CHAPTER III

TEXTILE ECONOMICS

Textile fabrics have design, color, and finish and are made up of one fibre or a combination of fibres. In judging any fabric to determine its value and wearing quality it is necessary to take all these factors into consideration. All materials, whether of cotton, wool, silk, or linen, should be so made as to conform to certain requirements or standards, these standards to be regulated for the purchaser by the quality claimed for the materials and the prices charged. At present, however, no definite standards exist, and wise selection must depend to a large extent on the knowledge of the purchaser.

In selecting materials the purchaser should know not only what quality or grade of material may be demanded for a certain price but be able to determine as well whether that quality has actually been secured on payment of the price. For instance, if damask sixty-six inches wide and sixty-nine cents a yard is bought, the purchaser has no right to expect good linen fibre firmly woven. The fabric of that width and price must necessarily have either poor linen fibre or linen and cotton combined with a loose weave and concealed with much sizing. If, on the other hand, a bengaline silk twenty-seven inches wide is purchased for two dollars a yard, it can scarcely be claimed that proper value is received if the fabric is found to be two-thirds cotton.

In order to select materials wisely both knowledge and experience are required.

First, it is necessary to know—

(a) The characteristics of the various fibres used in the manufacture of the materials, their feel, appearance, strength, their similarities and differences before manufacture and after, and the manner in which they respond to various tests.
(b) The general processes of manufacture required to make various standard kinds of fabrics from these fibres. Without some knowledge of the many operations necessary it is difficult to have a just appreciation of the value of the finished product.

(c) What substitutions or adulterations are possible in manufacturing the fibres into fabrics. (i) The various operations by which one fibre may be made to resemble another or one fibre may be concealed when combined with another for the purpose of adulteration. (ii) Simple tests by which these substitutions and adulterations may be detected.

Second, based on this ascertained knowledge there should be unlimited experience in the handling and testing of the materials themselves for comparison of quality and price. Facts, unless supplemented by experience, are of little value in judging materials. Discrimination in selection can result only from the experience which is gained by the constant use of both eyes and hands in a careful study and comparison of materials. In beginning such work, standard materials should be chosen rather than novelties, and as a starting-point or basis for comparison of any kind of material a good quality of that material should be used. The necessary qualifications for such a material are as follows:

(a) It should be woven of well-spun yarn which is not only made of a uniformly good quality of fibre but is sufficiently twisted to give the required strength to the fabric. Because of the finishing, short and imperfect fibres and substitutes may not show in the new fabric unless it is very carefully examined, but they will appear after the material has been worn a short time.

(b) The yarns for warp and filling should be well balanced to prevent the unequal strain or wear of one set and their consequent breakage. This balance is usually secured (i) by having the yarns of warp and filling of comparatively the same size, weight, and twist, or (ii), if either warp or filling yarn is finer, by having a sufficient number of the finer to give the required strength. This latter
method is not satisfactory in every case. Any dimity which has a few heavy lengthwise cords with a fine, tightly twisted filling and no heavy crosswise cords is an excellent illustration of lack of balance. The heavy cord, because of the extra strain of its weight, has practically a cutting action on the finer crosswise or filling threads, which, with wear and laundering, soon break.

(c) To permit the developing of any desired finish from the fabric itself, without the aid of any applied fibres in the finishing processes, the yarn should be of such weight and quality and so woven as to give the fabric a sufficiently firm foundation or structure. For instance, many fabrics, particularly those made of wool, have the ends of the fibres brought to the surface to form a thick pile or nap by the use of teasles or wire gigs. If the foundation—the stock—of the cloth is too poor to supply these fibre ends it is necessary in the fulling process to add material to give substance enough for this finish. Good materials properly applied during manufacture do not injure the finished product, but in too many cases cheaper qualities are used and so carelessly added that with wear they drop out and reveal the lack of substance in the woven foundation.

(d) The weave should have strength and endurance. The weaving should be so firmly done that sizing is not necessary to give the material the substance and appearance of a good fabric. The kind of weave chosen should depend on the use for which the material is intended. Designs like the basket have aesthetic but not economic value and consequently should be avoided in fabrics of which wearing quality is demanded. There are many others, however, such as the twills, which are good in design and are unrivalled from the standpoint of wear.

(e) The material should have a true finish, one which can be brought up from the fibre by the pressing of the fabric rather than one which is artificially made by the application of various polishing and finishing mediums. The first is permanent; the latter disappears with little wear or laundering. Such finishes are difficult to recognize because of their great variety, but they may be found in many of the
cotton, wool, silk, and linen fabrics. There are also many designs which are made by pressing down sections of the surface of the material with engraved rollers and then treating those sections with a starchlike substance which holds them in place temporarily but is quickly rubbed off with wear. These designs are most frequently seen in novelty cotton fabrics. Because of their finish they often command a price much above their actual value.

(f) When possible the color of the material should be lasting for the use required of it; that is, the color of a cotton fabric is subjected generally not only to the test of wear, but of laundering as well, and must be made to meet both tests. Usually the color of a wool fabric has merely that of wear to withstand. Few colors are really "fast" to all treatment but may be to some. Constant improvements are being made in dyes, especially those used on cotton fabrics where fast colors are most necessary. Effort should be made to obtain the names of firms who guarantee fastness to certain colors.

I. COMPARISON OF FIBRES

As has been said, all testing of materials for fibre or fibres should be based on a comparative knowledge of the characteristics of the different raw fibres and the manner in which each fibre responds to certain physical tests. Although the fibres may be somewhat changed in the manufacturing operations, they are essentially as before and respond in the same general way when similar tests are applied to them in the fabric.

The four important fibres—cotton, wool, silk, and linen—differ from each other in various ways, many of which may be detected without using even a simple microscope or linen-tester. In comparing various grades and qualities of the same fibre, however, such as good wool and remanufactured wool, little can be determined accurately even by an expert with the use of a powerful microscope. In identifying fibres by physical tests the following factors should be considered:
(a) Appearance; (b) length; (c) feel; (d) tensile strength; (e) elasticity; (f) behavior in burning.

Before considering these, however, it is necessary to establish a foundation by knowing as much as possible concerning the structure, the composition, the hygroscopic quality, and the behavior toward dyestuffs of these fibres. These are not facts which can be determined by physical tests; they have, however, been worked out and proved by chemical and microscopic analysis and are recorded in books which are easy of access to the majority.

*Cotton* is a vegetable fibre. It is a flat, ribbonlike band with thickened edges and a slight spiral twist. Unripe or dead cotton has no twist and does not spin well. It has its inner canal closed and does not take dye. Cotton is largely made up of cellulose; it absorbs from six to eight and one-half per cent of moisture without evidence of dampness. It does not dye easily.

