THE TEXTILES
WE BUY AND USE
Helen E. McCullough

University of Illinois
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The Textiles We Buy and Use

By HELEN McCULLOUGH

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FOREWORD

More and more women, as the family purchasing agents, are asking for information that will help them buy textiles to better advantage. They realize the rapid changes taking place in the textile industry; they want to have some basis for judging quality and some assurance that they are getting value in proportion to money expended.

This circular was written to help the girl or woman who wishes to be a more intelligent buyer whether she buys yard goods or ready-to-use articles.

Mrs. Kathryn VanAken Burns
State Leader in Home Economics Extension
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### INDEX
The Textiles We Buy and Use

BY HELEN E. McCULLOUGH, Associate in Textiles

TEXTILES for clothing and household use consume a considerable part of the income of the majority of American families. In fact, economists tell us that one-sixth of all income in the United States is spent for textiles in one form or another. In considering what proportion of this money is spent wisely we are led to ask ourselves many questions. What do we know about the textiles we use—what makes them beautiful or ugly, lasting or temporary, what are the factors involved in their cost, how may we test them to determine whether we are getting the quality of material that we desire or are willing to pay for, what can we do to improve the character of textiles put on the market?

Before machinery replaced hand labor in the making of cloth, women had an opportunity to know, appreciate, and judge the quality of the fabrics they used because of their first-hand experience in producing many of them. Today the problem is very different. Factories turn out huge quantities of fabrics marvelous in construction and infinite in variety, methods of finishing cloth have increased and improved, one fiber may be made to resemble another so skilfully that ordinary means will not reveal the difference, and a whole new field of valuable synthetic fibers has opened up.

With the increasing complexity of textile manufacture and the great variety of textiles on the market, the average person finds it difficult to know the different kinds of materials, to be a good judge of their quality and their suitability to various purposes, and to know how to care for them. It is the purpose of this publication to supply some of this information. It includes facts about the fibers used in cloth making, their properties and production, and some points in their manufacture; it discusses the way in which textile design and cloth finishes affect the appearance and durability of cloth, describes some simple, dependable tests for ascertaining the fiber content and quality
of fabrics, indicates some of the factors that enter into the cost of fabrics, and suggests ways in which women as the chief buyers of textiles may help to improve the quality of materials offered on the market. Some of this information is purely practical in nature and some has for its purpose the giving of a deeper appreciation of one of man's great arts—the art of cloth making.

The value of various textiles from the standpoint of style, beauty, and suitability for various occasions is not considered except incidentally, since that is a subject by itself.

PART I—FIBERS USED FOR MAKING CLOTH

ALTHOUGH many materials are used to clothe and decorate the human body, there are in the United States today but five major textile fibers—cotton, linen, silk, wool, and rayon. Three of these fibers—cotton, linen, and wool—are called prehistoric textiles because they were used in highly developed form at the beginning of written records. Silk has a definite date for its discovery—2700 B.C. Rayon, the only manufactured, or artificial, fiber that is used extensively, has been of outstanding importance only during the last few years.

It is interesting to know that our complicated modern textile industry is based on materials and principles developed by primitive man centuries ago. Long before the days of written records man had learned to use certain materials provided by nature for making cloth. He first used materials that required little alteration, such as skins of animals, leaves, and bark. Next he learned to weave crude substances, such as reeds, pliable twigs, grasses, and strips of skins. Much later, but still during prehistoric times, he discovered the process of spinning, that is, the process of combining short, fine fibers into long strands by means of twisting. Thus the foundation for the modern textile industry was laid.

In addition to the five major textile fibers—cotton, linen, wool, silk, and rayon—there are numerous others, spoken of as minor fibers, used in limited amounts or for limited purposes (see page 21). Jute and hemp, for example, although not used to
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any appreciable extent for clothing, are important fibers commercially; ramie is used extensively in China and other Oriental countries; pineapple fiber is important in the Philippine Islands, while metal threads play a part in decorative textiles.

Out of the vast supplies of nature such a comparatively few substances are suitable for cloth making because a material, to be suitable for spinning and weaving, must possess certain essential characteristics.

Tensile strength, the ability to withstand strain, is one of the first necessary properties for a textile fiber.

Length is essential, since very short fibers cannot be twisted together to form yarn or thread. However, length is closely related to the property of cohesiveness, the ability to adhere or stick together. The shorter the fiber, the greater is the cohesiveness necessary. For example, wool and cotton short fibers have a high degree of cohesiveness, while silk and rayon, very long fibers, have a lesser degree of this characteristic.

Fineness of staple, that is, smallness of diameter, is necessary if a fiber is to be spun and made into cloth. Material such as reeds, twigs, and grasses may be woven into mats and baskets, but are too coarse for cloth making.

Uniformity of staple, or evenness of diameter throughout the length of the fiber is desirable in order to have uniformity of strength and evenness of texture. Linen is the least uniform in staple, and as a result, linen fabrics have an uneven surface.

Pliability, the ability to withstand bending and twisting without breaking, is a very important requirement of textile fibers. Molten glass may be drawn out into filaments and woven, but it is not satisfactory for textile purposes because it lacks pliability. All the commonly used textile fibers rank high in this property.

Elasticity, the ability to be drawn out and then spring back to the original length, adds to the ease of handling, to the durability of fibers, and to the comfort of fabrics. It also prevents wrinkling. Silk and wool have this characteristic in a high degree, while linen has very little of it.

Porosity, the characteristic of having fine pores or openings in the fiber, has a very decided effect upon the character of fab-
rics. When a fiber is porous, air is held in the openings, and since still air is a non-conductor of heat, porous fibers are warm. Porous fibers also hold a large amount of water without feeling damp, and evaporation from them is slow. The rate of evaporation of moisture is another factor influencing warmth. When water evaporates quickly, heat is absorbed from the surrounding atmosphere, thus cooling it. Linen is non-porous, and water evaporates from it very rapidly; it therefore is a cool fabric. Porosity seems to add to the ease of dyeing. Wool is the most porous fiber; linen is the least.

**Durability** is essential because the processes of manufacturing fibers into cloth are strenuous, and unless durability is present the fibers cannot withstand these processes. Furthermore, unless a certain degree of durability is present, the cloth is not worth purchasing.

**Luster** is less important than most of the characteristics listed, since the manufacturer is able to add it or detract it in making the cloth. Mercerizing cotton, for example, adds luster to a naturally dull fiber, while in manufacturing certain silk and rayon fabrics the natural luster is removed.

The *quantity* in which fibers are produced and the ease of manufacturing them into cloth also play an important part in their use. The greater the amount of a fiber that is available, the cheaper it is. For example, cotton is easily produced and manufactured and therefore makes a cheap fabric.

**COTTON**

Cotton is the most important textile fiber, both as to quantity and as to the variety of its uses. Not only is a large percentage of the world’s clothing made of cotton, but also the largest percentage of household textiles and fabrics used for industrial purposes, such as automobile tires, tops, and upholstery, bags, tents, awnings, sails, book bindings, typewriter ribbons, and machine belts. Cotton’s popularity depends upon several factors. It is strong and enduring and at the same time is low in price because in spite of its many enemies, such as the boll weevil, it is easy to produce and manufacture. Because it is a home product, it is comparatively inexpensive in our country.
Cotton is a vegetable fiber which grows around the seeds of the cotton plant. It is produced in warm climates, about two-thirds of the entire crop of the world coming from the southern part of the United States. The remainder is produced in Egypt, India, China, South America, and Africa. India is thought to be the first country in which cotton was made into cloth, fabrics of this fiber having been used there long before the Christian era. In America cotton has been important only since the invention of the cotton gin in 1792.

The cotton fibers are clean, creamy white or buff in color, fluffy, and short, varying in length from one-half of an inch to two inches or more. Under the high-power microscope the fibers appear like spirally twisted bands with thick edges (see page 71). The twists in the fiber, which may number from 300 to 500 to an inch, explain why it is so easy to combine the short cotton fibers into yarn and thread.

The fact that such a great variety of fabrics, ranging from the sheerest organdy to the heaviest canvas and blankets, may be made from cotton, explains much of its demand. The variety of its uses is increased thru the fact that cotton may be made to imitate linen, wool, silk, and often is used as a substitute for these fibers (see page 58). Altho cotton fabrics soil easily, owing to the fact that the ends of the short fibers protrude and
make a rough surface, yet they are easily laundered. If undyed they may be boiled, which both cleanses and sterilizes them.

Cotton absorbs less moisture than the animal fibers, the amount varying from 5 to 10 percent. The processes of absorption and evaporation are rather slow, thus causing the fabric to feel damp for a long time. Since it is a good conductor of heat, it is a cool fiber altho the type of cloth into which it is made affects this property. The fiber itself shrinks to some extent, but most of the shrinkage of cotton fabric is due to the fact that the cloth is dried under tension after the sizing is added. When it is laundered, the sizing is removed or softened, the tension is loosened, and the fabric returns to its original size.

Cotton is difficult to dye and as a result, a mordant—that is, a substance which causes the dye to adhere to the fiber—has to be added to most types of dyes. However, with the improvement of dyes, beautiful colors and fairly fast ones are given to cotton. If only one fiber could be used for all textile purposes, undoubtedly cotton would be chosen.

It is interesting to know that in the cotton industry there is no waste. The seeds, which are pressed by special machinery, yield cottonseed oil for food and also for industrial purposes. A meal obtained from the seeds is used for cattle food and the hulls are used for bran, fuel, fertilizer, and for pulp out of which paper is made. The linters or very short fibers which adhere closely to the seeds, as well as the longer fibers, are manufactured into rayon, celluloid, photographic films, automobile finishes, artificial leathers, lacquers, paper, and explosives. It is said that in 1925, 190,000 bales of cotton were turned into these products.

LINEN

Altho cotton has replaced linen for many purposes, linen has many characteristics which make it unexcelled for certain uses. The tough, leathery, non-elastic qualities of linen fabric, its smooth surface and luster make it excellent for table covers, dresser scarfs, table runners, and doilies. The fact that it does not absorb or hold stains readily increases its value for table uses. Its freedom from lint, the fact that bacteria do not thrive upon it readily, and the ease with which it may be sterilized make it
valuable for surgical use. The rapidity with which it absorbs and gives up moisture makes it useful for towels. Its coolness and ease of cleaning recommend it for clothing materials in warm weather.

Linen is a vegetable fiber obtained from inside the stem of the flax plant. Its use began in prehistoric times and some authorities believe it to be the first fiber used in making cloth. The Old Testament contains many references to linen, and linen mummy cloth thousands of years old has been found in Egypt. Among ancient people linen, because of its snowy whiteness and purity, was frequently used in religious rituals, and "fine linen and purple" were symbols of royalty.

Previous to the invention of the cotton gin in 1792 linen was much more important than cotton. In colonial times flax was grown by practically every family, and linen was spun and woven in the homes. Today considerable flax is produced in the United States but it is grown for the seeds and not for the fiber. However, new machinery is being tried for flax production and experiments are being made with new methods of obtaining the fibers from the stalks. Therefore, as time goes on, the United States may produce flax for fibers. At present Russia, Belgium, Ireland, Czecho-Slovakia, the Netherlands, Italy, and France are the chief flax-producing countries.
Linen fiber is much longer than cotton, averaging about eighteen inches in length, and it may be fine or coarse depending upon the degree of subdivision during the manufacturing process. The fiber is straight, brown, tough, strong, heavy, non-porous, and non-elastic. Under the microscope it appears like a bamboo cane with frequent nodes or joints (see page 71). It is difficult to bleach, but after bleaching it is snowy white and seems to retain its whiteness better than other natural fibers.

The disadvantages of linen may be summed up in the following sentences. It is an expensive fabric because so much hand labor is required in its production and manufacture; that is why the United States does not raise more flax for fiber. However, its durability makes up in part for this disadvantage. Its non-elastic nature causes it to wrinkle badly which is a disadvantage in dress fabric. It is the heaviest fiber used, being about 17 percent heavier than cotton, which is a disadvantage in handling large pieces, especially in laundering them. It does not dye readily and often fades badly—another disadvantage in dress materials. Its natural advantages, however, give it a place of respect and usefulness in the textile world.

**WOOL**

Wool ranks next to cotton in the amount used for clothing. It is an outstanding fabric because of its warmth, comfort, beauty, and serviceability.

Wool is an animal fiber forming the covering of a great variety of sheep. The use of wool for clothing began far back in prehistoric times. Because of the ease of spinning, it may have been the first fiber used in making cloth.

Altho sheep are produced in practically every country of the world, the best wool comes from the temperate zone and the majority of sheep are scattered over countries in this latitude. Since sheep live by grazing, they thrive best in wide, open ranges. Australia, Argentina, Uruguay, and New Zealand, the western part of the United States, and the southern parts of South America and Africa afford the best conditions for wool growing.

