known as "summer ermine" is from the brown weasel obtained in Pennsylvania and New Jersey.

In some species of ermine only the tip of the tail is black; in others, the tip half of the tail is that color. The finest ermine is obtained in Siberia and has a fine, crisp under fur that is the same length as the silky guard hairs.

Fisher. This is a long-haired fur with rough guard hair and is obtained from the large marten found in Canada. The serviceability of fisher, used chiefly for neckpieces, is rated high.

Fitch. A fur with good wearing qualities, used more for trimming than for coats, is obtained from a species of ferret common to Europe and Asia, the most popular at present being found in Russia and China. This is a white or pale yellow silky fur with a dark line of guard hairs down the back. A darker fitch is found in Europe, particularly in Germany. Fitch is very frequently dyed to simulate the more costly sable.

Fox. This fur is used in greater amount than any other, except possibly rabbit, as the supply is both abundant and varied. In addition to the soft, flattering quality of its long hair, fox is very durable. The better qualities come from countries with a cold climate.

Black fox, of the red fox species, has a blue-black silky fur. If silver guard hairs are present it is known as silver fox and considered valuable, its worth being determined by the quality of the fur and the abundance and spotting of the silver guard hairs. Silver fox is frequently imitated by inserting the white hairs of badger into the fur of red fox that has been dyed black. *See* p. 214.

The blue fox has a bluish brown color and is found in Alaska, northern Europe, and Asia. Cross fox is black fox with a reddish tinge to its hairs, and a dark cross marking on the shoulder. It results from the crossing of the silver with the red fox. It is rarely dyed.

Gray fox, almost always dyed to simulate silver fox, is a native of North America and characterized by its rather coarse, grayish fur fiber liberally sprinkled with silvery guard hairs. This is considered a very durable as well as inexpensive fur for trimming.

Red fox, found in practically all parts of the world, is the most abundant of the fox family. The color of the red fox varies from a pale yellow to a rich yellow red. It is very commonly dyed, however, to simulate the choice fox furs.

White fox, from Russia, North America, and Greenland, has a bushy fur with an abundance of guard hairs that give it a silky texture.

Kit fox has a yellow-tinged fur fiber protected by white guard hairs, is of small size, and is native to North America, Russia, and Siberia. It is a rather perishable fur.

Galyak. This name, of Russian origin, is applied to the pelts of extremely young lambs and kids with their very short fur fiber just beginning to develop and slight moiré patterns. It is an extremely perishable fur as the short fur fibers rub off.

Goat. The fur of goats varies considerably in length and texture with the type of breed. Chinese goat hair is long and silky, varying in color from white, light tan, or gray to occasionally a dark brown. This fur is sometimes dyed black to imitate natural monkey fur. The Mongolian goat possesses a soft, silky fur fiber with coarse guard hairs that are pulled out of the pelt. Another name for this fur is *mouflon.*

Hudson Seal. This is a trade term for plucked, northern muskrat skins that have been dyed and sheared to resemble Alaskan sealskin. Muskrats from the northern sections of the United States are considered best for Hudson seal, and if good, well-furred pelts are used coats and trimming of this fur give good service.

Jaguar. This spotted cat from South America has a short fur of deeper yellow than that of the leopard, with large black spots surrounded by narrow black rings. Coats of jaguar fur are decided luxuries as the flat, short fur is very brittle and breaks off easily.

Kidskin. The young goats of Siberia, India, Africa, and China provide a pliable pelt with lustrous, short, all guard hair. The best pelts have a moiré pattern. Kidskin is frequently dyed black to imitate lamb caracul, which it closely resembles. Chinese kidskins are more pliable and thickly furred than those from India and Africa and do not tend to shed so much as these other pelts. The fur of kidskin rubs off along the edges when used in coats and trimmings.

Kolinsky. One species of the weasel of China and Siberia furnishes a silky fur, with good wearing qualities, whose natural yellow color with guard hairs of brown is dyed to resemble sable.

Krimmer. See Lamb.

Lamb. Lambs of many varieties and from many parts of the world provide what is considered on the whole a type of fur that wears well. The terms used to indicate lamb pelts are numerous, among the better-known ones being krimmer, broadtail, caracul, and Persian lamb.