*Wool* is an animal fibre with a scalelike surface. It is made up of flattened and overlapping cells which form a series of scales called serrations. These serrations help to give to wool its shrinking or felting quality. *Kemp* is the diseased fibre. It is solid and without cellular formation. It has the same structure throughout as the scales of the fibres. It is short, stiff, brittle, and large in diameter. It does not spin and does not take dye. It cannot be improved by any process of manufacture. Wool is a protein substance composed of oxygen, hydrogen, carbon, nitrogen, sulphur, and phosphorus. It can absorb from twelve to nineteen per cent of moisture without evidence of dampness. It usually dyes easily and the color is quite lasting.

*Silk* fibre is a smooth, structureless filament with a transparent lustrous surface. It has an outer coating of gum called *serecin*. This encloses two combined filaments of silk or *fibroin* which is a protein substance. Silk can absorb eleven per cent of moisture without evidence of dampness. It dyes easily.

*Linen* is a vegetable fibre made up of cylindrical cells. Its surface shows lengthwise fine lines and crosswise markings like breaks in the fibre. It is cellulose and can absorb
eleven per cent of moisture without evidence of dampness. It does not dye readily nor hold its color well.

Based on these facts, a comparison of the fibres may be made as follows:

(1) General Appearance

Cotton: Fine, fluffy, straight, dull.
Wool: Wavy, fuzzy, rather wiry, bright. The wool fibre varies—the long is usually lustrous, the short is soft and has less lustre.
Silk: Fine, smooth, straight, shining.
Linen: Smooth, stiff, straight.

(2) Length

Cotton: $\frac{3}{4}'' - 2\frac{1}{2}''$; $1'' - 1\frac{1}{8}''$ average length.
Wool: $1'' - 1\frac{3}{4}''$.
Silk: 500 yds.—1,300 yds.
Linen: $12'' - 36''$; $18''$ average length.

(3) Feel

Cotton: Matted, unresponsive; inelastic, soft.
Wool: Springy, spongy, elastic, harsh.
Silk: Smooth, soft, elastic, cool.
Linen: Wiry, harsh, cold, inelastic.

(4) Tensile Strength

Cotton: Third in strength.
Wool: Generally weakest, but varies greatly.
Silk: First in strength.
Linen: Second in strength.

(5) Elasticity

Cotton: Third, very slightly elastic.
Wool: Second, very elastic.
Silk: First, most elastic.
Linen: Fourth, inelastic.
(6) Behavior in Burning

(a) Odor:
Cotton: Like burning paper or wood (cellulose).
Wool: Like burning hair (animal oil).
Silk: Much like wool.
Linen: Much like cotton (cellulose).

(b) Rapidity:
Cotton: Burns rapidly, brightly, and steadily; does not extinguish easily.
Wool: Smoulders, burns slowly, with difficulty; extinguishes often.
Silk: Burns rapidly, darting flame.
Linen: Burns rapidly, like cotton, but is not so inflammable; has more oil.

(c) Appearance:
Cotton: Steady yellow flame, leaves gray ash without residue.
Wool: Blue, unsteady flame, leaves oily globule, gummy residue.
Silk: Leaping flame, leaves oily globule.
Linen: Much like cotton, leaves ash.

II. Design

Textile design is produced in many ways, all of which may be grouped under two general heads: structural design, that which is made during the formation of the fabric, and surface design, that which is made after the formation of the fabric.

I. Structural Design

Structural design is by far the larger class. In general, it may be said to have more effect on the wearing quality of a fabric than do the majority of surface designs. Structural designs are made while a fabric is being woven. The design may depend entirely upon the character of the weave—the way in which the warp yarn is interlaced by the filling yarn; or, in addition to weave, there may be variety in the threads or yarns used.
1. Design by Yarn.

(1) Yarns Made of Different Fibres.—Combinations of yarns of different fibres are seen in wool materials in which there is a silk stripe; in wool brocades which have the figures in silk; in lansdowne, in which silk and wool are evenly combined; in silk gingham, in which silk and cotton are used; in mohair, alpaca, etc., in which mohair filling is combined with a cotton warp; in such materials as Tussah Royal, in which mohair and wool are used and give to the surface a crinkled appearance due to the different shrinkage of the two fibres; in many upholstery materials, in which jute or hemp is combined with plain or mercerized cotton.

(2) Yarns Having Different Twists.—Various materials are given an irregular or pebbly surface by combining yarns of different twists. The warp and filling yarns may have different twists, or different twists may alternate in both warp and filling. Crépe de chine and Georgette crépe are illustrations of different-twisted yarns.

(3) Colored Yarns.—The use of colored yarns gives a great variety of design.

(a) Solid Color.—Materials in which the warp and the filling are always alike, as in galatea, sateen, nun’s-veiling, or wool batiste, and panama cloth.

(b) Changeable.—Materials which have a warp of one color and filling of another. Chambray is an excellent example, as this characteristic really distinguishes it. True chambray always has white filling and colored warp yarns, with the exception of a few white warp yarns added at each edge to keep the selvage white.

(c) Stripes.—Materials in which colored yarns may be introduced warpwise, with warp varied and filling solid, or fillingwise, with filling varied and warp solid. Stripes are more generally seen lengthwise than crosswise, unless to meet an occasional demand for novelty. They are found in a variety of materials—in gingham, in madras, and in silks and wools.

(d) Checks and Plaids.—Materials which have both warp and filling striped—evenly for checks, unevenly for plaids.
This kind of pattern is seen in Irish poplins and shepherd's plaids. Checks and plaids are also found from time to time in wools, such as serges and broadcloth, and in silks, such as taffeta and surah, but are not characteristic of them.

(4) Yarns of Different Sizes and Weights.—Pattern is frequently made by the use of heavier yarns. These yarns may be introduced into either warp or filling, forming stripes, or into both, forming checks or plaids. Dimity is given its chief characteristic by the heavy yarns which, according to their placing, form stripes, checks, and plaids. The heavy yarns introduced fillingwise give to poplins and a large class of silks, such as bengaline, eolienne, and faille, the corded surface which makes them distinctive.

(5) Yarns of Different Sizes and Weights Combined with Colored Yarns.—Many materials are given more decorative surfaces by having the stripes, checks, or plaids formed by the colored yarns outlined by heavy cords. Such effects are frequently seen in ginghams and madras.

(6) Novelty Yarns.—These are generally made in the final process in the manufacture of the yarn, that of twisting. Yarns of the same or different fibres may be combined. Novelty yarns have been much used recently in materials both of wool and cotton, which were sold under the general names of ratine or éponge. Nearly all such materials may be classed under the general term of novelties. They change constantly because of their dependence on passing fashions.