Wool fibers are short, varying in length from one inch to twenty inches or even more. Under the microscope the fiber is
seen to be covered with many overlapping scales which protrude slightly at the edge (see page 71). It is kinky, elastic, and before being cleaned, contains a large amount of oil and impurities. Altho wool varies in color, most of that produced for textile purposes is creamy white.

The porosity of wool is one of its outstanding characteristics (see page 71). This property makes the fiber warm, permits it to absorb and hold a large amount of moisture without feeling damp, and enables it to take dye readily. The elasticity of wool prevents the cloth from wrinkling easily and adds to its comfort and serviceability.

Wool is not so well adapted to washing as the vegetable fibers since when warm and moist, the fibers shrink. The scales on the surface have a tendency to soften and interlock, causing felting. Hot water, strong soaps, and rubbing increase this tendency to felt and become harsh. Unlike cotton, wool continues to shrink every time it is improperly laundered.

Owing to the rough surface and porous nature of wool, dirt and impurities cling to it readily, making it less hygienic than the vegetable fibers. Care should be taken to have wool outer garments dry-cleaned frequently and wool undergarments washed frequently, carefully, and thoroly.

In general wool is valued for its comfort, serviceability, and beauty. Because of its warmth and the fact that it will hold
moisture without feeling damp, it is especially valuable for babies
and invalids and for those who are exposed to extremes of mois­
ture or cold, such as firemen, brakemen, and people living in very
cold climates. However, because wool often irritates the skin,
there may be a question as to the advisability of wearing wool
garments next to the body. This holds true for babies as well
as for adults.

HAIR

Hair is closely related to wool and may be considered in
the same class. It is obtained from goats, llamas, vicuñas, horses,
and camels. It differs from wool in that it is straight or wavy
rather than kinky, usually is longer, more lustrous, stiffer, less
pliable, shrinks less, and will not felt. When examined under
the microscope, the scales are seen to be less prominent than
those on wool and they do not protrude at the edges (see page
71). This explains why hair is smoother, more lustrous, less co­
hesive, and less easily soiled than wool. Very short hair, such
as that obtained from rabbits, may be combined with wool and
used in making felt but it is not suitable for spinning.

Mohair, obtained from the angora goat, is the hair used most
largely in the textile industries. Angora goats are raised in large
numbers in Turkey and Cape Colony and to some extent in
Texas, New Mexico, Arizona, California, and Oregon. The in­
dustry in the United States seems to be increasing. Mohair may
be twenty inches in length or longer and is fine and silky. It is
especially beautiful for knitted garments and also makes at­
tractive and serviceable woven fabrics. In woven cloth, because
of the stiffness of the mohair yarn, a cotton warp is frequently
used. This combination of cotton with the mohair not only
makes the fabric softer but also makes it cooler. As a result
mohair materials, such as alpaca and palm beach, are popular
for men's summer suits. Other fabrics made of this fiber are
brilliantine, Sicilian cloth, drapery and upholstery materials,
and braids. Mohair also is used for doll and costume wigs.

Horses, alpaca goats, cashmere goats, camels, llamas, and
vicuñas supply only comparatively small amounts of hair for
textile purposes.
Horsehair, obtained from the manes and tails of horses in South America, is used for hat braids and is woven into cloth used to stiffen the shoulders of men's and boys' suits. Formerly horsehair was used commonly for upholstery materials and it is still used to some extent for that purpose.

Alpaca comes from a species of goats found in the mountainous regions of Peru and is little used outside of South America.

Cashmere is obtained from the cashmere goat of Tibet and India. It is extremely soft, almost silk-like wool and is used in the manufacture of the famous cashmere shawls.

Camel's Hair. From the camel two grades of wool are obtained. One is the soft down close to the skin and is used for the manufacture of fabrics; the other is a long and wiry hair, used for blankets and carpets and for fabrics in combination with softer wool. Camel's hair cannot be bleached and for this reason is used in the natural brown color, or it is dyed dark colors. It is strong and the finer quality is very soft.

Llama fiber is found in South America and is little used in other countries.

Vicuña wool comes from a small goat-like animal also found in South America. It is a very fine, soft, silky fiber that is highly prized. Because the vicuña is so wild, it has to be shot in order to obtain the fiber. For this reason only a limited amount is available.

It is probable that many fabrics bearing the names of these less usual wool fibers contain little if any of the fiber from the animal from which the name was derived; the names have become in many instances mere trade names.

SILK

Silk, the most beautiful of all fibers, is of animal origin but very different from wool and hair. It is the filament secreted by the silkworm to make its cocoon. Unlike cotton, linen, and wool, which had their beginnings far back in prehistoric times, a definite date is given for the beginning of silk culture. According to legends, in 2700 B.C. a child empress of China, Si Ling Chi, discovered the use of silk and for this discovery was deified and made the goddess of the silkworm. For more than
two thousand years the Chinese people guarded the secret of silk culture, and altho silk fabrics were sold to other countries, the method of producing this exquisite cloth was not told. Eventually, however, the secret was learned in Japan, Byzantium, and India and from these countries silk culture passed into Europe. None of the attempts made to introduce silk culture into the United States have been successful because the raising and caring for the silkworm, in itself an important industry,
involves so much tedious handwork that this country cannot compete with Asiatic and European countries, where labor is much cheaper. Altho the United States ranks first in the manufacture of silk fabrics, China, Japan, Italy, and France are the chief producers of the filament.

The silk filament is the longest natural fiber, usually four hundred yards or more in length. It is soft, lightweight, elastic, smooth, fine, and lustrous. Under the microscope the fiber shows no cellular structure, but looks like a clear glass rod (see page 71). When secreted by the silkworm, two filaments are held together by a gummy substance, but part or all of the gum is removed during the manufacturing processes and the filaments separated.

A few hundred years ago only royalty was permitted to wear silk, but today, in the United States at least, silk is worn by almost everyone. As a result of this great demand much poor, adulterated silk is on the market.

Wild or uncultivated silk, from which such materials as pongee, tussah, and shantung are made, is obtained from the cocoons spun by the uncultivated silkworms and found in the forests. It differs from cultivated silk in many respects. It is deeper in color, more irregular, difficult to unwind in long strand, difficult to degum and to dye. It is often used in the natural color, and cloth made from it is irregular in texture and usually not so soft and light in weight as that made from cultivated silk.

Spun silk is prepared from waste resulting from short and tangled fibers from the exterior of the cocoon, from cocoons which have been broken by the moth in escaping, and from waste due to manufacturing processes. The fibers are spun into yarn by a process similar to that used in making worsted, and the yarn is used to quite an extent in the United States.

RAYON OR SYNTHETIC FIBERS

Rayon, a lustrous textile fiber, is notable because, altho it is a synthetic, or manufactured, fiber instead of one produced by nature, it holds third place in quantity used for clothing and household purposes. It is used in fabrics ranging from the thinnest voiles and chiffons to the heaviest taffetas and satins. It is
employed for practically all clothing purposes and for many household uses. It is woven alone or with cotton or silk warps, and frequently it is combined with cotton, wool, silk, or linen for decorative purposes. Huge quantities also are used in the knitting industries.

Rayon is made by converting pure cellulose, obtained chiefly from cotton or wood (usually northern spruce) into thread formation by means of chemical and mechanical processes. During the eighteenth and nineteenth centuries various scientists tried to produce an artificial silk by studying the food, digestive fluids, and spinning processes of the silkworm. Chardonnet, a French scientist, in 1884 was the first man to succeed in this experiment. He called the fiber artificial silk and this name was used until 1924, when the term "rayon" was adopted as the name for synthetic fibers made from cellulose. Because this name has been used so commonly for synthetic fibers made by the viscose process, the manufacturers of other synthetic fibers in certain cases have objected to having their products, some of which are superior in quality, called by the same name. Since the matter has not yet been settled, the term "rayon" will be used in this publication for all the synthetic fibers. Rayon has had commercial importance only during the last twenty-five years, and its chief development has come since the World War. The United States not only leads in the quantity and quality of rayon produced, but it is to the United States that the impetus to the recent manufacture of the fiber has been due.

There are two types of rayon: regenected cellulose in which the rayon has the same chemical properties as the cellulose

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Regenerated cellulose rayon is made by three different chemical processes: (1) the nitro-cellulose process, the first method used, with cotton linters as a base; (2) the cuprammonium process, also using cotton linters; and (3) the viscose process, used in making by far the largest percentage of rayon manufactured in the United States, wood pulp (northern spruce) being used as the source of cellulose. Nitro-cellulose rayon is often called by the trade name "tubize." "Bemberg" is the most important fiber made by the cuprammonium process. Viscose rayon is often called "viscose." For practical purposes it is not necessary to distinguish between the rayons made by these three processes since their general characteristics are quite similar.
from which it was made, and cellulose acetate, which is an entirely different substance from the original cellulose. Because these two types are so different in many of their properties, they will be discussed separately.

**REGENERATED CELLULOSE RAYON**

This type of rayon, which comprises by far the largest percentage on the market, has great beauty and luster which in some cases surpass that of silk. These properties are a great advantage when combining rayon with other fibers. The hard, metallic luster of early rayons is now regulated by chemical treatment, so that this characteristic may no longer be a disadvantage. Rayon takes dye well, giving full, rich colors. When undyed it remains white throughout its lifetime. It is a smooth, pliable, almost wiry fiber. These characteristics give it both desirable and undesirable properties. The smoothness adds to its luster and prevents it from soiling readily. The smoothness and flexibility add to its comfort, prevent clinging, and make it resistant to friction. However, these characteristics plus its wiryness are disadvantages in draping, cause the material to fray badly, and the yarns in woven fibers to slip and separate and in knitted fabrics to drop-stitch and run. These disadvantages are being remedied by spinning finer filaments and using special methods of weaving and knitting.

Perspiration does not injure regenerated cellulose rayon, a very great advantage in any material used for clothing. Bacteria do not grow upon it readily; this adds to its hygienic properties and makes it resistant to mildew. It absorbs moisture readily, thus keeping the skin dry. Evaporation from it is slow and steady, preventing chill due to sudden drying, but this is a disadvantage from the standpoint of laundering. It is a good conductor of heat, and thus is a cool fabric under ordinary conditions. This characteristic may be a disadvantage under conditions of severe exposure.

Regenerated cellulose rayon may be dry-cleaned entirely satisfactorily, and in spite of the fact that it loses strength when wet, it is easily laundered if handled carefully. This disadvantage, like others, is being overcome by modern methods of manu-
facture. One of the outstanding advantages of rayon is the fact that because it is a manufactured fiber the supply may be regulated by the demand, thus keeping the price stable and within the reach of everyone.

Bemberg is considered the most superior of the regenerated cellulose rayons, owing partly to the fact that the yarns contain as many as or more filaments than natural silk. This adds to its softness and strength and decreases the luster.

**CELLULOSE ACETATE RAYON**

Altho made by a process partly known for the last thirty years, cellulose acetate rayon became important commercially only recently. The cellulose is changed chemically in the process of making, and an entirely different product from the regenerated cellulose rayons results. Often the statement is made that cellulose acetate fabrics are not rayons. “Celanese,” “celestron,” and “lustron” are trade names for fabrics made of this fiber.

Cellulose acetate rivals silk in its beauty. The luster is soft, and may be lightened or subdued in the process of manufacture. Design may be given by combining the lustrous and delustered finish in one fabric. Special dyes are used for this rayon and the resultant colors are both beautiful and fast. Like other rayon, the white products never become yellow.

Not only is cellulose acetate beautiful, but it is also practical. Because of its hard, smooth surface, it does not soil readily. It has the lowest power of absorption of any fiber—only 3 to 4 percent—and because of this it has certain valuable characteristics. It dries very quickly, an advantage in laundering, never feels damp next to the skin, and does not absorb perspiration or stains. Cellulose acetate is not affected by body secretions, salt, light, or metallic weighting. It is easily washed and does not shrink, stretch, or alter shape or appearance to any appreciable extent, but care must be taken in ironing it since too hot an iron will cause it to melt, thereby permanently injuring the fabric. It dry-cleans well in any cleaning agent except chloroform or acetone. It is pliable and has more elasticity than some other rayons. It has enough wiryness, however, to cause it
to fray badly, and this has to be taken into consideration in seam allowances and seam finishes. Unlike other rayon this type is a nonconductor of heat, which makes it a warm fiber. Of course the weight of the fabric and the closeness of the weave affect this property.

Unusual hygienic properties are claimed for acetate rayon. It is naturally a clean fiber and one on which bacteria do not thrive. Its low power of absorption increases this characteristic since it will not take up or hold impurities to any great extent. The claim that the ultra-violet rays of sunlight, which have health-giving properties, pass thru it more readily than thru other fibers has been exaggerated, since experiments show that the openness of the weave and the color of the fabrics determine this rather than the fiber used. It is an interesting fact that electricity will not pass thru cellulose acetate.