Broadtail is the name given to the pelts of very young Persian lambs. These pelts are characterized by a flat moiré-like pattern. American broadtail is derived from the Lincoln lamb of South America whose wool is sheared to bring out the moiré design. Broadtail is a very short-haired fur of great beauty but low durability as the skins are very tender and light in weight. It is dyed black, gray, or tan.

Caracul is a lamb pelt with a wavy, flat, open curl. China and Russia provide most of this fur, the astrakhan sheep producing a silky, lustrous pelt. Good caracul has a tight, firm curl and considerable luster, and it renders fair service. Caracul kidskin, from China, has the appearance of caracul lamb but is not a serviceable fur. Like broadtail, caracul is dyed black, brown, tan, and gray. The leg pieces and paws of caracul are used to make coats that are attractive but lack durability.

Krimmer. Cross-bred lambs of Persian type raised in the Ukraine, northern Russia, and Rumania produce the fur known as krimmer. The pelt of krimmer is smaller than the true Persian lamb; the hair is looser and the luster less pronounced. Krimmer is naturally black or gray in color and rarely dyed.

Persian Lamb. In many sections of Persia are reared the species of lamb with tight curls, although in the fur trade the variety from Russia, Afghanistan, and Southwest Africa are designated as Persian lamb furs. The natural color of Persian lamb is brown, gray, or black. Today, however, practically all Persian lamb is dyed black. The silkiness and luster of the hair as well as the tightness of its curl determine the quality of this type of fur.

Leopard. The best leopard skins come from Somaliland, Africa, but many are obtained in India and China. The light orange-colored, short, silky fur is marked with black rosette-type spots with tan centers. The hair tends to break off as well as shed. Leopard cats from South America, Asia, and Africa have a solid black spot rather than the broken type of the leopard. Leopard furs do not wear well.

Lynx. This long, silky fur resembles fox, is perishable, and comes from Canada, Russia, Alaska, and Siberia. Naturally gray or reddish yellow in color, lynx is frequently dyed black.

Marmot. This member of the squirrel family provides a well-wearing straight fur of silky texture, either blue or yellow in color, the blue being of better quality than the yellow. The marmots most used today come from Mongolia, Manchuria, and Russia, are inexpensive, and usually dyed to imitate mink.

Marten. There are many varieties of this branch of the weasel family. The fur, of medium length, is silky and varies in color from the pale or dark yellow of the *Japanese marten* to the dark gray of the *stone marten*. The *baum marten* has a reddish brown pelt that frequently is dyed or blended to simulate sable. The best American marten is dark brown with a full heavy coat. Marten is considered a durable, satisfactory fur for trimmings and neck scarfs.

Mink. The pelts of this member of the weasel family are prized for their dark brown, silky texture and good wearing qualities. Eastern Canada and northeastern United States furnish pelts of very high quality, Japan and China producing furs of coarser quality and lighter color.

Mole. This extremely small animal has taupe-colored, fine short hair of silky, velvetlike texture of great beauty but exceedingly low durability. The moles furnishing the best skins are found in Scotland and the Netherlands.

Monkey. The long, black and very lustrous hair of the African monkey is used for trimming, occasionally for coats.

Mouflon. *See* Goat.

Muskrat. This water rodent of North America has a dense, silky, very soft under fur with glossy, coarse guard hairs. The muskrats vary in color: some are brown, others black, the black being considered more desirable. Silver muskrat is a trade term applied to the strips of fur taken from the belly of the muskrat pelt where the hair is shorter and lighter in color than that on the back. Entire coats are made from these light-colored strips. The muskrat, from New Jersey, Maryland, New York, and Maine, are dyed black to imitate Alaskan seal and called Hudson seal.

Nutria. Closely resembling beaver is the water rodent of South America known as nutria. The under fur of this animal is soft, dense, and brown with less luster than beaver and with a tendency to mat. The guard hairs are always removed. The wearability of nutria is good, but less than that of beaver.

Opossum. The variety of fur known as American opossum is from a marsupial animal native to the southern sections of the United States and to Argentina. The Australian opossum fur, from the marsupial of the phalanger species, is silkier, softer, and less fuzzy than the American type, and its color is a clearer gray. This is an inexpensive and excellent wearing fur.