(7) Yarns at Different Tension.—Some materials are given a crinkled surface by the use in weaving of warp yarns at different tension. This necessitates the use of two warp-beams to carry the two distinct sets of threads. These may be arranged to give the entire fabric an irregular surface or may be made to form stripes of regular or different widths. This kind of design is most frequently seen in such cotton fabrics as crêpe and seersucker, which do not require pressing after laundering.

2. Design by Warp Printing.—Many materials are given a design by the printing of the warp yarn after it is practically prepared for weaving. A plain filling is used,
resulting in a less pronounced design and softer colors. Dresden ribbon and taffetas are made in this way. The method of printing is described under Surface Design.

3. Design by Weaves.—In studying weaves there are two lines of yarns or threads to consider: the warp, or lengthwise, threads—those which are put on the loom first and which may be said to form the foundation upon which the pattern is worked out; and the filling threads—those which cross the warp at right angles and make the pattern simple or elaborate by the manner of their interlacing. In the finished fabric the warp-threads are usually called ends and the filling threads picks, particularly in trade, and in any comparison of material for fineness and strength the number of picks and ends to an inch is considered.

(1) Classification of Weaves.—The various weaves which are used in materials offer an interesting and by no means difficult study once a general classification has been arranged. The one given here is simple and easily understood. (a) Plain and its variations: derivatives, basket and rib; (b) twill and its variations; (c) satin and its variations; (d) figure: damask, brocade, huck, diaper, granite, etc.; (e) double cloth; (f) pile; (g) lappet and swivel; (h) gauze; (i) leno.

(2) Method of Making Weaves.

(a) Plain Weave.—The simplest weave, and one which is important because of the large number of materials in which it is used, is the plain weave, also called tabby, cotton, homespun, or taffeta. It is found in cotton materials—muslins, cambrics, percales, and batistuses; in wools—nun’s-veiling, panama, voile, and challie; in silks—taffeta, China, and India silks; in linen—chintz, handkerchief linen, and sheeting. The plain weave requires two harnesses, through one of which all the odd threads (1, 3, 5, 7) are drawn; through the other all the even (2, 4, 6, 8). If the harness holding the odd threads is raised in opening the first shed, the shuttle on its trip through the shed goes under all the odd threads and over all the even; that is, the first warp-thread is up, the second is down, and so on across the fabric. When the next or second shed is open and the
shuttle is sent through, just the reverse happens: the odd threads are covered by the filling and the even are on top. In this the first warp-thread is down and the second is up. This completes the design, and when the third shed is opened it is a repetition of the first, the fourth is a repetition of the second, and so on until the fabric is finished. The filling passes under one and over one in regular order, alternating in each row.

This weave, while giving a strong and firm material, is not particularly close because the threads do not pack as compactly as those of some other designs. A material woven in this way, if held to the light before any finishing is done, will usually show openings between the threads; these are filled with sizing sometimes, if the holes are large and the fabric inexpensive. Shrinking or fulling during finishing helps to make the threads lie closer. The plain weave is often made more decorative by the use of the methods already referred to as forming designs; that is, the introduction of colored yarns, of heavier yarns, of yarns at different tension, etc.

There are several weaves which are usually called derivatives because they are based on another with a slight variation. From the plain weave we have the basket and rib weaves.

(i) Basket Weave.—The basket weave is found in cotton materials, such as monk’s cloth; in wools and linens, called basket cloth; and in silks, such as louisine.

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warp. This makes a rib lengthwise with the selvage. The cross rib formed by the warp is more often seen.

(b) Twill Weave.—The twill weaves are practically equal in importance to the plain weave because they are used in so many materials and with such variety of effects. Twills are found in cotton materials—canton flannel, drillings, jean, outing flannel; in wools—serges, whicords, cheviots, broadcloths; in silks—plain foulards, surah, silk serges; in linen—diagonals and some kinds of towelling. In the twill the warp and filling threads intersect, so that they produce a diagonal line or rib across the fabric either to right or to left. The regular twills have an angle of forty-five degrees. All twills are a progression of one; that is, instead of alternating, as is done in plain weaving, the filling moves forward in each row, one thread to right or left of the crossing of the first line, and in this way makes the diagonal.

There is a great variety of twills, their names sometimes indicating the number of harnesses necessary for the weaving. There are even and uneven twills. In the even equal quantities of warp and filling yarn show on the surface of the material, as in the common, or plain (two warp up and two warp down), twill. In the uneven one yarn shows much more than the other, as in what is frequently called the prunella, or three-shaft (one warp up and two warp down), twill. Besides the twills already mentioned there are many others, among them the corkscrew, broken, pointed, and fancy.

One of the simplest twills is the three-shaft or three-leaf (uneven). It may be either warp or filling face and re-
quires three harnesses. For a filling-face fabric in the first shed warp threads 1, 4, 7, 10 are lifted; the filling passes under one (1), over two (2 and 3), under one (4), and so on. In the second shed 2, 5, 8, 11 are lifted, and in the third 3, 6, 9, 12, giving a progression of one in the lifting of the warp in each row. For a warp-face fabric the filling passes under two (1 and 2), over one (3), under two (4 and 5), over one (6), and so on.

All of the twill weaves make exceedingly attractive surfaces, and for this reason they are used in many materials like the worsteds, which do not have their weaves concealed by any finishing process. They also give firmness and bulk to material, as many threads can be used and packed firmly. Because of this the twill is used for materials like broadcloth which, in the finishing, have fibre ends brought to the surface to form a nap. In many materials twills form the only decoration; in others they are merely the background for elaborate figures.

(c) Satin Weave.—The satin weave like the twill has a progression in each pick in the lifting of the warp, but it is a progression of two or more rather than one as in the twill. It might be called a broken or irregular twill. The terms satin and sateen are both used for this weave: satin to indicate a surface formed by the warp, as in satins, in Venetian cloth, in prunella, and in galatea, which have the floating threads running lengthwise of the material; sateen, a surface formed by the filling, as in sateen, which has the floating threads running across the material.

The satin weave gives a smooth, lustrous fabric, since the surface—because of the kind of weave used—appears unbroken and consequently reflects the light to the best advantage. As has been said, the surface may be formed by warp or filling threads. In either case, whether warp or filling, these surface threads are longer than in any other weave, as they are carried under one intersecting thread and over several, and they are so closely packed that the few intersecting or cross threads over them scarcely show. This weave is found in cotton materials—sateen, galatea;
in wools—Venetian cloth, prunella; in silks—satin, messaline, *peau de cygne*, and *charmeuse*; in linen—damask. An odd number of shafts is usually found; that is, five or seven shafts or even a greater number.