Rayons are not yet perfect, but great improvement has been made in them during the last few years and no doubt will continue to be made until they are as near perfect as scientific skill can make them. Their development marks a great epoch in the textile world and points to the fact that in the future synthetic fibers may become even more important than natural fibers. Already artificial wool is being produced and used quite extensively abroad, and artificial horsehair and straw are finding a place in the making of hats. It will be interesting to watch the growth of this new and important field of textiles.

MINOR TEXTILE FIBERS

Altho the fibers just discussed—cotton, wool, rayon, silk, and linen—are the major textile fibers in so far as clothing and household uses are concerned, there are other fibers which should be mentioned either because of their specific uses or because of their importance in certain countries.

JUTE

Jute is very important commercially. It is a vegetable fiber obtained from the stem of the jute plant, which grows in large quantities in India. It is a shorter fiber than linen, fine and lustrous. It is not used for clothing because the natural brown color
is very difficult to bleach and because water weakens it. It has the advantage of being very cheap, and for this reason is used in huge quantities for bags and wrappings where durability is not of prime importance. It also is used for burlap, for the backs of rugs and linoleum, and occasionally is mixed with other fibers in manufacturing drapery and upholstery materials.

**RAMIE, RHEA, OR CHINA GRASS**

This is a vegetable fiber which is thought by some authorities to be older than linen. It is produced in large quantities in China and India, and the reason that it is not used more extensively in other countries is because the process of obtaining the fiber from the woody tissue of the plant is such a difficult and expensive one. The fiber is several feet in length, is fine, very strong, lustrous, semi-transparent, stiff, may be bleached to snowy whiteness, and takes dye very readily. Altho it is used extensively in the countries where it is produced for clothing purposes, in our country it is seen chiefly in imported luncheon sets, dresser scarfs, and doilies. Because of its desirable properties it is probable that improved methods of refining it will be developed, and it will be used more commonly in the United States.

**HEMP**

Hemp, a vegetable fiber several feet in length, is noted for its strength. It is stiff, harsh, and loses strength when bleached, but unlike jute, it is not weakened by water. It is used chiefly for ropes, cords, and twines, but also is used for burlap, backs of rugs, stair carpets, and shoe thread. Since the World War the hemp industry has become important in the United States, the plant having been produced in Kentucky, Wisconsin, California, and North Dakota as well as in some other states.

**PINEAPPLE FIBER**

Obtained from the leaf of the pineapple plant, pineapple fiber is used extensively for clothing in the Philippines. The cloth made from it, called piña, is stiff, semitransparent, and lustrous and is made in attractive colors. When the fiber is combined with silk, a beautiful transparent fabric called justi cloth (pro-
nounced *husi*) is produced. The fiber is very well adapted to clothing for hot climates since the cloth made from it is stiff and stands away from the body.

**COIR**

Coir is the stiff brown fiber obtained from the husk of the cocoanot and in our country is seen in the brown door mats which are used extensively.

**ASBESTOS**

Asbestos is the one true mineral fiber and is of great importance industrially because it is fireproof and acid-resisting. It is obtained from a fibrous rock found in many parts of the world, the largest amount coming from Quebec, Canada. When the rock is subjected to pressure, it falls apart in stiff, inelastic fibers. These fibers may be woven into cloth by combining them with cotton and then burning out the cotton after weaving, but usually the asbestos is pressed into sheets and mats without weaving. It is used for holders, flatiron stands, table pads, mats to be used about stoves, for wrapping about furnaces and hot pipes, for fireproof roofs, floor and wall linings, for aprons and gloves to be worn in laboratories, and for theatre curtains. It is not used for ordinary clothing purposes.

**KAPOK**

Kapok is a short, silky fiber obtained from the seed pod of a tree which grows in the Philippines and Java. It is used extensively as a filling for mattresses and cushions and occasionally is made into cloth. The fiber is light, elastic, and very buoyant. Its disadvantage lies in the fact that it becomes dry and powdery after a few years of use.

**METAL THREADS**

At one time metal threads were made by heating and drawing out such metals as gold, silver, copper, or various alloys. At present they are made by coating cotton, linen, or silk yarn with metal. This may be done by wrapping thin layers of metal around the core or by depositing the metal by means of electrolysis. One type is made by coating cotton or silk yarn with a
solution of cellulose acetate in which fine particles of metal are held in suspension. Metallic threads are used for such materials as braids, brocades, embroideries, and tapestries.

PART II—TEXTILE DESIGN

From the beginning of its history the human race has worn clothing for the purpose of decoration just as much as or more than for protection or for modesty, with the result that the processes of making cloth beautiful have been inseparable from the processes of actually constructing it. Textile art has developed side by side with architecture, sculpture, and painting, and beautiful textiles should be considered in the same class with the products of the other arts.

Just as groups of people differ from each other in forms of government, social customs, architecture, so they differ in their textile arts. The ancient Greeks were noted for their beautiful tapestry weaving; the people of Egypt for their fine linens; India at a very early period became known for fine muslins and cashmere shawls; while the Chinese and Japanese for centuries have had silk fabrics outstanding in their intricate and elaborate designs. The exquisite rugs produced by the people of Persia, Turkey, and other countries of Western Asia had their beginning far back in the past and continue to be in great demand. In North America the colonists developed a home industry in textiles, producing characteristic cloth that was simple in design, interesting in texture, and excellent in durability and workmanship. The Navajo Indians of Arizona and northern New Mexico are noted for their unique rugs, or blankets, which are quite unlike any other form of weaving.

The subject of historic textiles abounds in a wealth of interesting material, and those who wish to know more about it will find many books to aid them. Today even our most elaborate textiles are made by automatic machinery. Craftsmen and artists draw upon the wealth of past ages, as well as upon every conceivable source in the present, for inspiration for their designs. With the great variety of designs available, women need to cultivate a sound appreciation of the true beauty
of textiles in order to distinguish the good from the bad which is offered each season.

Textile design is the term applied to all decoration given to cloth during the process of manufacture, whether by spinning, weaving, the addition of color, or by other means. Textile design is said to be either \textit{structural} or \textit{surface}. Design that is given cloth as the result of the way it is constructed is said to be \textit{structural}. All cloth therefore has this kind of design. It may be due to the way the yarn is made; to the way it is woven, knitted, or felted; or to the way in which color is introduced in different strands. \textit{Surface} design is design that is added after the cloth is made. It may be obtained by adding color or by pressing or adding other designs without color.

The design of cloth is to be considered not only in relation to its beauty but also to its appropriateness, its becomingness, the ease with which it may be constructed into garments, and its durability.

\textbf{STRUCTURAL DESIGNS}

\textbf{DESIGNS MADE WITH DIFFERENT YARNS}

The term \textit{yarn} is applied to the twisted strand of fibers that is used in making woven and knitted cloth. The process of making yarn is called \textit{spinning} and the way in which the yarn is spun may be the means of giving structural design to the cloth manufactured from it.

Yarn may consist of a single strand of fibers, called \textit{ply}, or it may consist of two or more plies twisted together. Yarn must not be confused with \textit{thread}, which is the tightly twisted strand of cotton, linen, or silk (not wool) made by combining two or more plies and giving them a smooth finish by adding dressing. Thread is usually stronger, smoother, and more uniform in diameter than yarn. It is used for sewing with a needle and in the making of lace.

Some of the variations which appear in yarn are described below.

\textbf{Different Fibers Combined.} Cloth is often composed of yarns made from different fibers. Cotton and rayon fibers frequently are combined, as are wool and silk, silk and rayon, and wool
Fig. 5.—Dimity illustrates use of yarns of different sizes and weights.

Fig. 6.—One of the crêpes made of yarns of different twists.

Fig. 7.—This piece of seersucker gingham has yarns of different tensions.
and rayon. Very attractive designs may be given by this method. Tissue gingham in which rayon is combined with cotton is one of the many examples of cloth made from different fibers.

**Different Sizes and Weights Combined.** Heavy yarns are combined with fine ones to form stripes or checks, as in dimity

(Fig. 5). Sometimes the yarns of different sizes and weights are combined with colored yarns, as in tissue gingham.

**Different Twists Combined.** When yarns spun with a left-hand twist are combined with yarns spun with a right-hand twist in weaving, the tendency of the yarns to slightly untwist when the cloth is removed from the loom gives a crêpe effect. Crêpe de chine, georgette, and Japanese crêpe are examples of this (Fig. 6).

**Yarns Woven at Different Tensions.** A second method of getting a crêpe effect is to combine yarns at different tensions. In weaving, part of the warp yarns are stretched tightly on the loom and others are left loose, with the result that a crinkled
or crêpe effect is given. Seersucker gingham with a crêpe stripe and crinkled bedspread materials illustrate the use of yarns at different tensions (Fig. 7).

**Novelty Yarns.** A special process of spinning is used which gives looped or knotted yarns known as novelty yarns (Fig. 8). Often strands of different colors are combined with novelty strands, increasing the novelty effect. Ratiné is a common example of material made with this type of yarn (Fig. 9). Novelty yarns resulting from the method of spinning should not be confused with novelty weaves.

**DESIGNS MADE WITH DIFFERENT WEAVES**

Weaving is the interlacing of two or more sets of yarns to form cloth. The lengthwise yarns are called *warp* and the crosswise yarns are called *filling* or *woof*. The frame, or the machine upon which the weaving is done, is called the *loom*. By far the largest percentage of cloth is made by weaving. The way in which the yarns are interlaced, called the *weave*, not only affects the durability of the cloth but also is one of the chief sources of its beauty. Sometimes the weave is the only form of design used.

**Plain Weave.** This is the simplest form of weaving and consists of passing a single filling yarn over and under successive single warp yarns, alternating the order with each successive row of filling (Fig. 10). It is used in muslin, gingham, voile, sheeting, handkerchief linen, dress linen, China silk, taffeta, radium, homespun, challis, and many other fabrics. Its strength depends upon the quality of yarn from which it is woven, the closeness of the weave, and the uniformity in the number of warp and filling yarns. It may be strong or weak depending upon these factors. For instance, sheeting made from 72 warp yarns and 68 filling yarns to the inch is stronger than sheeting made with 60 warp yarns and 56 filling yarns to the inch, and sheeting made with 72 warp yarns and 70 filling yarns is stronger than that made with 72 warp yarns and 56 filling yarns.

**Rib, Cord, Rep, or Poplin Weave.** This weave is a variation of the plain weave. True rib weave consists of two or more yarns
passed over and under a succession of single yarns, giving a cord effect (Fig. 11). The cord may extend lengthwise or cross-
Figs. 12-13.—Basket and twill weaves. The basket weave (12a) is used in a sample of monk’s cloth (12b). Note in the sample of twill (13a) the clear diagonal line; a piece of serge (13b) shows one type of twill weave.

wise of the cloth. Faille is an example of this weave. Often the cord is formed by combining heavy yarns with finer ones, making
it a plain weave. Bengaline, poplin, and grosgrain are examples of this weave and it is often spoken of as cord, rep, or poplin weave. These weaves often lack durability because the fine yarns wear thru over the double yarns or the heavy yarns.

**Basket Weave.** The basket weave is also a variation of the plain weave. It is made by passing groups of two or more filling yarns over groups of two or more warp yarns, the groups being alternated as the weaving progresses (Fig. 12). This combination gives an attractive texture, but if coarse yarns are used, the cloth is loose and stretches easily because the yarns cannot be beaten close together. In very fine fabrics, such as crêpe Romaine, this weave may be quite durable. A variation of the basket weave in which the yarns are interlaced more securely, thus giving a stronger weave, is often used. Crêpe Romaine, monk's cloth, and certain novelty fabrics are made with the basket weave.

**Twill Weave.** Twill weave is characterized by a diagonal line across the surface of the cloth. It is made by passing a filling yarn over and under a group of warp yarns, making a regular progression of one yarn in each successive line, consistently to the right or to the left (Fig. 13). Different combinations of yarn may be used to give different types of twill, and the diagonal line may be straight as in serge, or broken as in herringbone twill. It is attractive and is the most satisfactory of all weaves from the standpoint of firmness and compactness. In white cottons a fabric with a twill weave is more difficult to keep from becoming grimy than one with a plain weave because of the closeness of the yarns. Serge, gaberdine, tricotine, drill, khaki, galatea, and most foulards are a few of the examples of twill weave.

**Satin Weave.** Satin weave is similar in construction to twill weave, except that the yarns floating on the surface are much longer; the diagonal line is not so evident, and one set of yarns covers the other. If the warp yarns are on the surface, the satin weave proper results (Fig. 14). This weave is found in good satin. If the filling yarns are on the surface, the result is the sateen weave, which is found in most sateens (Fig. 15). The
Figs. 14-15.—Satin and sateen weaves. The satin weave, with warp yarns on the surface (14a), is used in a piece of satin material (14b). The sateen weave, with filling yarns on the surface (15a), is used in a piece of sateen (15b).
strength of weave depends upon the length of the yarn on the surface. If this yarn, called the float, is not too long and the yarns are beaten closely together, a durable fabric results. If the float is too long, the surface becomes rough and wears thru. In this weave a cheaper quality of yarn is often used on the back where it does not show, as in cotton-back satins.