Otter. The gray or dark brown, medium-length hair of the member of the weasel family known as otter, found along rivers and seacoasts, is excellent for coats subjected to hard wear. The silvery, stiff guard hairs are at times plucked from the pelt, which is then dyed to produce the effect of seal.

Persian Lamb. See Lamb.

Pony. Pony skins, particularly those from Poland and Russia, give rather good service when made into coats. The short, coarse hair, gray, tan, brown, or black, has good luster and occasionally a moiré pattern which is considered desirable.

Rabbit. These rodents from all parts of the world furnish peltries of exceedingly great numbers. The long hair is dyed, frequently sheared to imitate a great variety of costly furs, and known by such names as beaverette, lapin, squirrelette, as well as many others. As a whole the skins are rather tender and do not give more than fair service. French rabbit ranks high in quality, and is followed by Belgian and German in the order named.

Raccoon. This fur is used chiefly for sports coats, occasionally trimming, and is rated high in durability. The light brown or white under fur is wooly, the guard hairs silvery with dark tips. This animal is found in practically all parts of North America.

Sable. A species of weasel (marten) whose habitat is Canada and Siberia is known as sable, the variety coming from Siberia, Russian sable, being considered more desirable than that from the Hudson Bay region of North America inasmuch as the fur is finer, denser, and darker in color. Sables range in color from a light to a dark brown with a bluish cast, and have decided luster. The lighter-hued sables are blended to imitate those of darker hues. This is a costly fur only fairly good in wearing quality, and is commonly imitated by dyed hare, marmot, and fitch.

Skunk. This relative of the civet cat abounds in all sections of the United States, and furnishes a strong pelt with long, coarse, black hairs and stripes of white. The stripes are frequently removed by cutting the pelt or by dyeing the hair. Skunk is a well-wearing fur for coats as well as trimmings.

Squirrel. Lacking good wearing qualities, but excelling in beauty of texture and color, squirrel is a fur of considerable popularity. The back of this rodent furnishes the best fur and is usually separated from the belly section that is white in color and is known as squirrel lock, which is dyed, as are all streaked pelts, and used largely for coats, linings, and trimmings. The finer squirrel furs are steel or blue-gray in color, the less valuable ones possessing a reddish cast or streaks.

Wolf. Trimmings and scarfs are made from the long, coarse-haired pelts of wolf and are considered very desirable. They shed, however. Wolf is a comparatively inexpensive fur.

Wolverine. Blackish brown coloring characterizes the long, thick hair of the wolverine. The light-colored furs are dyed to resemble the more valuable dark brown furs. Wolverine fur rates high in wearing qualities and is moderate in price.

Selection of Furs. A great deal of experience is necessary for the wise selection of furs, an experience which the average consumer usually lacks. For this reason the purchaser of furs should deal with a thoroughly reliable fur dealer who knows his merchandise and can give the customer truthful information about the type of fur, its origin, its quality, and whether it is natural in color, tipped, blended, dyed, or pointed. In the summer of 1938 the Federal Trade Commission issued rules governing the selling of furs. As a result every retail seller of furs should have definite information concerning his stock as received from the manufacturer, and should be able to pass on this information to his customers. Briefly, these Trade Practice Rules require that there be no misrepresentation of grade, quality, or geographic origin of a fur; that the real name of the fur form the last part of its description, and that cross-breed furs be so indicated; that furs which have been dyed, tipped, blended, or pointed be so described; that used, worn furs as well as those damaged in some way in the process of manufacturing be so designated on the label or in an advertisement. The rules further require that if a fur is made up of paws, plates, pieces, or tails, this information be given on the label. The Trade Commission has thus made it possible for the consumer as well as the dealer in furs to have some protection in what many furriers frankly describe as a "skin game."

When investing a considerable sum of money in a fur coat, it is wise to ask to be shown something of the underside of the fur to see the size of the pieces of fur used. Quality garments are not made up of very small, irregular pieces of fur. Mink, however, is an exception as it is necessary to cut the pelt into long and very narrow strips so that long, slender, uniform stripes form the pattern of the fur. This process of "dropping" mink is expensive because of the great amount of sewing that is necessary and is used only in expensive coats made of high-grade furs. Reputable dealers leave a portion of the coat lining unsewed so that the customer may see the underside of the fur.