For a five-shaft, filling-face satin, as the name implies, five harnesses are necessary. When the first shed is opened the filling passes under one warp thread (1), over four (2, 3, 4, 5), under one (6), and so on; in the second row, to make the progression it passes over three warp threads (1, 2, 3), under one (4), over four (5, 6, 7, 8), under one (9), and so on; in the third row over one (1), under one (2), over four (3, 4, 5, 6), under one (7), over four (8, 9, 10, 11), and so on; in the fourth row over four (1, 2, 3, 4), under one (5), over four (6, 7, 8, 9), under one (10); in the fifth row over two (1, 2), under one (3), over four (4, 5, 6, 7), under one (8); then the pattern is complete and the sixth row is like the first.

The satin weave is very frequently used in materials in which there is a combination of fibre, as in cotton-backed satins, where the silk threads floating on the surface cover entirely the few cotton threads which intersect them. The result is a silk face and a cotton back with irregular twill effect. Skinner’s satin is a well-known illustration of this. Many of these materials are less expensive than all silk and prove satisfactory in wearing quality. If the threads have too long a float on the surface, as frequently happens in some foulards, they are likely to catch and pull, and thus destroy the face of the fabric, especially if there is a colored design. Some satin-face materials in dark colors have the disadvantage of becoming shiny with wear. Generally
speaking, however, the satin weave is satisfactory and gives many beautiful fabrics.

(d) **Figure-Weaving.**—Figure-weaving is closely allied to the satin and twill weaves, many of the designs being really a combination of the two. Figure-weaving is done on the Jacquard loom, or by some special attachments like the Dobby or Head motion, which may be added to the harness-loom. In this class the most frequently used are the damask, brocade, huck, diaper, and granite weaves, which are found in practically all kinds of materials.

Damask and brocade are terms often confused, but there is a distinct difference. In damask the design or pattern is complete on each side of the fabric and is, in consequence, reversible; there is no definite right or wrong side. In general, on one side the background is satin with the figure showing the twill; on the other the figure is satin and the background has the twill effect. Damask is often woven with a sateen background and satin figure or vice versa; this gives a crosswise twill to one on the back and a lengthwise twill to the other.

In brocade there is a decided right and wrong side. The design shows very indistinctly on the wrong side, as no effort is made to have it complete. The threads which form the pattern on the right side are woven in on the wrong side when not in use or left floating to be cut off later. The damask and brocade weaves are used in a variety of materials, the damask principally for table linen, which may be made either of cotton or linen or a combination.

Such weaves as the huck, diaper, and granite are much simpler in construction and do not require necessarily the
Jacquard loom. The diaper and huck weaves are used chiefly in linens and cottons; the granite weave in linens and wools, most often in materials called granite or crêpe cloth.

(e) Double-Cloth Weave.—Under this general heading may come materials of various kinds: (i) Cloths which are backed. The extra backing is usually done by warp-threads which give additional weight without in any way changing the appearance of the face of the fabric. In many cases the materials added to give weight are of decidedly inexpensive quality. (ii) Cloths which are reversible. In the reversible materials two warps or two filling threads may be used and interchanged in such a way as to make the designs alike or unlike on the two sides of the material. (iii) Cloths which are figured with extra materials. These frequently have two distinct sets of warp and filling and are reversible. (iv) Cloths which are really double or compound. Many double cloths are made with two sets of warp and of filling, which are so interlaced at intervals as to make the two fabrics inseparable; or there may be a double warp, double filling, and an additional warp which binds them together. Fabrics made in this way may easily be pulled apart. In this general class come many heavy suiting, coatings, steamer rugs, novelties, polo cloth, and silence cloth.

(f) Pile Weave.—The pile weave differs from others in that it does not have all the warp and filling threads in lengthwise and crosswise parallel lines, but has some threads of either the warp or the filling so raised in loops as to become vertical.

Under the general head of pile weave come several classes of fabrics: (i) those in which the pile is formed by the warp, as in good velvets and plushes; (ii) those in which the pile is formed on the two sides of the fabric by the use of a movable reed and two warps, one at loose tension, as in Turkish towelling; (iii) those in which the pile is formed by the filling, as in velveteen and the cheaper velvets; (iv) those in which two distinct fabrics are made at once and later cut apart.
(i) Warp-Pile—Cut or Uncut.—Warp-pile fabrics are of great variety, as they may be plain or figured, the latter a combination of cut and uncut pile. When the pile is formed by the warp there are two sets of warp to one of filling. Both the ground and pile warp are interlaced by the filling threads, but at short and regular intervals one set of warp-threads passes over an inserted wire which pulls the threads up to form loops. In making cut-pile fabrics the wire is provided with a knife at one end which cuts the loops as it is withdrawn. If a warp-pile fabric is to be given a design by a combination of cut and uncut pile, the pile is not cut in the weaving but during the finishing processes.

(ii) Warp-Pile—Uncut.—Turkish towelling and some novelty materials are made by using two sets of warp-threads one of which has a very loose tension. The regular loom is used, but the reed is so regulated that it does not beat each row of filling regularly; that is, two rows of filling are put in and beaten very lightly. After the third row, however, they are all firmly beaten into place. As a result the loose warp is pushed both up and down and forms a loop on both sides of the material.

(iii) Filling-Pile.—When the pile is formed by the filling there are two sets of filling threads and one of warp. One set of filling interlaces with the warp regularly and forms a firm groundwork; the other set floats over the woven surface for some distance and is intersected and bound to the fabric by the warp at regular intervals. After the weaving is finished this floating thread is cut in the centre and rises to form the pile. As there are a great number of these threads, a uniform and well-covered surface is formed. Velveteen and corduroy are woven in this manner, also many cotton velvets.

(iv) Double-Pile Weaving.—This method of weaving is sometimes employed for plushes. The weaving is done somewhat as in double cloth, but the two fabrics are far enough apart to give the requisite length of pile. The pile threads pass from one fabric to the other and are interlaced and kept in place by the filling threads. These pile threads
are later cut half-way between the upper and lower fabrics, giving two distinct materials.

If a pile fabric is poorly made, with few threads or the threads insecurely fastened, the surface soon pulls out or wears off and an ugly background is left.

(g) Lappet and Swivel Weaving.—By the use of attachments—either the lappet or the swivel—decorative figures may be woven over the surface of a fabric without affecting the groundwork weave. The effect is somewhat that of embroidery. Many figured muslins, such as the dotted swiss, are made in this way. When the figures are continuous the wearing quality of the material is in no way affected by the decoration, which enhances its beauty. If an intermittent design is used, such as a dot, the long threads connecting the dots on the wrong side must be cut. These ends may pull out if the material is not closely woven.