**Granite Weave.** Granite weave has no definite pattern and is broken and irregular in design. It is used in wool fabrics called granite cloth and in some linen towelings (Fig. 16).

**Gauze and Leno Weaves.** An open, gauze-like effect, as found in curtain or dress marquisette, is obtained by gauze or leno weaves. The terms are used more or less interchangeably, but in the gauze weave proper a pair of warp yarns twist around each other between the filling yarns, thus binding the latter securely (Fig. 17). The leno weave is like the plain weave but has an extra warp which passes from one side to the other of each regular warp and over and under alternating filling yarns. These two methods of interlacing the yarns give open weaves which are firm and strong. The yarns do not close together when the fabric is laundered, as may happen with a material such as scrim, made with the plain weave.

**Pile Weave.** Pile weave may be cut as in velvet (Fig. 18) or uncut as in Turkish toweling (Fig. 19). In most cases it is made by using two sets of warp yarns, one held taut to form the background of the cloth, the other released at intervals to form the loops. The pile may be made by pushing the extra warp into loops, first on one side of the cloth and then on the other, as in Turkish toweling, or terry cloth, or by looping it over wires. In the latter case if the pile is to be cut, the wire has a sharp edge which cuts the loops as it is drawn out. Wilton carpet and velvet illustrate this process. If the pile is to be uncut, as in body Brussels carpet, just the smooth, round wire is used.

Plushes and velveteens are sometimes made by weaving two layers of cloth close together with an extra yarn passing back and forth between them. The two layers are sliced apart after weaving, leaving a pile on one side of each layer of fabric.

The durability of a pile fabric depends not only on the quality of the yarn used for the pile, but also on the nature of the
Figs. 16-19.—Gauze, pile, and double-cloth weaves. The sample of marquisette (16) illustrates the gauze weave, in which there is an intertwining of warp yarns around the filling. Turkish toweling (17) shows the use of pile weave uncut, and a sample of velvet (18) shows the same weave cut. The double-cloth weave (19) shows two layers held together by an extra yarn.
background weave. Both the warp and filling should be strong and close together and there should be more than one row of filling between each row of the pile in order to hold it securely in place. These points should be noted, for example, in the selection of Turkish toweling.

**Double-Cloth Weave.** Double cloth is made either by using a double layer of warp yarns and a single set of filling yarns, as in two-faced ribbon, or by using two complete sets of warp and filling yarns and holding the two layers of cloth together

Figs. 20-22.—Granite, birdseye, and huckaback weaves. The weave in a piece of granite cloth (20) shows no regular pattern. Birdseye cloth (21) shows the diamond-shaped pattern of the birdseye, or diaper, weave. The huckaback or huck weave was used in the huck toweling (22).

with an extra or fifth yarn. Cotton bathrobe material and many reversible coat materials and blankets are made in this way. By examining the edge of the fabric and pulling the layers apart, it is possible to tell what method has been used. These materials are heavy and warm and often are reversible in design and color (Fig. 20).

**Figure Weaves.** In addition to the basic weaves described above, there is a very important group designated as figured or pattern weaves. Pattern weaving usually is effected by combining two or more basic weaves in such a manner as to give a design to the cloth. In this type of weaving, special attachments are added to ordinary looms, or special looms are used.
Figs. 23-24.—Damask and brocade weaves. In this sample of damask weave, right side (23a), the figure is formed by the satin weave, the background by the sateen; the wrong side (23b) shows the weaves reversed. A sample of brocade (24a) shows a variety of weaves combined; the wrong side (24b) is not reversible.
The dobby attachment, for example, is used in making simple patterns, such as birdseye and huckaback. Another special attachment is used for the lappet and swivel weaves, while elaborate Jacquard looms are used in making the more complicated weaves, such as damasks, brocades, and quilted effects. Intricate and elaborate weaves are continually increasing and changing. Because the novelties are numerous and sold under so many names, only staple types will be mentioned here.

**Birdseye Weave.** This weave is characterized by a small diamond-shaped pattern with a dot in the center looking somewhat like an eye. Fabrics with this weave usually are made of loose, soft yarns, making them highly absorbent. Diaper cloth illustrates this weave (Fig. 21).

**Huckaback, or “Huck” Weave.** Unless examined closely, huckaback weave may be mistaken for basket weave. It is woven in small geometric patterns, the small design being characterized by floats on the surface. Loosely spun yarns are used, which give a very absorbent fabric. This weave is used extensively for toweling (Fig. 22).

**Damask Weave.** Damask weave is a combination of other weaves, usually satin and sateen, or twill and satin or sateen. It gives a smooth, reversible fabric. It is a strong weave unless a sateen or a satin weave with too long floats is combined with other weaves, in which case the long yarns wear out first. Table damask illustrates this weave (Fig. 23).

**Brocades.** A combination of weaves are used in making brocades, the design being so woven that it stands out in raised formation against a background of flatter weaves. Brocades have a decided right and wrong side and may be very elaborate (Fig. 24).

**Lappet and Swivel Weaves.** These are forms of machine embroidery which are added to the material while it is being made. The lappet weave is made by working in a continuous yarn, connecting one figure with the next by means of a long yarn on the wrong side. Sometimes the connecting yarns are cut, leaving two loose ends on the back. Figure 25 illustrates the lappet weave. The swivel weave is an imitation of the lappet and not nearly so
Figs. 25-26.—Lappet and swivel weaves. In the lappet weave (25) is shown the connecting yarn which is sometimes cut. In the swivel weave (26) note the cut ends of the yarns used in forming the pattern. The wrong side of each weave is shown.

Figs. 27-28.—Padded and quilted effects are sometimes found in silk fabrics (27); the piqué weave (28) illustrates a padded effect in cotton.
good, since the figure pulls out easily. The swivel weave is made by weaving across a series of short yarns and may be distinguished from the lappet by the row of cut edges along both sides of the figure on the wrong side, as shown in Fig. 26. Dotted swiss and voiles with embroidery-like figures illustrate these weaves.

**Padded and Quilted Weaves.** Padded and quilted weaves are more difficult to classify. Such effects are produced by extra backing yarns which give a raised and padded design on the surface. These extra yarns may be so arranged that part of them are tighter than the surface yarns, thus giving a crinkled or quilted effect (Fig. 27). Piqué and Bedford cord, with their lengthwise raised and slightly padded wales, are made in this way (Fig. 28). Marseille, a heavy double cloth with interpadding, used most frequently for bedspreads, illustrates this principle of weaving. Also, many of the novelty crêpes on the market today are adaptations of this form of weaving.

**DESIGNS MADE BY KNITTING**

Knitting ranks next to weaving in importance as a method of constructing cloth. It is the process of making cloth from one continuous yarn on a special knitting machine which catches one loop into another instead of interlacing two sets of yarns as is done by weaving on a loom (Fig. 29). Knitted fabrics are used for hosiery, underwear, sweaters, and such materials as jersey and tricolet. Knitting may be plain, ribbed, or fancy, and often one material is a combination of these types. Ribbed knitting usually is the strongest. When a knitted fabric is well made, it is very durable. Because of its elasticity, it does not wrinkle as does a woven fabric; it is lightweight, warm, comfortable, and easy to launder, especially so since it does not require ironing. Its chief disadvantages consist of the appearance of holes or runners when loops are broken, and the tendency to stretch badly unless it is quite firmly knitted. The former difficulty is being overcome by machines which make a non-drop stitch.

When buying a knitted garment, it is well to know the way in which it has been made. Full-fashioned goods, such as full-
fashioned hosiery, are knitted in flat pieces and sewed together or shaped on a knitting machine by dropping or adding stitches to make the article conform to the proportions of the body. Semi-fashioned goods are made on a circular machine and shaped by changing the tension so that some stitches are closer together than others. Tubular goods are knitted in a tubular form and the shaping is done by shrinking or stretching. False seams may be added to either the semi-fashioned or the tubular knitted goods to make them appear like the full-fashioned. This is a rather common method of deception in knitted garments. Altho full-fashioned goods are the most expensive, they fit best and are most desirable.

DESIGNS MADE BY FELTING

A third way of making cloth is by felting. Wool is the only fiber which has properties enabling it to be felted; however, short hairs may be matted in with the wool. Sheets of wool fibers are felted or matted together by means of moisture, heat, and heavy pressure. Sometimes a loosely woven fabric is used as the basis of felt. Short wool fibers are pulled thru the open weave and then matted and felted together by means of moisture, heat, and pressure. Cheap blankets are sometimes made by this method. Hats and bedroom slippers are the principal pieces of clothing made from felt.

STRUCTURAL DESIGNS MADE WITH COLOR

Color is added to cloth either by dyeing or printing. In dyeing, the entire surface of the fiber, yarn, or fabric is immersed in a color solution. In printing, certain portions of the yarn or
fabric are colored by means of a color printing machine. Color may be added either while the cloth is being constructed or afterward. The different stages of construction at which color may be added to a fabric and the ways in which it may be added are indicated in the following paragraphs.

**Dyeing in the Raw Stock.** By dyeing the fibers in their raw state, before any manufacturing process takes place, fibers of different color may be blended so that one yarn will be made up of many colors. Certain gray effects are given in this way, also heather mixtures. In wool material dyeing in the raw stock frequently is used for fast, dark colors. This is called "dyeing in the wool."

**Dyeing in the Slub.** By dyeing strands of fibers after they are carded but before they are twisted into yarns, two or more colored strands, or plies, may be combined in one yarn. This way of adding color is used for many wool materials and some cottons, such as novelty ratinés.

**Dyeing in the Skein.** Here the yarn is dyed after it is spun but before it is woven. A number of effects may be obtained by using dyed yarns.

*Solid Color.* When warp and filling yarns dyed the same color are used, a fabric of solid color results.

*Changeable Color.* Weaving a cloth with a warp of one color and a filling of another gives a changeable effect to the fabric. Chambray, which always has a white filling, is an example. Taffetas and satins are sometimes made changeable; because of their luster they give a more attractive effect than cotton.

*Stripes.* A stripe design is made by having different colored yarns in one direction only, either lengthwise or crosswise.

*Checks.* In a check design an equal number of colored yarns extend in each direction and are evenly spaced. Examples are ginghams and shepherd’s checks.

*Plaids.* Plaids differ from checks in that there are an unequal number of colored yarns in both warp and filling and they are unevenly spaced. Many ginghams illustrate the results obtained by this method.
**Warp Printing.** In warp printing a design is impressed on the warp yarns before the filling yarns are put thru. This gives a soft edge to the design and a changeable effect such as found in Dresden ribbon and in some silks and cretonnes. The test for warp printing consists of fraying the cloth. The filling yarns will be a solid color while the colored design will be found on the warp yarns only (Fig. 30).

![Fig. 30.—Cretonne illustrates warp printing; note solid-color filling yarns, with design showing only on the warp.](image-url)

**SURFACE DESIGNS**

Surface design, as stated on page 25, applies to all decoration added after the cloth is constructed. It may be made with color or without. Designs made with color are more common and usually are more lasting than those made without color. They may be applied either by hand or by machinery. Because of the time and expense involved, hand methods are confined largely to making decorations on garments, accessories such as scarfs, and wall hangings, and are not used for large quantity production.

**HAND PROCESSES USED FOR COLOR DESIGNS**

**Block Printing.** In block printing, wooden or composition blocks are carved with raised designs. A different block is re-
quired for each color. The block is dipped in the color and pressed on the cloth. A succession of blocks is used until the design is completed. Block printing by hand is tedious and

makes cloth expensive. This type of design is found in imported chintzes and hangings, expensive negligees, and high-priced silks.

**Stenciling.** In this process the design is cut out of heavy paper and the color is painted on the fabric thru the openings in the paper. Japanese stencils especially are noted for their beauty and delicacy.

**Batik.** In recent years batik, an old form of dyeing, has been revived. The portion of the cloth not to take the dye is covered with wax. This prevents the dye from being absorbed when the cloth is dipped in the color solution. After the cloth is dipped in the first color, more wax may be added to other portions before it is dipped in the second color, and so the process continues until very elaborate designs are worked out. When the dyeing is complete, the wax is removed either by dipping the fabric in benzine or in a similar agent or by placing blotters over the material and pressing it with a hot iron until the melted wax is absorbed by the blotter.
Tied and Dyed. In this process cords are wound about portions of the cloth, or the cloth is knotted. When the cloth is dipped in the dye, the pressure of the cord or knots prevents the absorption of dye. With care, elaborate designs may be worked out by this method. This form of dyeing is used for scarfs, ties, kimonos, cushion covers, and special decorations (Fig. 31).

Painting. Sometimes designs are painted on cloth without the aid of stencils, blocks, or wax. The beauty of the design depends upon the skill of the painter. There are special paints on the market, guaranteed fast in color, to be used for this type of decorating.