In some types of fur coats, particularly Hudson seal-dyed muskrat, the leather is reinforced by sewing to it a cotton fabric; this also tends to make the silk lining render better service as it protects the lining from the rubbing of the seams of the fur.

Care of Furs. Whatever the quality of a fur coat or neckpiece may be at the time of its purchase, intelligent care will increase its period of usefulness to the purchaser. As a cold climate is necessary to bring most furs to their prime condition and development, so is it necessary to their preservation. Heat dries the natural oil of the pelt as well as those worked into it during the dressing processes, causing the leather to crack and tear readily. For this reason furs should not be hung in warm cupboards or dried when wet in a warm room or near a radiator. When wet the fur should be combed lightly, shaken carefully, and dried slowly in a cool place where the air circulates freely.

Exposure to strong light will cause all furs, natural, dyed, or blended, to fade; consequently it is not advisable to hang a fur coat or neckpiece in the sunshine for any length of time.

As furs are particularly attractive to moths they should be protected from the ravages of these pests when not in constant use. Cold storage is advisable, as the temperature and humidity are kept at points favorable to the leather and unattractive to moths. If the fur garment is stored at home, it should be inspected frequently and kept in a moth-proof bag containing paradichlorbenzene crystals. Before it is put away for the summer the fur should be thoroughly cleaned by a reliable furrier who will remove all dirt and soil from the hairs with sawdust that will in no way remove the natural oils from the leather. A fur coat should not be dry cleaned like wool and other garments, as cleaning fluids remove the oils.

Furs that mat as a result of wetting or friction may be quickly restored by glazing or electrifying. In glazing the hair is first combed then brushed with water and pressed lightly with a warm iron to bring up the oils and luster. Usually a piece of brown wrapping paper is placed over the fur before the iron is applied.

Rips and tears in fur garments should be repaired immediately, preferably by a furrier who will reinforce or stay the seam or torn edges. Minor rips in seams may be repaired at home by overhanding the edges of the skins together, using very shallow stitches and cotton thread. Rips and tears may be quite generally avoided by purchasing fur coats that are sufficiently large, particularly through the hips and width of back, and unbuttoning the coat when the wearer is seated.

Worn spots occur as the result of friction from purses, gauntlet cuffs of gloves, heavy jewelry, and hat brims especially. Constant driving and riding in automobiles tend to cause fur to mat and rub off. Furriers generally advise purchasers to avoid stroking fur with the hand as the fur will absorb oil from the hand, and thereafter tend to collect dirt and dust.

LEATHERS

The leathers used in the wardrobes of men, women, and children are numerous and varied and are supplied by almost all the countries of the world. The skins and hides of such animals as cattle, sheep, goats, deer, kangaroos, and horses; such reptiles as snakes, lizards, alligators, and sharks; and from ostriches, when properly prepared serve mankind in the form of belts, gloves, purses, shoes, traveling bags, and in many articles used in industry.

Preparation for Tanning. Before the skins or hides are subjected to the all-important process of tanning they must be thoroughly prepared. The hair, all preservatives and dirt must be removed by washing in chemicals and scraping with knives. After a soaking in a suitable solution to open the pores the hides and skins are pickled in a salt solution to prepare them for tanning.

Tanning. The transformation of hides into leather, called tanning, consists of from twenty to eighty treatments, depending on the type of leather desired. The tanning is done by one of four methods:

1. The vegetable process, which employs liquors and extracts from fruits, nuts, barks, and woods.
2. The chrome process, in which the hide is subjected to a solution containing some salt of chromium.
3. A combination of the vegetable and the chrome processes.
4. The alum or combination of alum and chrome process, which is used on skins to be made into white leathers.

Special types of tanning are required for certain leathers: sheepskin, for the making of chamois, and buckskin require an oil dressing that gives a very soft, pliable leather; formaldehyde is used in the dressing of doeskin. Some types of tanning require from four to six months; others may be performed in four to eight or more hours.