Frequently these designs are imitated; that is, similar effects are produced in inexpensive materials without using any attachment. Dots are a favorite method of decoration, but without the attachment each dot is not made of a continuous thread. They are put in by an extra bobbin, which carries the filling back and forth across the full width of the material, letting it appear on the surface to form the dot. Each thread of the dot is a separate thread. The back of the material is covered with the long lines of floating threads between the dots, which must be cut in order not to catch. With very little wear the short threads which form the dots soon pull out. Many of the designs in cotton materials are made in this way.

(h) Gauze Weave.—In the gauze weave we have an openwork effect obtained by a crossing of the warp-threads. Grenadine and marquisette are the best-known illustrations of this.

While gauze fabrics are light and open they are exceedingly firm, more so than any other fabric in proportion to the quantity and quality of material used. An even number of warp-threads is used, and between every two filling threads two warp-threads entwine to right and left alternately; the warp-thread, which is on top in the crossing,
passes under the filling and vice versa. This occurs regularly, because of the alternating of the warps to right and left, and gives firmness to the material.

(i) Leno Weave.—Leno is a name usually given to a variation of the gauze, a combination of gauze and plain weaving. Many cotton curtain materials have this combination.

II. Surface Design

As the name indicates, this kind of design is applied after the fabric itself is made. The majority of fabrics having a surface design have also structural design, as, with but few exceptions, fabrics are formed by weaving. Surface design may be applied in various ways, some of which are not of sufficient importance here to require more than passing mention.

In many of these designs the decoration is made by the application of color in various ways. In others it is made in the finishing processes by pressing with special rollers without the use of color. It may also be made by hand or machine embroidery, when the pattern may be in a contrasting color or may not.

1. Design with Color.

(1) By Hand.—There are two or three hand methods, the best known of which are block-printing and stencilling.

(a) Block-Printing.—Block-printing is the method in which the design is applied by blocks, a separate block being necessary for each color. The blocks are applied one at a time.

(b) Stencilling.—In stencilling, the pattern is cut out of stout paper or metal and the color applied to the fabric through the interstices of the pattern.

(2) By Machine.—There are different machine processes, the best known of which are block-printing and roller-printing.

(a) Block-Printing.—When block-printing is done by machine the general principles are the same as in the hand method. In the machine method there are at present limitations not found in the hand work as to the number of colors and the size of the pattern.
(b) Roller or Machine Printing.—The most important method of textile printing is roller, cylinder, or machine printing. The majority of surface designs are made by this method.

When fabrics are properly printed the color applied in this way becomes a part of the fibre and resists both washing and friction. In general, for machine-printing there is (i) a large cylinder covered with several thicknesses of material called lapping, over which passes the cloth to be printed. Against this large cylinder there is (ii) a smaller cylinder which is the engraved copper printing-roller. This copper roller in revolving touches (iii) another roller which supplies it with color. To keep the copper roller free from the lint of the material and to regulate the amount of color on it there are (iv) two knives which are so set as to operate against its surface and keep it clean.

In roller-printing a different cylinder is required for each color. These different copper cylinders, to the required number, are placed around the central cylinder and print one after the other. Various methods are employed in engraving the copper rollers and there are also many different finishing processes for setting and bringing up the color.

2. Design without Color.—The design without color, made by pressing rollers, gives many different results which are determined by the surface finish of the rollers.

(i) Design on Plain Weave.—A material with the smooth surface which a plain weave gives may have a design made by using embossed rollers. In this method the background, which is pressed flat, is often treated with a finishing gum or paste which further accentuates the difference between the flattened background and the raised pattern. Such fabrics belong to no special class and are generally termed novelties. Many of the cotton ratines are finished in this way. Various crêpe effects are given to fabrics having a plain weave by the use of special rollers. The crinkled surface of albatross is made in this way.

(ii) Design on Pile Weave.—Many pile fabrics have designs made in much the same way. They may be made with uncut-pile background and cut-pile design or vice
versa. The method is the same for both. The design is made on the uncut-pile material by using engraving or embossing rollers as in the plain weave. When the design is made, if the background is to remain uncut it is pressed flat and treated with a paste to keep it flat during the next process, which is that of shearing or cutting the pile left standing. The material is then washed, a process which removes the paste and releases the background pile. The result is a light background of uncut-pile with a design in a darker shade which is given by the cut-pile. The opposite effect is secured by pressing the design and cutting the background.

(3) Moiréing.—Another method of securing design without color is the moiréing process. The surface of the material used is generally slightly cored. This cording is made by having the threads which form the filling heavier than those of the warp. The material is folded face to face along its lengthwise centre and a paper inserted; it is so pressed and dampened that some of the cords are flattened and its surface given the watered effect which is seen in many materials, such as percaline, moreen, moiré antique, moiré velour, etc.

III. Tests for Fabrics

Before beginning any tests on fabrics it is necessary to know the various processes required in their manufacture and, with this information as a basis, to establish familiarity with the raw fibres and with the ordinary designs, by careful and constant observation and comparison of fibres and materials. In the materials many weaves are concealed by the finishes, and the fibres are combined with various substitutes, adulterated by weighting, and covered with sizing, thus greatly increasing the problem of identification.

As has been said, in the beginning it is much wiser to apply all tests to good fabrics—those which are sold as good by reliable firms at fair prices. If the first testing is done on cheap materials it is a discouraging task, as there are
usually more difficulties to be met in the way of poor fibres, substitutes, sizing, and weighting. A knowledge of good materials—of all that the term good implies—should when possible be made the basis of all textile testing.

Some of the same tests may be applied to fabrics as to fibres, and while any one test may not give absolute results by itself, in combination with others it will help to determine, in a general way, the character of the material. Many tests require the unravelling of the threads of the material until the fibres are so separated that they can be examined. These tests may be left until various others have been used for such factors as the strength, finish, feel, and color of the material itself.

1. **General Comparison of Fabrics.**—A comparison of the four general classes of fabrics—cotton, wool, silk, and linen—may be made, but is valuable only to a limited extent, as each class includes so great a variety of fabrics which differ widely in appearance, feel, strength, etc.

1. **Appearance.**—Because of the perfection of the art of finishing, the general appearance of many fabrics counts for comparatively little, except to the expert, in indicating the structure of the fabric and the exact quality and combinations of fibres used.

2. **Feel.**—Many fabrics, however, frequently have somewhat the same feel as the fibres of which they are made.