MACHINE PROCESSES FOR ADDING COLOR DESIGNS

Direct or Roller Printing. By far the most common method of adding color in surface designs is by roller printing. Designs are engraved upon copper cylinders, a separate cylinder being used for each color. The cloth passes between a succession of these cylinders until the design is complete. The more colors in the design the more cylinders are needed and the more expensive is the process. Sometimes the design is printed on both sides of the fabric, giving the effect of a design woven in. Raveling the cloth to see if one yarn shows different colors instead of one solid color will tell whether or not the design is printed on the surface. Formerly there was a risk that colors printed on the surface would fade badly. Today many printed fabrics are guaranteed fast in color.

Machine Block Printing. This process is similar to hand block printing except that the blocks are mounted on cylinders and stamped by machinery. It is used very little for cloth printing today, roller printing having replaced it.

Dyeing. Several forms of dyeing take place after the cloth is woven, bringing them in the class of surface designs.

Piece Dyeing. This is the term applied to dyeing cloth in the piece after it is manufactured. A solid color results. Dyeing at this time has the advantage of giving a more even color than when the yarns are dyed before they are woven. Sometimes, however, the dye is not thoroughly absorbed into the yarns, with the result that light places are found where the yarns cross.
Cross Dyeing. This is a form of piece dyeing in which different colors result because the cloth is woven from a mixture of animal and vegetable fibers, the animal fiber taking one shade, the vegetable another. It is a common method of getting a mixed color effect when cloth is woven from yarns of different fibers. Rayon combinations often are dyed this way. Sometimes the same result is gained by treating part of the yarns with chemicals before they are woven, so they will not take the dye.

Resist Dyeing. In this form of dyeing a chemical is printed over certain portions of the cloth, preventing those parts from taking another color; then the fabric is dyed a darker color. This method is used in such materials as foulard when light-colored figures are found in dark backgrounds.

Discharge Dyeing. Discharge dyeing is just the reverse of resist dyeing. The fabric is dyed a dark color and then a chemical which acts as a bleach is stamped on in patterns, discharging the color. This gives a white or a grayish-white design on a dark background and is found in calicoes, voiles, and foulards. Sometimes the chemical used to discharge the color weakens the cloth so that holes appear where the figure has been. This often happens in dark calicoes that have white figures (Fig. 32).
SURFACE DESIGNS MADE OTHERWISE THAN WITH COLOR

Various means are employed other than color to add design to cloth after it is made. Many such designs disappear with friction, dry cleaning, or washing. Others are permanent.

Paste. A paste may be stamped on the surface of cloth in the form of dots or other small patterns (Fig. 33). The figures on Normandy voile are stamped on in this way. Laundering or perspiration sometimes removes these dots, and they may give a stiff texture to the cloth. In the better grades of cloth, however, they are quite satisfactory. These paste dots should not be confused with dots made by lappet or swivel weaving described under structural designs on page 37.

Liquid Rayon. Rayon in a liquid form may be stamped on cloth, giving very beautiful designs.

Delusterizing. Designs may be made on rayon by delusterizing part of the surface, leaving the remainder with a high luster. This process is said to weaken the fabric.

Flexible Glass. In England flexible glass has been printed on cloth, giving the effect of beading. This is said to be very lasting as well as very beautiful.

Crêpe Effects. In addition to the crêpe effects obtained by using yarns of different twists and of different tensions (page 27), a crêpe design may be given by covering part of the material with a resist substance and then dipping it in an alkali solution. The alkali causes the parts not protected by the resist to shrink, thus giving a crinkled effect to the cloth. Plissé crêpe is made by this method (Fig. 34).

Sometimes temporary crêpe effects are given by pressing the cloth over a specially prepared rough surface. Ironing the material while it is damp is apt to destroy this type of crêpe effect.

Embossed Design. Pressing with a heavy roller which has a design raised upon it will emboss the design on the fabric (Fig. 35). Gums and starches are often used to add to the effect. Fabrics used for hat trimmings and for other purposes where wear and tear do not enter in often are decorated in this manner.
Figs. 33-36.—Surface designs made without color. Paste dots (33) are often used for decorating voile. A crinkled effect is shown in the sample of plissé crêpe (34). Embossed designs (35) are applied by means of a heavy roller. Moiré design (36) is most frequently found on a cord weave.

Moiré or "Watered" Design. The cloth is folded face in with sheets of damp paper between the layers, and pressed be-
Figs. 37-38.—Designs on pile weave. (37) A design pressed on a pile weave; (38) one made by removing part of the pile with a chemical.

Fig. 39.—In order to make this napped finish, the surface of the cloth is roughed up with fine wire teeth.
tween heavy rollers with irregular lines raised on them. Part of the surface is pressed down, bringing out luster and thus giving a watered effect. When this finish is given to a cord weave, it is called moiré. This weave affords more surface than a plain weave and gives a more distinct design (Fig. 36). The term "watered" effect is broader in its meaning, including this finish as applied to any weave. Moiré ribbon and percaline illustrate this design.

**Designs on Pile Weaves.** Designs on pile weaves may be obtained by pressing, by cutting, or by the application of a chemical. Part of the pile may be pressed down, with the result that a different light reflection is given, part of the surface appearing lighter than the rest (Fig. 37). Sometimes part of the pile is glued down and the remainder clipped. Then the glue is removed and the pile brushed up, a definite design appearing. This may be used on either cut or uncut pile fabrics. Again, designs on pile weaves are obtained by weaving the back of the fabric from one fiber, the pile from another, and then removing part of the pile with a chemical (Fig. 38). This is the method employed in making the beautiful fabrics having silk backgrounds and pile designs of rayon. Surface designs on pile weaves may be distinguished from structural designs by examining the back of the fabric. If it is a surface design, the weave on the back is the same; if a structural design, the weave varies.

**Designs on a Napped Surface.** The design on a napped surface may be made by methods similar to those employed in making designs on pile weave. The surface of the cloth is roughed up, or napped, and then parts of the cloth are pressed down or trimmed close. Sometimes coat materials are decorated in this way.
PART III—FINISHING PROCESSES

A KNOWLEDGE of the finishes that are applied to cloth is essential to a full appreciation and an intelligent judgment of textiles. Various treatments are given to the yarn before the cloth is made or to the fabric after it is woven, in order to produce beauty, to impart a desired texture quality, or to determine the type of material, and these are called cloth finishes. Frequently one finishing process may accomplish all three purposes. Finishing a piece of cloth to make the surface crinkled, smooth or fuzzy, dull or lustrous, bleached or colored, for example, not only affects beauty and texture but also determines the type of cloth.

It has been said that from one piece of cotton material any one of twenty different fabrics may be obtained, depending on which finishing processes are applied after the cloth is removed from the loom. If, for example, a cotton material is mercerized and treated with oil, batiste results; the same piece of material treated with mucilage and gum produces lawn; treatment with chemicals plus pressure develops plissé crêpe. Weight, compactness, elasticity, degree of softness, and other qualities that may be imparted by the finishing process all affect texture. Finishes may also be used to hide defects and to make cloth appear more desirable than it really is.

Descriptions of the more usual and typical finishes for cloth in general are given below. Specific finishes for fabrics made of each fiber are given on pages 57 to 65.

BLEACHING

The natural coloring matter found in fibers and discolorations and stains due to manufacturing usually must be removed from cloth by bleaching. Originally bleaching was done by "grassing," that is, by spreading the material on the grass and exposing it to dew and sunlight until the small amount of free oxygen in the air did the bleaching. This process has the advantage of not injuring the fabric but it is too slow and requires too much space to be practical commercially. It is still used for part of the bleaching of high-grade Irish linens.
Commercial Bleaching. Commercial bleaching is done by using chemicals which liberate oxygen or sulfur. Calcium hypochlorite, commonly called chlorid of lime, which gives off oxygen, is the commercial bleaching powder used most commonly for all vegetable fibers except jute. The process requires several days and each step must be regulated very carefully in order not to injure the fiber. Linen is more difficult to bleach than cotton and requires more care.

In addition to chlorid of lime other oxygen-liberating agents are sodium peroxid, potassium permanganate, and hydrogen peroxid. The latter is best for all fibers but is so expensive that it is not used to any great extent in textile bleaching.

Sulfur is the common bleaching agent for wool, silk, and jute. It is used in the form of a gas obtained by burning sulfur, or in the form of a liquid, sulfurous acid. The gas is used more frequently than the liquid. Oxygen under certain conditions is thought to destroy the coloring matter entirely, whereas sulfur merely changes it to white, leaving the substance in the fiber. For this reason fabrics bleached with sulfur are more apt to turn yellow after they are used than those bleached with oxygen.

Home Bleaching With Javel Water. If a white cotton or linen article has become yellow, dingy, or stained, it may be bleached at home by dipping in Javel water. Javel water is prepared as follows:

\[
\begin{align*}
\frac{1}{2} \text{ pound bleaching powder (chlorid of lime)} \\
1 \text{ pound washing soda} \\
1 \text{ quart boiling water} \\
2 \text{ quarts cold water}
\end{align*}
\]

For mixing Javel water use an earthenware jar or granite container, never tin or aluminum, since the solution destroys those metals. Pour boiling water on the washing soda and let stand until dissolved. Stir bleaching powder and cold water until dissolved. Combine the two solutions, allow the mixture to settle, preferably over night, and either dip off the top liquor or strain thru several thicknesses of cheesecloth. Store in tightly closed bottles keeping in a dark place if possible.

When needed, add \(\frac{1}{2}\) pint of Javel water to 1 gallon of cold or lukewarm water. Immerse the articles to be bleached and
let them remain until the desired amount of bleaching is accomplished—never longer than one-half hour, usually much less time. Rinse thoroughly, wash with soap, and rinse again.

Javel water should never be used for silk or wool or for any colored fabric.

**DYEING**

The adding of color to fabrics must be classed as one of the most important finishes. Color alone often distinguishes one fabric from another, such as drill from khaki, or challis from nun's veiling. Furthermore, no one factor adds so much to the beauty of cloth as does color. Color may be added by dyeing or printing. The difference between dyeing and printing and the different stages in the manufacture of cloth at which the coloring may be added have been discussed under the subject of Textile Design. A brief discussion of the history, types, and uses of dyes will be given here.

There are two big groups of dyestuffs: natural and artificial. The natural dyes, those used from time immemorial, are divided into three classes according to their origin: vegetable dyes, obtained from countless leaves, barks, roots, and berries, represented by indigo, logwood, fustic, and madder; mineral dyes, such as Prussian blue, iron buff, and chrome yellow; and animal dyes, chief of which are cochineal red, obtained from the body of a small insect, and Tyrian purple obtained from a species of shellfish.

Altho natural dyes were the only coloring materials used until the discovery of artificial dyes in 1856, they have many drawbacks. The number of colors is limited; their application to certain types of cloth, particularly cotton, is difficult; and the process of obtaining and applying them is a tedious one. The chief advantage in these dyes lies in the fact that they give soft colors which grow softer in fading instead of changing their hue entirely as sometimes happens with artificial dyes.

The history of artificial or aniline dyes started in 1856 when Sir William Henry Perkins, an English chemist, discovered that coloring matter could be obtained from coal tar, a by-product of the coke industry. Since that time chemists all over the world have experimented in developing new colors, and today every
conceivable shade and tint is produced by artificial dyes. As a result, artificial dyes have replaced almost entirely the natural dyes. Since the World War the United States has developed a very satisfactory dye industry and today is independent of other countries for this commodity. The quality of these domestic dyes is evident from the fact that many of the cotton fabrics on the market today are guaranteed fast to light and washing. Many women believe that it is possible to set the colors in fabrics by means of such agents as salt, vinegar, or alum. Laboratory experiments, however, indicate that these household methods have no value in increasing the permanency of color.

Dyeing is a chemical process, and to secure successful results many factors are involved. The cleanliness of fabrics to be dyed, pure water, the amount of dye in relation to the weight of the material to be dyed, the amount of liquid, the temperature, the length of the process, the method of handling and especially of choosing the correct dye for the particular fiber, all are important factors. Some dyes require the addition of a mordant, a chemical which causes the dye to adhere to the fabric, for successful results. In spite of all these factors commercial dyes have been perfected to such an extent that the average woman can use them successfully in her own home provided she carefully follows the directions purchased with the dyes.

**DRESSING OR SIZING**

Dressing or sizing in cloth is used commonly in finishing cottons, linens, and silks. Starches of various types are used to give stiffness, weight, and body. Glues and gums add stiffness and also cause other dressings to adhere to the fabric. Oils and fats give softness and elasticity. Paraffin and waxes are used to give glazed effects and add stiffness. Often, antiseptics, such as carbolic acid, zinc chloride, boric acid, and formaldehyde, are used to prevent mildewing or molding; certain rare earths also are used for this purpose. China clay, magnesium sulfate, magnesium chloride, and alum are used to add weight, especially to cottons. Silk is weighted usually with metallic salts, a more permanent form of weighting and also more detrimental than that given by china clay or alum (see page 63).
Many factories have secret formulas for dressings, and frequently a combination of several of the above substances is used in dressing a fabric. Most of the dressings are not permanent but are removed by laundering or friction. Silk weighting and some other special processes are exceptions to this.