The Finishing of Leathers. Many treatments are necessary before the tanned leather is ready for its designated use. In order to remove all pieces of flesh as well as to secure uniform thickness the leather is shaved on the flesh side. If too thick for certain uses it is split into two or three thicknesses. The top thickness, known as the grain split, shows the grain markings on the upper side of the hide. The lower thickness is known as the flesh split. Splits are used for many purposes, such as upholstery for furniture, book covers, and inexpensive luggage. They are not particularly durable, and articles made of split leather should be labeled to that effect but they are not always so designated.

As the actual tanning of hides and skins removes their natural oils they must be lubricated with such oils as neat's-foot, castor or codfish oils, and egg yolks after they have been thoroughly worked to remove all traces of the tanning solutions and dried. The leather may be dyed in large drums during this oiling or "liquoring" process, or directly after. If afterward, the dye is applied by means of brushes. Liquoring is followed by the process of staking which softens the leather evenly as well as removes from it most of the stretch. The remainder is removed by stretching the leather on metal frames or tacking it to boards. When dry the leather is trimmed, undesirable pieces being removed.

Special Finishing Processes. The final appearance and texture of leather depend on its quality and intended use. Leathers scarred on the grain surface are buffed with an emery wheel; those suitable for a bright finish are treated with several coatings of special dressing and "boarded." This consists of folding the leather over on itself and pressing the fold with a board. The glazing operation consists of striking and rubbing the leather with a glass cylinder subjected to strong pressure. Glacé kid is largely used for gloves and shoes. Dull finishes are obtained by running the leather over a special type of busking wheel. As a final finishing process the leather is pressed either with a hand iron or in an hydraulic press to smooth out the leather and make it lie flat.

In patent leather a mirrorlike surface is given to the grain side of calf, cattle, horse, goat, and kid leathers of vegetable or chrome tanning. The skin of tanned leather is stretched on frames after all excess oils from the liquoring operation have been removed and subjected to a coating of banana or linseed oil combined with dye and a varnishing coat of a flexible lacquer, and carefully dried.

Calf and kidskin are made into suede leather by subjecting the flesh side to carborundum wheels and raising a soft, very fine nap. Special types of staking and stretching operations give great pliability to the leather.

The natural grains of reptile leathers are simulated by embossed leathers, chiefly calf. An engraved metal plate is placed over the leather and with great pressure the markings are stamped on. The leather is then colored by brushing, spraying, and, at times, by stenciling.

The following leathers are commonly used in wearing apparel and accessories:

Alligator. The belly skins of this reptile are tanned by a special combination process, softened, dyed, and smoothed on the surface. They make very durable shoe and luggage leathers as they are highly resistant to scuffing and do not scratch or crack readily.

Buckskin. Deerskin is the source of genuine buckskin, which is expensive, porous, therefore cool, and pliable. This leather stretches and scratches rather easily. As it is oil-dressed it is suitable for washable gloves. The grain side of the skin is buffed to produce a velvety suede finish. The full-grained deerskin is also used for gloves. Buckskin is very frequently replaced as material for shoes by cattle hide dressed to resemble it.

Cabretta. The hair sheep, cabretta, furnishes a strong leather that closely resembles kidskin and is used for gloves (capeskin) and shoes for women and children.

Calfskin. Calf leathers are the hides of very young cattle. They are strong, supple, and porous, with a distinct and fine-grained surface. They stretch and scuff but slightly and are in very general use for shoes.

Capeskin. The leather obtained from the hairy sheep from South Africa shipped from Cape Town and named after that town. As it is tough, flexible, as well as light and washable, this leather is excellent for gloves for ordinary hard wear. Cape is somewhat heavier and stronger than kidskin, which it resembles closely, and is dip-dyed, the color showing on both sides of the skin.

Chamois. This supple, porous leather was originally provided by the skin of chamois but today is usually made of the flesh split of sheepskin tanned with oil.

Chevrette. This is a glove leather from the skins of grass-eating kids.

Kidskin. Young goats furnish a light-weight, thin, rather strong, and exceedingly pliable, fine-grained leather largely used for gloves and shoe uppers as well as shoe linings. The leather may be finished in one of several ways: it may be given a dull or "mat," a semi-bright or a full glazed finish, or be covered with gold or silver leaf for use in evening shoes.

Lambskin. The skins of young lambs are tanned to simulate doeskin, and gloves of lambskin are frequently sold as kidskin gloves. Lambskin is pliable, thin, but with a loose grain that renders it susceptible to abrasion.