   (a) Cotton material: unresponsive, soft, inelastic. (It may be made to look and feel somewhat like wool, but it still retains these characteristics.)

   (b) Wool material: springy, harsh, elastic. (When combined with much cotton or with much shoddy it is less elastic and springy.)

   (c) Silk material: smooth, elastic, cool. (When weighted or adulterated it has less elasticity.)

   (d) Linen material: firm, stiff, smooth, cold, inelastic. (When adulterated it loses somewhat its firmness and smoothness.)

3. **Strength.**—No comparison of the strength of the different classes of materials can be made based on the strength of the respective fibres. Two materials made of the same
fibre differ absolutely in strength, as the strength depends on the size and quality of the yarn and the kind and quality of the weave. For instance, wool fibre, which is weak in tensile strength, makes generally a strong material.

(4) Burning.—Burning a small section of cloth gives practically the same results for materials as for fibres, with the exception that the quickness with which any fibre burns may be somewhat affected by the firm twisting of the yarn and the closeness of the weave.

(5) Tearing.—The tearing of material sometimes helps in a general way in determining the kind of fibre as well as the strength of the material itself.

(a) Cotton tears easily, with a shrill sound, and the ends of the fibres along the tear curl up and are fuzzy.

(b) In a wool fabric the weight of the thread and the firmness of the weave have much to do with the way in which it tears. Ordinarily, however, it tears with difficulty and the sound is dull and muffled. If much cotton is present it facilitates the tearing, and the ends of the cotton fibres are unlike those of the wool.

(c) Silk, unless it has a special design, such as very heavy filling or cording, tears easily, with a sharp, shrill sound.

(d) Linen is difficult to tear; the ends of the fibres are straight and smooth. If cotton and linen fibres are used in one fabric the tearing test may indicate such a combination because of the difference in the torn ends. It proves little or nothing, however, as to the proportion.

2. Testing for Strength and Color in Fabrics.—The tests used for determining strength and color are practically the same for all fabrics.

(i) Tests for Strength.—The strength of a fabric has much to do with its wearing, but it can have no fixed standard. Each material should be strong enough for its intended use. If the warp and filling threads are not well balanced, if one is much finer than the other, the fabric breaks or tears along the line of the heavy threads. Dimity, with its heavy lengthwise cords, is the most obvious illustration of this. With wear and laundering the filling threads break along the cord. No matter what design is chosen the
weaving should be well done; that is, there should be enough threads and they should be closely enough packed to give firmness and body to the cloth.

To judge the strength of a fabric it should be held firmly in both hands, with the fingers underneath and the thumbs on top, and pulled straight out, first warpwise, then filling-wise. The weaker threads, whether warp or filling, will break easily and quickly unless there are so many of them used that they acquire sufficient strength to balance the other stronger threads. Later, when the material is unravelled, the respective strength of warp and filling may be tested more accurately by breaking and by comparison for size, firmness, twist, etc.

Many materials which seem strong as far as quality and size of yarn are concerned are woven in a design which allows the threads to slip out of place easily where there is the slightest strain, especially in the seams. This fault in the material may be detected by attempting to push the threads apart with the finger-nail. Many fancy weaves, like the basket, do not usually stand this test.

(2) Tests for Color.—There are several ways of testing for fastness of color, because color is affected by various factors—chiefly by washing, boiling, and the use of strong soap, by pressing with too hot irons, by wearing, by exposure to sun and air, and by friction.

It is, in general, the cottons and linens which must be tested for laundering. This can be done only by obtaining a sample and subjecting it to the ordinary rubbing and soaping which must be used in cleansing such materials. It is well to keep part of the sample for comparison to know the exact loss of color. Some colors which a few years ago faded almost immediately are now, if special dyes are used, absolutely fast.

Many materials, particularly those worn next the skin, must have sufficiently fast color to withstand friction. This can sometimes be fairly well determined by rubbing the fabric with another which is white.

For sunlight tests it is best to expose a sample for a number of days, having half of it carefully covered with some-
thing which will exclude the light. By this method easy and accurate comparison may be made.

3. Testing for Fibres and Finish in Fabrics.—The tests used for determining fibres and finish differ for the different fabrics.

(i) Cotton Fabrics.—In cotton fabrics it is not necessary to consider substitutes; they are not used, because the cotton fibre is cheaper than any other fibre which could take its place. The length and quality of the fibre in the material may vary greatly, however, the weaving may be loose, and much sizing may be used. These are facts which must be considered in determining the soundness and wearing quality of the material.

(a) Fibres.—Good cotton fibres are blunt at the end which was attached to the seed, while the other end tapers, and the centre is a little larger than either end. The entire fibre shows a strong uniform twist. The dead or unripe fibres have practically no twist; they do not dye or spin satisfactorily, but usually they are not present in great numbers. In untwisting the cotton yarns to identify the fibres, the general appearance of the yarn itself should be observed as to uniformity of size, evenness of twist, smoothness, etc. Care should be taken not to break the separate fibres. Only an experienced worker with the help of a good microscope can secure satisfactory results in identifying the fibres. This work is, in consequence, not possible for general use.

Any experience which is gained in examining the different qualities of cotton fibres in cotton fabrics assists materially, however, in detecting cotton in various wool and linen fabrics where there are distinct differences in the different kinds of fibres.

(b) Finish.—The plain weave is more frequently used in cotton materials than any other. The twill weave is also found, especially in such fabrics as canton flannel and outing flannel, which are made to look and feel somewhat like wool fabrics by having a nap raised on one surface or on both.

The twill weave gives firmness and bulk to material, but
the plain weave, while strong, is not particularly close. If the weaving is not well done, openings or spaces can be seen between the different threads.

Many cotton fabrics have both poor quality of fibre and loose weave concealed with a sizing which is put on while the material is being finished. This sizing, which is somewhat like starch, fills in all the spaces between the warp and the filling threads, giving weight to the material and providing a surface for the desired finishing processes, such as pressing and polishing. There are various ways to detect this sizing. Rubbing between the hands or, if there is a great deal of sizing, tearing the material or flecking its surface sharply with the finger-nail will cause a fine dust or powder to rise. Soaking in warm water will usually dissolve at least a part of the sizing and leave the material sleazy. By moistening the fabric with the tongue a sticky, starchy taste may frequently be detected. These tests are not possible if it is a fabric from which a sample cannot be taken, but something may be learned from its appearance and feel. If it is loosely woven and much sizing is present, the sizing will probably show between the threads when the material is held to a strong light. It will also give the material a feeling of harshness which cotton does not otherwise have.