Dressing usually is added by being applied to the back or the face of the cloth in the form of a liquid paste, or by saturating the entire fabric by passing it thru a tank of liquid. In both cases the dressing is dried and pressed in by passing the fabric over or between heated rollers. The permanency of this form of finishing and the degree of luster given often depend upon the type and degree of pressing.

**CALENDERING**

Pressing in some form or other is a common process in finishing cloth. It adds to the beauty of a new fabric, but the effect is lost when the material is subjected to laundering, dry cleaning, or hard wear. Special forms of pressing, spoken of as *calendering*, are applied in order to obtain finishes spoken of as beetling, moiréing, embossing, and Schreiner finish.

**Beetling.** This treatment consists of passing the cloth over padded rollers and pounding it with wooden mallets in order to flatten the yarns, making the weave appear closer and bringing out the luster. Linens especially are treated by this process, also some cotton fabrics. The threads are flattened, luster is increased, and in the case of linen, the characteristic toughness and leatheriness are made more prominent.

**Moiréing or “Watered” Effects.** See page 47.

**Embossing.** Raised designs are pressed into cloth by passing it between heavy, engraved rollers. Sometimes dressings are added to increase the effect. Fabrics used for hat trimmings and other purposes where friction and wear are not great, often have embossed designs on them (see Fig. 35).

**Schreiner Finish.** In this process, named for the man who invented it, the cloth is passed between rollers engraved with as many as six hundred fine, oblique lines per square inch. Great pressure is used, and the surface of the cloth is broken up by the
impression of the lines, thus reflecting more light and giving a very high luster. Often this finish is given to the surface of mercerized fabrics, such as sateen. Laundering removes it, and this explains why so many mercerized materials have less luster after being laundered. The microscope is the only means for identifying this finish.

MISCELLANEOUS FINISHES

TENTERING

Tentering is the process of drying cloth under tension and is given to practically all fabrics as one of the final finishing processes. The tension is applied by a device which holds the material tightly while it is dried over heated rollers. Shrinkage of cloth, especially cottons which contain dressing, often is due to the material having been stretched much in warp or woof during the drying process. When the material is laundered, it springs back to the original width or length (see page 10). If the cloth is tentered unevenly so that the warp and woof yarns are not at right angles, the material will not be even at the ends of the yarn. Stretching the fabric in a diagonal line is the remedy for this. Laundering also may remedy it.

MERCERIZATION

The process of mercerization was discovered by John Mercer, an Englishman, in 1850. It consists of immersing cotton yarns, thread, or cloth in a solution of caustic soda under tension, then neutralizing it with a weak acid, rinsing, and drying. The caustic soda affects the cotton both chemically and physically, changing the cellulose into hydrocellulose and causing the flat fiber to swell, shrink, and lose part or all of its twist depending upon the length of the process. The tension counteracts in part the tendency to shrink and brings out the luster. Thus, mercerization really gives a new fiber, one that is more lustrous, stronger, and takes the dye better than unmercerized cotton. Different degrees of mercerization are given, the more complete processes giving the higher and more permanent luster.

Mercerized cotton is a very important material in the textile world. Sateen, batiste, and embroidery yarns are familiar ex-
amples of this finish, as are also the better grades of cotton damask, poplin, and broadcloth.

**LISLE FINISH**

Cotton yarn and cloth are characterized by a more or less fuzzy surface due to the protrusion of the ends of the short fibers. The purpose of the lisle finish is to make the yarn or thread smooth and hard. This is done by singeing the thread over gas flames or between electric plates. Sometimes cloth is given this finish by immersing it in a weak acid solution and tumbling it about until the fuzz is eaten off the surface, then neutralizing the acid and rinsing the fabric. The acid method is apt to injure the cloth and is much less desirable than singeing.

A good grade of cotton is usually used for the lisle finish and is made into such materials as hosiery and knit underwear.

**NAPPING**

Napping consists of roughing up the surface of the cloth by means of fine wire teeth or vegetable teazles (Fig. 39). It may be done on one or both sides of the fabric. Outing flannel, blankets, and broadcloth are illustrations of this process. Often it gives a false impression of thickness and durability. Unless done carefully it may injure the body of the fabric.

**WATERPROOFING**

This finish is given in many different ways and in many different degrees. A very tightly spun and closely woven fabric, such as canvas, may shed water without any special treatment. Some of the substances commonly added to make cloth waterproof are paraffins and waxes; drying oils, such as linseed; varnishes and lacquers of different types; insoluble metallic compounds, such as aluminum soap; and solutions of rubber.

**FIREPROOFING**

Asbestos, a mineral fiber, is naturally fireproof but it is unsuited for clothing purposes. Ordinary fabrics are made fireproof by impregnating them with a chemical which will not burn. The “Non-Flam Process” is used commercially and gives a permanent fireproof finish to cotton. Since the cost of this finish
is not great, it should be used more commonly, especially for fabrics used for children’s clothing.

Homemade Fireproofing Solution. A cheap, effective solution for fireproofing which may be used at home is as follows: 1 4 ounces of sal ammoniac, 4 ounces of ammonium sulfate, 6 ounces of dibasic ammonium phosphate. Dissolve in 1 gallon of water. After the clothing is washed and rinsed, wring out and immerse in enough of this solution to saturate the cloth. Allow to soak for five minutes or so, then wring out and dry without rinsing. The solution may be sprayed on articles which cannot be immersed.

COTTON FINISHES

Singeing. This is done to remove the ends of fibers protruding on the surface.

Bleaching. Chlorid of lime is the agent commonly used for bleaching cotton (see page 51).

Dyeing. Skein and piece dyeing are used most for cotton. Occasionally the dye is added to the raw stock, in which case the coloring matter thoroughly penetrates each fiber (see page 41). Sometimes novelty effects, illustrated by certain ratinés, are given by dyeing in the slub (see page 41).

Printing. This form of decoration is very frequently used for cottons. Illustrations: calico, percale, print, cretonne, and voile (see page 44).

Mercerizing. (See page 55).

Dressing. Practically every cotton fabric has one or more of the following dressing materials added. Starches to add stiffness, as in calico and gingham. Glycerine, oils, and fats to increase softness, suppleness, and luster, as in sateen. Mucilage and gums to add stiffness, as in linings, swisses, and lawns. Paraffin and waxes to add stiffness and give a glazed effect, as in cambric and glazed cretonne. China clay, magnesium sulfate, or magnesium chlorid to add a solid appearance and weight, as in heavy cretonne, denim, duck, and canvas.

Pressing and Calendering. Practically all cottons are either pressed or calendered (see page 54).

¹From Woolman and McGowan’s “Textiles.”
Napping. For such materials as outing flannel, canton flannel, and cotton blankets the napping process is used (see Fig. 39 and page 56).

Plissé Finish. A resist gum is printed over portions of the fabric, then it is treated with an alkali solution. The alkali causes the part not treated to shrink; the remainder puckers, giving a crêpe effect as in plissé crêpe (see Fig. 34).

FINISHES TO MAKE COTTON RESEMBLE OTHER FABRICS

Because cotton is cheaper than the other fibers commonly used for clothing and household purposes, and because it may be finished in a great variety of ways and is adapted to many uses, very often it is substituted for other fibers. Sometimes the imitation is so perfect that it is almost impossible to detect it in a new piece of cloth. Tests for detection are given on pages 72 and 73. Following are descriptions of finishing methods frequently employed to make cotton look like other fibers.

COTTON MADE TO RESEMBLE LINEN

During and immediately following the World War, linen was very scarce and high priced. As a result, cotton replaced it for many purposes and continues to do so. Often no effort is made to cover up this fact. Today, for instance, most housewives buy cotton sheeting as a matter of course, and the manufacturer does not exert special effort to make it resemble linen sheeting. However, for other purposes, such as toweling and table covering, where linen is decidedly more desirable than cotton, deception is often practiced. A combination of the following processes is used to give cotton the appearance of linen.

Mercerization is used to give a linen-like luster to the cotton.

Beetling is employed to make the threads flat, smooth, and close together. Dressings are added to the fabric before the pounding takes place. After the cotton is laundered a few times, this finish is removed.

Spinning processes are used that will give the cotton threads an uneven effect, imitating the irregularity of linen threads.
Weaving. Designs commonly used for linens, such as the huck or damask weaves, are used and then the fabric is finished with much dressing and heavy pressing or beetling.

COTTON MADE TO RESEMBLE WOOL

Cotton oftentimes is used to mix with or substitute for wool. However, since it lacks the spring and warmth of a wool fabric, wrinkles more, shrinks less, and has such entirely different characteristics, the difference usually appears after it has been used a short time. The methods used to bring about a resemblance of cotton to wool are given here.

Spinning. Cotton may be spun by the same method as wool. This gives it a fuzzy and kinky appearance.

Weaving. A yarn spun to resemble wool may be woven into a worsted pattern, twill for example, and finished to resemble serge or some other wool fabric.

Dressing and Calendering. The cloth is dressed and then calendered with rollers covered with cloth. This gives to a cotton fabric a rough or woolly appearance which is quite temporary in nature.

Napping will also give a rough, woolly appearance.

Chemical Treatment. Cotton fabric may be given a wool-like appearance by treating it with concentrated nitric acid at a temperature below 77° F. followed by thorough washing. The material shrinks, becomes creamy in color, is strong, and has great affinity for dye. This finish is quite permanent.

“Animalizing” cotton fiber, that is impregnating it with albumin or casein and then steaming it, will cause it to take wool dyes.

COTTON MADE TO RESEMBLE SILK

Because silk is the most expensive fiber, very frequently cheaper materials are used to adulterate it. When cotton is used it is given one or more of the following treatments.

Mercerizing, Schreinerizing, and Lisle Finish are used to give smoothness and luster.

Weaving. Sateen, for example, is made from a thread which is mercerized and singed, then woven with a sateen weave to resemble satin.
Dressings. Special dressings are added to give the appearance of silk. Glycerin plus calendering does this, also the use of Glauber salt. Dressings are usually combined with calendering to bring out luster. Pile fabrics are treated with wax and polished to give luster.

Treatment With a Solution of Silk. Waste and scrap silk are dissolved in a chemical solvent and the cotton material treated with this solution. A glossy material results.

LINEN FINISHES

Good linen requires fewer finishing processes than any other fiber. Only four are used—bleaching, dyeing, dressing, and beetling.

Bleaching. Natural linen contains a large amount of coloring matter which is difficult to remove. The general process of removing this color is described on page 49. Linen may be full bleached, three-fourths bleached, one-half bleached, one-fourth bleached, or unbleached. The partially bleached linens are sometimes called silver bleached or ivory bleached. Bleaching weakens the fibers considerably. As much as 25 percent of the strength may be lost in the process.

Dyeing. Dyeing. (See page 52).

Dressing. When it is of good quality, linen requires no dressing. Inferior qualities may be starched or weighted with China clay.

Beetling. In finishing linen, the fabric is commonly pounded to flatten the threads, bring out the luster, and increase the toughness and leatheriness of the cloth. This is called beetling. Linen damask illustrates the finish resulting from this process.

WOOL FINISHES

Wool fabrics are divided into two big groups, woolens and worsteds, each requiring different manufacturing and finishing processes. Woolens are made from the shorter wool fibers, carded but not combed, with the result that the little fibers in the yarn are in a criss-cross position, giving a soft, fuzzy yarn, as in broadcloth (see Fig. 41). The weave of a woolen fabric is
more or less concealed by the finish, and the surface of the cloth is fuzzy. A woolen usually is softer and less firm than a worsted (Fig. 41).

The longer fibers are used for worsteds and they are combed in addition to being carded in the manufacture of the yarn. The combing process places the fibers parallel, giving a smooth yarn which is spun more tightly than the woolen yarns, as in serge (Fig. 40). A worsted has a clear-cut weave and a smoother surface than a woolen. A much longer period is required for the making of worsted yarns than for woolen, but after the cloth is woven, the finishing of woolens is more complicated than that of worsteds.

**Dyeing.** Wool may be dyed in the raw stock, slub, skein, or piece (see page 41).

**Fulling or Shrinking.** One of the outstanding characteristics of wool is its property of shrinking or felting (page 13). The kinky fibers covered with scales intertwine, swell, shorten, and lock together when subjected to moisture, heat, and pressure.
Worsted fabrics are shrunk very slightly, just enough to make the weave close and firm. Woolen fabrics, on the other hand, are fulled very extensively, often subjected to hot water for hours until they shrink as much as one-third in both length and width. Allowance for this shrinkage is made in weaving the cloth. The process of shrinking causes the weave to lose its distinctness.

In spite of the fact that more or less shrinkage is given to wool cloth during its manufacture, the maximum shrinkage is not reached. That is why it is advisable to shrink wool fabrics by sponging and pressing them before making them into garments. This precaution, because it removes the gloss given in the final finishing processes at the factory, also will prevent water-spotting.