Mocha. Genuine and high-quality mocha leather for gloves is made of the skins of Arabian blackhead hairy sheep raised near the town of Mocha, from which the leather receives its name. A soft, velvety nap is raised on the grain side of mocha so that in appearance this leather resembles suede but is heavier and less harsh and wears better for gloves. Some mocha gloves are washable. The most common color is gray.

Ostrich. South African ostrich leather makes desirable shoes of nearly all types. It stretches sufficiently for the comfort of the foot and is porous and resistant to scuffing. It is also used for bags and novelty leather articles.

Patent Leather. The skins and hides of horse, cattle, calf, goat, and kid are used in this specially finished leather. *See* p. 224. Leathers with this finish tend to scratch and crack unless very well cared for.

Pigskin. For such merchandise as gloves, luggage, and wallets the skins of hogs from South American countries make enduring, serviceable leather. The grain surface is characterized by groups of minute holes from which the bristles have been removed. The toughness and pliability of genuine pigskin make it desirable for washable gloves suitable for sport and general wear.

Reindeer Skin. The skins of reindeer are sometimes tanned for use in gloves. They are extremely durable, as they are close-fibered; they have the appearance of very heavy mocha and are very expensive.

Sealskin. Pin seal leather, so largely used for handbags and purses, somewhat less commonly for shoes, is obtained from the hair seal. It possesses a distinctive pebbly grain that is soft, flexible, very durable, and not easily marred. Frequently calf and goat skins are finished to imitate pin seal.

Sharkskin. This very tough but expensive leather is highly resistant to scuffing and to moisture, two characteristics that make it desirable for footwear and luggage.

Sheepskin. Because of its flexibility, sheepskin makes satisfactory gloves and sports coats, but its sponginess and its tendency to stretch easily render it less desirable for shoe leather. It is finished to simulate chamois.

Snakeskin. The skins of watersnakes, cobras, pythons, and boas when properly tanned, softened, staked, and glazed make thin, serviceable leather for shoes. Their hard grain causes them to mar but slightly and to require little care.

Suede Leather. Calf and kangaroo are excellent for suede shoe leathers, the calf being used most commonly on account of its abundance and availability. Lamb, sheep, and goat skins buffed on the flesh side make satisfactory gloves. Unless suede leather is well dyed the color may crock. This characteristic should be noted before purchasing gloves or handbags of this finish. *See* p. 224.

Care of Leathers. Satisfactory service from an article made of leather depends in large measure upon the care given to it. Under no circumstances should wet leather be dried quickly or in great heat. Experts recommended that heat that can be borne comfortably by the hand is sufficient to dry the wet leather and will not hurt it, and slow drying will cause it to shrink but little. Wet shoes should be stuffed with paper or placed on shoe trees to preserve their shape while drying. A light coating of castor or neat's-foot oil well rubbed into leather shoes, bags, and similar articles restores the natural pliancy of the leather, prevents cracking, and makes it more waterproof. A good cream used to polish shoes helps to preserve the leather. Articles made of patent leather should be cleaned and polished with neutral soap and water rather than polishes, which tend to dull this particular finish. Shoes made of patent leather resist cracking if they are warmed very slightly before being worn in cold temperatures.

Buckskin and all suede shoes should be freshened with a cleaning solution containing a matching dye, then brushed with circular strokes with a stiff, fine bristle brush.

Dry cleaning is advisable for dark-colored gloves and all leather gloves not specifically stamped as washable unless experience has proved them to be washable. Chamois and doeskin, pigskin, cape, and goatskin are all considered washable; especially tanned deerskin and mocha may also be cleaned in this manner. For most satisfactory results gloves should not be permitted to become too soiled before washing. Authorities on this subject recommend that the gloves be placed on the hands for washing with mild soap suds of moderate temperature. Repeated washings and rinsing in clear water are necessary. Chamois and doeskin should be rinsed finally in soapy water. Grain leathers may be scrubbed lightly with a hand brush. When removed from the hands the gloves should be placed in a Turkish towel, carefully shaped, blown into, and dried slowly and away from all heat. All washed gloves should be gently rubbed before being put on the hands; doeskin and chamois should be rubbed between slightly moist hands.

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