The wearing quality of many surface designs, especially those in which either the design or the background is pressed flat and held there by starchy preparations, can easily be determined by rubbing the fabric between the hands. In many cases a little rubbing destroys the design entirely by removing the paste or starch.

(2) Wool Fabrics.—The problem of identification for so-called wool material is a difficult one. It is possible to use a greater variety of substitutes for good wool and conceal them more successfully than in the case of any other fibre. Wool cannot be adulterated in worsteds, but in some cases cotton may be combined. This is not generally done in suitings, however. In woolens there is a great variety of substitutes possible, as cotton, shoddy, and wool wastes may all be used. A variety of weaves may be employed
for both. The twill weave is frequently used because it is attractive and gives the necessary background or foundation for any desired surface finish.

(a) Good Fibres and Substitutes.—Good wool fibres show a series of scales on their surface the number and size of which depend on the variety of wool. These scales give a saw-like edge to the fibre which is also kinky and wavy. This waviness must be distinguished from the twist of the cotton fibre. In untwisting yarns to determine the fibres present the general appearance of the yarn should be observed, as in the cotton, as to uniformity of size, evenness of twist, smoothness, etc.

The substitute fibres may be divided into two classes:

(i) Vegetable, which includes cotton, ramie, and jute. Of these cotton is most frequently used, not only because of its cheapness but because of the ease with which it may be made in its manufacture to resemble wool.

(ii) Animal, which includes waste wool and the remanufactured, reclaimed, regenerated, or recovered fibres from materials like shoddy. This class is the more important of the two.

Waste wool comes from both the worsted and woolen industries and includes the fibres which are so mixed with burrs that they cannot be freed by the burr-guarders or burr-pickers.

The remanufactured wools, as all the terms imply, have already been manufactured and many of them have been worn. In passing through the various processes of the first manufacture and in the tearing up preparatory to remanufacture the physical structure of the wool fibre has been somewhat changed and damaged. In general, all the remanufactured wools are included in the term "shoddy," but by some authorities they are divided into distinct classes, such as shoddy, mungo, and wool extract, varying in quality and in the use to which they may be put.

In testing for different fibres all the vegetable fibres in a wool fabric are easy to detect because they respond to the burning test as when in the raw state. For instance, in burning a material which has cotton in one direction and
wool in the other the cotton disappears, leaving only ashes; the wool is but slightly burned; the odor is unmistakable, and each wool fibre shows the usual gummy residue on its burned end. If cotton and wool threads exist in both warp and filling or if the fibres are combined in the yarn itself, it is necessary not only to unravel the material to test the yarns separately but to untwist the yarns for the individual fibres.

It is, however, very difficult—in fact, for the majority impossible—to identify the different qualities and kinds of animal fibres which may be used in one wool fabric. They all respond in the same way to the burning test or to chemicals, and even under a compound microscope the very expert cannot always detect them. Occasionally the presence of shoddy may with care and patience be discovered. It is frequently confused with noils, however. The wool fibres in shoddy may be of many colors, and both dyed and undyed fibres may be found. There may also be no uniformity in the size, length, or general condition of the fibres.

(b) Finish.—When wool fabrics reach the finishing process extra materials, such as noils, flocks, and waste wool, are often added to conceal defects or to give the desired weight or surface which has not been supplied in the making of the yarn or in the weaving. Noils come from the combing. Flocks come from the various finishing operations, such as clipping the nap of woolen fabrics. The waste wool is swept up in the mill and is frequently of more value than flocks. All these may be of fairly good quality or of very poor, depending on the amount of good wool or shoddy used in the various materials from which they come. They are usually added while the material is being fulled or felted. If they are of good quality and carefully applied, so that they do not wear off or drop out, the material is not injured. If they are poor, carelessly added, and rub off with a little friction, the weave itself is soon exposed and, on account of its lack of substance, cannot stand wear.

It is generally difficult to detect these added fibres except when the fabric is unravelled and its substance examined with the microscope. There are some exceptions,
however. If a large enough sample can be secured its surface can be tested by hard brushing with a stiff brush. Some fuzz always comes off, but if in large quantity the material should be avoided. Occasionally inexpensive materials, such as chinchilla and imitation zibelines, are found from which the entire fancy surface can practically be removed by pulling and rubbing.

Too high a polish on an inexpensive quality of material should be avoided. This is particularly true of broadcloth. Because of the number of processes necessary in its making and finishing, to be well made and of good-quality fibre it must be expensive. A cheap broadcloth with a high polish soon loses its lustre and wears unsatisfactorily. Good wool responds to pressing and steaming and takes a beautiful lustrous finish which is lasting. Cheap wool, which must of necessity be present in cheap fabrics, may be given a temporary lustre, but wearing soon removes it. Tests for water-spotting should be applied to all wool fabrics. It is not wise to make up even expensive wool materials until they have been sponged.

(3) Silk Fabrics.—In silk fabrics it is necessary to consider the use of both substitutes and weighting. Raw silk fibre is sometimes combined with wild silk; with waste silk, which is a shorter fibre; with cotton, mercerized and un-mercerized; and with artificial silk, which has the same basis as cotton. It is also frequently filled or weighted with salts of tin or iron.

Many kinds of weaves are found in silk fabrics; those most used are the plain, the satin, and the rib, or the plain with a rib or corded effect made by the use of a heavy filling. Of the three named, the last usually proves least satisfactory for wear. Such silk as the bengalines and poplins are of this kind and are frequently woven with heavy cotton fillings. The cords which the filling forms frequently have their silk coverings, the warp-threads, worn off by slight friction or rubbing, and the beauty of the material is entirely gone.

If materials made in this way become soiled or faded they cannot be redyed, as the silk and cotton yarns do not
dye alike. The silk, unless of very good quality, is apt to mat and separate in the dyeing and thus leave the cotton filling exposed. The result is extremely unsatisfactory.

(a) Good Fibres and Substitutes.—Good reeled silk fibre is long, strong, elastic, and lustrous. It differs in appearance from its substitutes. In untwisting yarns to determine the fibres present the general appearance of the yarn should be observed.

The substitute fibres may be divided into two classes:

(i) Animal, which includes wild silk and spun or waste silk. The wild silk fibres are generally coarse, broad, thick, and flat; they have lengthwise markings. The spun or waste silk differs from the raw silk principally in being much shorter. This shortness of fibre may make a fuzzy thread or yarn, which will affect the surface of the fabric, just as cotton fabrics, because of the shortness of the fibre, have a tendency toward fuzziness. This fuzziness may be avoided by careful manufacture or it may be concealed by a surface finish which is more or less temporary.