**Weighting or Flocking.** Short wool fibers and clippings called flocks are collected, made into a paste, and added to the back of woolen cloth while it is being fulled. The tiny fibers are felted into the cloth to increase weight, and when carefully added, they also increase the strength and warmth of the cloth. Unless held securely in place, however, they work out in the form of lint or wool dust. Sometimes if the back of woolen cloth is brushed with a stiff brush, flocks may be detected.

**Crabbing.** This is a process of steaming, used for worsted. The steam sets the weave and adds to the firmness of the fabric.

**Napping.** The surface of the cloth is roughed up by passing it over fine wire teeth or vegetable teazles. Worsted are napped very slightly and then singed to make the surface clean. Woolens are napped to a greater degree, sometimes on one side, sometimes on both; then the nap is trimmed to the desired length and brushed, as in broadcloth. Usually the nap is pressed so that there is a decided up and down to the fabric. Special finishes may be given to woolens by passing them thru machines which twist the nap unevenly or roll it into balls, as in chinchilla.

**Pressing.** The final finish of most cloth consists of pressing, usually done by pressing between heated rollers. This finish gives smoothness and luster. Water-spotting often is due to the removal of this luster in the spots where the water comes in contact with the cloth. Sponging remedies this.
Before cloth is placed on the market it is given a careful inspection, knots are cut off (a process called burling), and broken weaves are mended. Not only wools but all fabrics pass thru this process.

**SILK FINISHES**

A variety of finishing processes are applied to silk, as indicated by the following descriptions.

**Bleaching.** Silk is bleached with either sulfur or peroxid (page 51).

**Dyeing and Printing.** Silk absorbs dye very readily, giving soft beautiful colors, but the dyeing process requires great care since the fibers are injured by boiling. Before the dyeing takes place, the natural gum is removed from the silk. About twenty percent of the weight of the fiber is lost in this process. Because of this fact the manufacturer justifies the use of weighting to replace the natural gum. If metallic weighting is used, it is added during the dyeing process. Silk may be dyed in the skein or in the piece. Many silks are printed, and both resist and discharge dyeing are used to give designs (page 45).

**Stretching and Lustering.** Skeins of silk are stretched and twisted, both by hand and by machinery, to soften the fiber and bring out the luster.

**Dressings.** A variety of dressings and sizings are used to soften, to stiffen, to add body and weight, to bring out luster, to decrease luster, and to glaze. Glues, gums, starches, isinglass, sugar, sugar of lead, and gelatin are among the substances used.

**Weighting.** In addition to certain dressings, salts of iron, tin, and zinc added in the form of a liquid during dyeing are used to weight silk. The amount varies from a small percentage to as high as five times the weight of the silk. When heavily weighted, the silk is said to be loaded or dynamited. Sometimes the weighting is done so skillfully that the fabric is not injured, but in the majority of cases sunlight, perspiration, or salt water will cause deterioration of weighted silk (Fig. 42). The presence of weighting cannot be detected by the appearance or feel but the burning test, described on pages 66 and 67, reveals it. Weighted silks are always a risk.
Breaking. Machines pound the cloth to "break" the stiffness given by dressing, and make it soft.

Singeing. The surface of the cloth is made smooth by passing it over a gas flame or between electric plates.

![Image](image_url)

Fig. 42.—The breaks and slits in this sample show the effect of metallic weighting on silk fabric.

Calendering. A variety of effects may be given by calendering. Moiré or embossing may be obtained in this way. See pages 46 to 49.

RAYON FINISHES

Since rayon may be manufactured by any one of four processes (see pages 18 to 21), the finishing processes vary with the type of rayon used, and many of the processes are kept secret by manufacturers. However, some general finishes may be listed.

Bleaching. A chlorin solution is used to bleach rayon. The solution is used cold and the process requires from two to three hours.

Dyeing. Dyes that are quickly absorbed are used for rayon. The material must be handled carefully since it is weaker while wet than when dry. In general, rayon dyeing is similar to cotton dyeing altho special dyes are needed for certain types of rayon.

Dressings. Fats and oils, soap, glue, starch, paraffin, and acetic or lactic acid are the dressings commonly used. Even
metallic weighting is used for some types of rayon the manufacturer claiming that it has no detrimental effects. New preparations are being tried out by manufacturers, and no doubt the substances used will be added to and changed as the rayon industry develops.

**PART IV—TEXTILE TESTS**

TEXTILE tests have two purposes: (1) to disclose the fiber that has been used in a fabric; and (2) to indicate the quality or durability of the fabric.

The fibers used in cotton, linen, wool, silk, and rayon cloth each have their particular characteristics. They differ as to length, strength, evenness, elasticity, pliability, porosity, and luster. It is necessary, therefore, to know the fiber that has been used if one is to select the fabric best adapted to a given purpose. Testing of the fiber is necessary also if the buyer is to make sure that she is getting what she is paying for, for manufacturers are very skilful in making one fiber resemble another, and neither feeling nor appearance will reveal the difference. Naturally it is a cheaper or inferior fiber that is made to resemble a more expensive one, cotton to replace linen or wool, for example.

Tests to determine quality and durability are necessary because many types of material—sheeting, for example—are manufactured in different grades. The quality of a fabric depends upon the fiber used, the way in which the yarn is spun, the type and closeness of the weave, the kind and method of dyeing, the finish given, and many other factors.

Because the average housewife does not have access to a testing laboratory, the tests given here are simple ones that may be applied in the home. While many tests of this nature cannot be scientifically accurate, with practice they will give a good basis for judging textiles.

**TESTS TO DETERMINE FIBER USED**

**GENERAL TESTS**

1. **Appearance and “Feel.”** Appearance and “feel” of cloth are closely related in these tests, since it is often difficult to tell whether we are aware of certain properties thru our eyes or our
finger tips. These tests are not infallible for cotton, linen, wool, silk, and rayon in general, since different fabrics made of any one fiber may have an entirely dissimilar feeling and appearance due to the method of manufacturing and finishing—for example, organdie as compared to muslin. It is advisable to launder samples of cotton and linen in order to remove the dressing and other finishes before drawing conclusions. The general appearance and "feel" of fabrics made from each fiber may be given as follows:

*Cotton:* No luster (unless mercerized), soft, dull, lifeless, limp, lacks spring and elasticity

*Linen:* Lustrous, smooth, leathery, crisp, and cool

*Wool:* Luster varies, springy, elastic, kinky, and warm

*Silk:* High, soft luster, smooth, pliable, lightweight, soft

*Rayon:* High, brilliant luster as a rule although some fabrics are subdued in luster. In general, wiry, non-elastic, non-pliable, slippery, cold, smooth

2. **Burning Test.** The burning test is one of the most valuable of the simple tests, both because it is easily applied and

![Fig. 43.—The burning test for silk. Pure silk (a) leaves tiny balls of black residue; weighted silk (b) leaves a black residue in the outline of the yarn or weave.](image)

because of the amount of information it gives. There are four things which it tells: (1) whether the fiber is animal or vegetable, (2) whether silk is weighted or unweighted (Fig. 43),
(3) whether the fiber is silk or rayon, and (4) the type of rayon, whether it is regenerated cellulose or cellulose acetate (see Fig. 44).

The fabric should be frayed and the warp and filling burned separately when making this test, since the fabric may be a combination of fibers or it may be weighted silk yarn combined with unweighted. The chart below gives the various reactions to the burning test.

**BURNING TESTS TO DETERMINE FIBER IN CLOTH**

<table>
<thead>
<tr>
<th>Fiber</th>
<th>Way in which fabric burns</th>
<th>Residue</th>
<th>Odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>Ignites quickly. Burns readily with large yellow flame. Difficult to extinguish flame. Smolders.</td>
<td>Small amount of light, feathery ash — usually floats away.</td>
<td>Like that of burning wood or paper.</td>
</tr>
<tr>
<td>Linen</td>
<td>Practically the same as cotton.</td>
<td>Same as cotton.</td>
<td>Same as cotton.</td>
</tr>
<tr>
<td>Wool</td>
<td>Ignites slowly. Burns with a small flickering flame. Bubbles as it burns. Flame easily extinguished.</td>
<td>Crisp, black residue, irregular in shape.</td>
<td>Disagreeable odor similar to that of burning hair or feathers.</td>
</tr>
<tr>
<td>Silk unweighted</td>
<td>Ignites more readily than wool, not so readily as cotton. Burns rapidly with small flame. Easily extinguished.</td>
<td>A round ball of crisp, black residue.</td>
<td>Less pronounced and less disagreeable than that of wool.</td>
</tr>
<tr>
<td>Silk weighted</td>
<td>Ignites with no flame. The fabric or yarn glows and chars.</td>
<td>The outline of the yarn or fabric is left. Sometimes curls at the edges.</td>
<td>Same as unweighted silk.</td>
</tr>
<tr>
<td>Regenerated cellulose rayon</td>
<td>Ignites readily, burns rapidly with a yellow flame. Very much like cotton.</td>
<td>A black powdery ash is left.</td>
<td>No special odor.</td>
</tr>
<tr>
<td>Cellulose acetate rayon</td>
<td>Ignites readily and burns even more rapidly than regenerated cellulose. The flame is smaller and bluer; the material appears to melt, and spatters and puckers as it burns.</td>
<td>A very hard shiny black residue remains.</td>
<td>No special odor.</td>
</tr>
</tbody>
</table>
3. Alkali or “Lye” Test. The alkali or “lye” test is a simple chemical test which may be applied in the home. It is valuable in determining whether a fabric is made of animal or vegetable fibers and is especially good when a mixture of animal and vegetable fibers is used in one fabric. It is better than the burning test for this purpose since it gives an idea of the proportion of each used.

To make the test: Add a tablespoon of household lye to a pint of water and boil a sample of the cloth in this solution for 10 minutes. (Never use an aluminum utensil when making this test since the alkali will dissolve aluminum.) Animal fibers—silk or wool—will dissolve while those of vegetable origin—cotton, linen, or rayon—will remain floating around in the liquid.

In the laboratory a 10-percent solution of potassium or sodium hydroxid may be used instead of the lye solution (Fig. 45).

4. Microscopic Tests. The microscope is one of the most dependable means of identifying fibers and, in the case of cotton and linen combinations, sometimes the only means of identification. It is unfortunate that the average housewife does not have access to this means of testing. A high degree of magnification
Fig. 45.—The alkali, or "lye," test for animal and vegetable combinations in fabrics. (A) Cotton remaining after wool is removed with alkali; (B) cotton remaining after silk is removed; (C) rayon remaining after wool is removed; (D) rayon remaining after silk is removed.
—from 200 to 350 times the original size—is necessary to show the distinguishing characteristics of the different fibers.

*Cotton* when magnified looks like a spirally twisted band or tape with thick edges (Fig. 46). When mercerized, the flat fiber swells, becomes more circular in diameter, and part or all of the twist is removed, depending upon the degree of mercerization.

*Linen* resembles a bamboo cane or a cornstalk with frequent nodes or joints (Fig. 47). A cross-section shows that the fiber is made up of a large number of many-sided cells.

*Wool* is covered with serrations or scales which overlap and protrude slightly at the edges (Fig. 48). On hair the scales are smaller, flatter, and do not protrude at the edges. Sometimes it is almost impossible to see them (Fig. 49).

*Silk*, which has no cellular structure, looks like a clear glass rod. When secreted by the silkworm, two filaments are held together by a gummy substance, but the degumming processes separate them (Fig. 50). Uncultivated silk filament, such as pongee and tussah, appear to be flat and show lengthwise markings and occasional cross markings.

*Rayon*, a manufactured fiber, varies somewhat in microscopic appearance. The regenerated cellulose rayons, except that made by the cuprammonium process, have many longitudinal markings and sometimes show minute air bubbles in the fiber. (Fig. 51). Cuprammonium rayon shows no markings and might easily be mistaken for silk. The cellulose acetate rayons have fewer lengthwise markings than viscose and nitro-cellulose rayons and do not show air bubbles. The cross-sections of rayons differ greatly, some types being circular, some irregular, some shaped like a half moon, etc.

**DIFFERENTIATION TESTS**

Tests made in order to determine the particular fiber or the combination of fibers used in a given piece of cloth are called differentiation tests. Naturally it is a cheaper or an inferior fiber that is combined with or substituted for a more expensive one. Cotton, the cheapest fiber commonly used for clothing and household purposes, often is substituted for or used in combination with the other more expensive fibers, and the imitation may be so clever that careful testing is necessary to detect its presence (see page 58 for methods of making cotton resemble other fibers). The same is true of rayon, which often is sold as silk. The chief differentiation tests, then, consist of identifying cotton or rayon, and in many cases the tests already described under
fiber identification will be the only ones needed. These tests will be listed and additional ones described.