(ii) Vegetable, or cellulose, fibres, which include all cotton fibres and the artificial silk. Cotton fibres are short and without lustre; even when mercerized the lustre does not equal that of silk. They also lack elasticity and strength. Artificial silk has almost too much lustre. It has not the strength and elasticity of silk, is apt not to dye well—that is, evenly—and at present it does not stand constant moisture well. Its specific gravity is great, and all artificial-silk fabrics are heavy, as the yarns do not cover well and in consequence a large quantity must be used.

Any silk material in which a quantity of cotton or artificial-silk fibre has been introduced lacks the elasticity and spring of the all-silk fabric. As a result it wrinkles much more when used.

(b) Weighting.—Silk fibre is often weighted with salts of tin or iron, the adulteration chosen depending somewhat upon the color of the material. Weighting, if done to excess, seriously affects the wearing quality of the silk and makes it much more unsatisfactory than are the various substitutes. The metallic weightings used are variously affected;
for instance, some crystallize when exposed to air and light and act as ground glass would; they cut the silk fibres and absolutely destroy the strength of the silk. Bargains in silks should be avoided, as after they have remained on shop-counters for any length of time they are apt to disintegrate rapidly when subjected to any use.

In testing for the different fibres the waste or spun silk is the most difficult to identify as it is in general structure like the reeled silk. It is, however, shorter and the yarn made from it is frequently much fuzzier. When cotton and artificial-silk fibres are combined with raw silk they are easy to detect because the response to the burning test is the same as with combinations of cotton and wool; that is, there is present the combination of animal and vegetable fibres. Artificial silk, like cotton, is cellulose and burns in the same way with the same results.

When weighted to any extent silk fibre, which ordinarily burns quickly and with a darting flame, burns much more slowly and the framework of weighting remains.

(3) **Finish**.—Various kinds of dressing, such as glues, starches, and waxes, are used in silk finishing to produce various results. They are exceedingly difficult to detect. They may make the silk stiff, soft, lustrous, waterproof, or fireproof; but they may also give poor quality of fibre the appearance of good. Dressings are not in general nearly as injurious as are weightings. While they frequently make a fabric appear what it is not they do not destroy any silk fibre that has been used.

If appearance and feel of silk are to be relied on in purchasing, in general it is wise to avoid stiff silks. The soft-finished, such as crêpe meteor and charmeuse of good quality, wear exceedingly well. In darker colors the satin surfaces sometimes take on an unattractive, rather greasy, polish after they have been worn some time. Good crêpe de chine, which has a closer-twisted thread than the others and is fairly evenly balanced in warp and filling, wears well and usually washes satisfactorily. As has been said, silks with heavy fillingwise cords generally do not wear well, as the floating threads on the surface of the cords wear off. Bed-
ford cord is, however, an exception; its cords are lengthwise and are made with a woven surface rather than with floating threads. It gives excellent service.

(4) *Linen Fabrics.*—In linen materials the use of substitutes must be considered. As linen is an expensive fibre, imitations are frequently attempted. Linen fibre is often combined with tow, with cotton, and with ramie.

A variety of weaves may be found in linen fabrics. Those most frequently used are the plain and damask, or figured. As in cotton, the weaving may be loosely done and much sizing used.

(a) *Good Fibres and Substitutes.*—Good linen fibres are long, strong, and have a slightly transparent lustrous appearance. In untwisting the yarn the general appearance should be observed. All the fibres which are used as substitutes are vegetable, as is the linen, and in consequence they are rather more difficult to distinguish.

Tow, the short linen fibre, is frequently used with the long or line fibre. It generally makes a somewhat rougher thread and consequently a less even and less desirable fabric.

Of all the substitutes, cotton is more frequently used than any other because of its cheapness and the fact that it can by manufacture be made to resemble linen temporarily. It lacks the lustre, strength, and length of linen.

Ramie is a long bast fibre like linen. It has strength, an even higher lustre than linen, and is exceptionally white in color. It is difficult to manufacture and cannot withstand the test of wear as the linen does. It cracks and easily becomes fuzzy. It is not easy to identify when used with linen.

The burning test is useless in identifying any of these fibres, as, being vegetable, they all respond in practically the same way. A linen fabric usually burns more slowly than a cotton fabric, because its fibres, being longer and smoother than the cotton, give a smoother surface which is more resistant to the flame.

When linen yarn is tested for the presence of cotton, the linen fibres in comparison with the lustreless white of
the cotton show a slight transparent yellowness. If material is torn or threads are broken the torn ends of the two fibres are dissimilar; the linen-fibre ends are straighter and smoother than the cotton, the ends of which are fuzzy and have a tendency to curl. Much of the cotton fibre used with linen is mercerized and is thus given additional lustre and strength.

A test which is frequently used to distinguish pure linen from a cotton or a cotton-and-linen mixture is the dropping of water on the fabric. If it is pure linen the water spreads quickly and rather unevenly along warp and filling and dries quickly. For a similar test ink and glycerine also are sometimes used instead of water. The use of the latter gives a particularly good result as the linen shows a transparency which is not seen in the cotton.

(b) Finish.—Linen fabrics may be treated in finishing much as are cotton, with the difference that the sizing is used in many cases to conceal not only a loose weave but the presence of substitutes as well. The amount of sizing in a linen fabric may be tested, as in cotton, by rubbing, flecking with the finger-nail and soaking in water. Both cotton and tow give a fuzzy surface if used in linen materials. This fuzz may be temporarily concealed by sizing. In the wearing, however, it reappears and destroys the beauty of the fabric. The presence of cotton fibres affects the strength of a material as well as its beauty, as the cotton fibre has much less strength than the linen.

Probably there is more difficulty experienced in the purchase of damask than in that of any other linen material. Good linen, because of the natural lustre of the fibre, is easily given a lustrous surface in finishing. The weave used for damask adds to this gloss, and but little sizing, if any, is required. As has been said, cheaper qualities of linen and combinations of linen and cotton may be given much the same appearance temporarily by the use of sizing and much polishing. The sized linen, however, has not the feel of good linen; it is harsh, while the good is strong and leathery though soft and flexible. The expert depends as much upon the feel as upon the appearance of a fabric in
selecting linen. For the ordinary purchaser much experience in comparing qualities and prices is necessary.

All the tests suggested here are exceedingly simple and require no apparatus. Even these are impossible, however, if samples cannot be secured of a size to give sufficient length to both warp and filling yarns when unravelled.

When these tests are not effectual, as in identifying different qualities of wool in a fabric, the purchaser must give the most careful consideration to a comparison of the appearance and feel of fabrics of varying qualities and prices, in order to establish a basis for judgment and a relation between quality and price.