Figs. 46-51.—Cotton, linen, wool, hair, and silk fibers and rayon (viscose) filaments highly magnified. The cotton fibers (46) show spiral twists; the linen (47), joints or nodes; the wool (48), scales with slightly protruding edges; the hair (49), scales less pronounced than on wool; the silk fibers (50) show no cellular structure; and the rayon (51) show lengthwise grooves and minute air bubbles.
To Distinguish Cotton From Linen. Because cotton and linen are practically the same chemically, they are difficult to distinguish, especially when they are combined. In physical structure, however, the cotton fiber consists of one cell and the linen fiber of many cells cemented together with a vegetable glue. Scientists are agreed that it is this difference in physical structure which explains why linen is more difficult to bleach and dye than cotton, why it absorbs water and gives it up more rapidly than cotton, and why it is such a good conductor of heat. Consequently most of the cotton-linen tests are physical rather than chemical in nature.

In making the following tests it is very important that the fabric to be tested be thoroly washed first, in order to remove the dressing and other finishes before the testing is done.

1. The "Feel" Test (page 65). The experienced person soon can distinguish between the crisp, cool, smooth, leathery feel of linen and the soft, limp, lifeless feel of cotton. When the two fibers are combined in one fabric, however, this test is not very helpful.

2. Appearance Test. Unravel the yarn, pull it apart with a pin or needle, and look at the ends of the fibers. Linen fibers appear straight, pointed, semitransparent, and lustrous. Cotton fibers spread out and curl in different directions and appear white and opaque. Carefully pull out some of the fibers. The cotton fibers will not average more than an inch in length, while the linen, unless of very poor quality, will be longer.

3. Tearing Test. When torn, cotton gives a soft, dull sound, while linen gives a loud, shrill sound.

4. Moisture Test. Perhaps the oldest cotton-linen test consists of placing a drop of water on the fabric. Linen absorbs the water immediately; cotton does not. A variation of this test consists of fraying the cloth and dipping the yarn in water. If linen, the yarn sinks in water immediately, while cotton will glance off the surface. The moisture tests are not infallible, however, since it is possible for the manufacturer to treat cotton so that it will absorb moisture just as rapidly as does linen.

5. Oil Test. Oil dropped on the surface of linen makes the fabric much more transparent than cotton under similar treatment.

6. Ink-Blot Test. Ink dropped on linen makes a round, even blot, while on cotton the blot is very irregular in outline.

7. Laundry Test. If linen fabric is washed and while still wet ironed dry, it will be smooth, crisp, and lustrous. Cotton given the same treatment will be limp and fuzzy (except in the case of cotton with special finishes, such as organdie). This is one of the best simple tests for cottons and linens.
8. **Microscope Test.** It is only fair to state that none of the above tests for cotton and linen are infallible. The only absolutely accurate test is the microscope (see page 68) and unfortunately this is a means of testing not accessible to many women. However, samples of material may be sent to certain commercial testing laboratories or to state universities which have the proper equipment for testing. If complete tests are to be made, the sample should be at least 6 by 12 inches, preferably larger.

**To Distinguish Cotton From Wool.** (1) Appearance and feel (page 65). (2) Burning (page 66). (3) Alkali (page 68); this is the most accurate test. (4) Microscope (page 68).

**To Distinguish Cotton From Silk.** When made to imitate silk, cotton usually is mercerized (page 59). This will make it more difficult to identify cotton by appearance and "feel." The best tests will be:
2. Alkali (page 68).

**To Distinguish Rayon From Other Fibers.** Because of its high luster, rayon is apt to be used in combination with other fibers as a decoration rather than as a substitution. This is especially true when rayon is combined with cotton or wool. However, rayon may be and often is substituted for silk. With a little experience the following simple tests are sufficient to identify it:
1. **Appearance and "Feel"** (page 65). The hard luster, slippery feel, and non-elastic nature of rayon make it quite unlike any of the natural fibers. The luster alone often is sufficient to distinguish it from cotton or wool. In the newer types of rayon the luster may be greatly reduced but the feel remains characteristic.
2. **Burning Test** (page 66). It must be remembered that the two types of rayon, regenerated cellulose and cellulose acetate, give decidedly different burning tests. The first burns very much like cotton and linen; the second might be confused with silk if it were not for the puckering of the cloth and the hard residue.
3. **Moisture Test.** Most rayon is much weaker while wet than when dry. Water does not have this effect on the other fibers. Immerse a yarn in water or stretch a yarn between the fingers and touch the tongue to the center of it. If it becomes perceptibly weaker and pulls apart more readily than when dry, it is rayon. The other fibers will not give this reaction.
TO DETERMINE QUALITY AND DURABILITY

Durability is not always the most desirable quality in a fabric, since for certain purposes appearance and texture are of more importance than lasting qualities. However, for garments which are to receive hard wear and for practically all household textiles the actual wearing qualities of the cloth are of very great importance. Since price is no longer a means of judging quality, the housewife needs a few definite, simple tests to enable her to judge the durability of the cloth which she is purchasing. The tests given below are based upon the factors which influence the strength and serviceability of fabrics, namely the quality of the fiber used, the type of yarn spun, the type and closeness of the weave, the permanency of the dye used, and the kind of finish given. All of them may be applied at home.

TESTS FOR QUALITY OF FIBER

Not only the kind of fiber used but also the quality of the fiber is important in relation to the durability of cloth. To judge this the fabric should be raveled and then, using a sharp needle, the yarn should be torn apart and the individual fibers examined as to length, strength, elasticity, and uniformity. However, since so much experience in studying and comparing various fibers is needed to make this test of value, in most cases it is advisable to omit it and rely upon the yarn and weave tests explained below to indicate the quality of the fiber.

TESTS FOR QUALITY OF YARN

The quality of the yarn used in making cloth depends upon the quality and amount of fiber used, the number of plies used, and the amount of twist given in the spinning process. To study yarn the cloth should be raveled and the warp and filling examined separately.

1. Test for the Quality of the Fiber.

2. Test for Ply. Ply is the term applied to a strand made by twisting fibers together. Warp and filling yarns may consist of one such strand, called a single-ply yarn, or of two or three strands combined, referred to as two-ply yarn or three-ply yarn, as the case may be. The more plies a yarn has the stronger it is. By untwisting a yarn the number of plies may be determined. Very often the warp yarn will have more plies than the filling.
3. **Test for Twist.** The amount of twist given to a yarn in spinning affects its strength; the greater the twist, the stronger the yarn. Untwisting the yarn will indicate the amount of twisting. For laboratory use there are machines called twist counters which indicate the number of twists per inch in any given piece of yarn. Not only the frequency of the twist, but also its evenness and uniformity affect the strength of the yarn. Practice in untwisting yarns will enable one to judge this.

4. **Tearing Test.** Tearing is a good test for the strength of yarns in cotton cloth. A piece of cloth made of strong yarns is more difficult to tear than one made of weak yarns. The material should be torn both lengthwise and crosswise.

5. **Breaking Test.** The ease with which a piece of yarn may be broken indicates how strong it is. Different yarns made of the same fiber and yarns made of different fibers should be broken in order to get a standard for judging strength.

**TESTS FOR QUALITY OF WEAVE**

The construction of weaves has been described on pages 28 to 39. The closeness of the weave and the uniformity of the number of warp and filling yarns, as well as the kind of weave, determine its strength.

The **twill weave** is the strongest because the yarns may be pushed very close together in the weaving process. The **plain weave** ranks next to the twill if the yarns are strong, close together, and uniform in warp and filling. The strength of the **satin weave** depends upon the length of the yarn on the surface. This yarn on the surface is called the "float." A long float catches and breaks and the fabric becomes fuzzy on the surface. A satin weave with a short float may be very firm and durable. The **cord weave** is apt to give poor service because of the difference in the weight of the warp and filling yarns. The fine yarns wear thru before the heavy ones. Furthermore, the cord is apt to catch in ironing or with friction.

Because of its construction the yarns in the **basket weave**, unless very fine as in crêpe Romaine, cannot be pushed close together; therefore this weave lacks strength. The **gauze** and **leno weaves** are strong in spite of their openness, because of the way in which the warp and filling yarns interlace.

**Figured weaves** vary in regard to strength, depending upon their construction. When a weak weave, such as the satin, is combined with a stronger weave, such as the twill or a huck, the
weaker weave wears thru first. Toweling and table damask with large figures made with the satin weave often illustrate this tendency for the satin weave to wear thru (Fig. 52). The small-figured weaves—huck, birdseye, and diaper—usually are very serviceable. Figures woven in with the swivel attachment are not so durable as those made with the lappet on account of the cut edges of the yarn. (See illustrations on page 38).

Several simple tests may be applied to determine the strength of the weave.

1. **Scraping Test.** Scrape the surface of the cloth with the finger nail, testing it both lengthwise and crosswise. If the yarns are easily pushed apart, the weave lacks firmness (Fig. 53).

2. **Light Test.** Hold the cloth toward a light or window. If the weave is loose and open, the light will show thru. (This test will not help with the gauze or leno weaves since they are meant to be open.)

3. **Pin Test.** Run a tuck in the cloth with a pin. Pull on both sides of the tuck. If the weave is weak, the threads will separate easily (Fig. 54).

4. **Pulling Test.** Grasp the cloth between the forefinger and thumb of both hands, leaving about an inch between. Give a straight, steady pull, testing both warp and filling (Fig. 55). The amount of resistance the cloth offers indicates its strength. If it is easily torn, it is weak;
Fig. 53.—Scraping test for determining strength of a weave. When yarns are easily separated, as indicated here, the weave is weak.

Fig. 54.—Pin-tuck test for strength of weave. If the yarns separate easily, the weave is weak.

Fig. 55.—Position of fingers for pulling test. If the fabric tears easily, it is weak.
if it cannot be torn, it is strong. Of course this test is only relative, since
the strength of individuals differs and since one person may pull harder
at one time than at another. For laboratory use there are testing ma-
chines which indicate in pounds the amount of force necessary to tear
or break cloth. These machines are very valuable in determining and com-
paring the strength of fabrics.

DETERMINING ELASTICITY AND DRAPING QUALITIES

The degree of elasticity and pliability possessed by a fabric
determines whether or not it will crush and wrinkle badly and
the grace with which it will fall into folds. The various fibers
naturally differ greatly in these qualities. Silk and wool rank
high in elasticity; therefore, when pure and well manufactured
they hang in soft folds and do not wrinkle badly. Cotton, linen,
and most rayons have less elasticity—linen practically none—
and for this reason they wrinkle much more than silk and wool,
and are not well adapted to draping. However, in spite of the
natural properties of the fibers, the method of manufacturing
and finishing may do much to influence these properties.

Elasticity not only adds to the attractiveness and ease of
handling a fabric, but also to its wearing qualities, with one ex-
ception. In linen, altho the lack of elasticity is a disadvantage
for dresses, it is a decided advantage in table covers, bureau
scarfs, etc., since it causes the fabric to be flat and smooth.

Simple tests for elasticity and pliability follow.

1. Elasticity Test. Crush the material in the hand. If it springs back
to its original shape and the wrinkles shake out readily, it ranks high in
elasticity; if the wrinkles remain, it is deficient in this property.

2. Pliability Test. Drape the fabric. If it falls into soft, graceful folds,
it is satisfactory in regard to this property. Of course the style of the
garment for which the fabric is to be used determines how important it
is for it to have this characteristic.

TESTS FOR FASTNESS OF COLOR

Color, to be really fast, must resist the action of light, laun-
dering, friction, and perspiration. A color may be fast in one of
these respects but not in others. Therefore the use to which the
fabric is to be put should be considered when testing for fastness
of color. A wash dress needs to be fast to all the agents listed
above, rugs to light and friction, window drapes to light and
laundering, lining materials to perspiration and friction. Some of the color tests are tedious, but none of them are difficult.

1. *Laundry Test.* Wash a sample five times, using warm water and soap. Dry and iron or iron dry between each washing. Then compare with the original fabric to see if there has been any change in color. Notice whether the water is stained with the dye. If so, the fabric is said to “bleed.” Bleeding sometimes occurs when the fabric is first washed, with no apparent effect on the color, but if it continues, it indicates fading. This may not be serious if the garment is all one color, but if trimmed with white or light colors, it is. Sew samples of the colored cloth and white cloth together and wash to see if the color runs.

2. *Light Test.* Place in a book a five-inch strip of the cloth to be tested, letting about an inch extend out. Place the book where the sun-

Fig. 56.—Sun test for fastness of color. The portion marked (a) was kept in the dark; (b) was exposed to sunlight for one week; (c) was exposed for two weeks; and (d) for three weeks. The color of this material proved to be not fast to sunlight.

light will fall upon the exposed edge of the fabric. At the end of a week draw out another inch and continue until the first portion has been exposed to sunlight about three weeks. It will be interesting to see the different stages of fading on one sample (Fig. 56). A more simple test is to pin a sample of the fabric on a window curtain where the sun will strike it and expose it for about three weeks; then compare it with the original. If a fabric withstands sunlight every day for three weeks, the color is said to be fast. The disadvantage of any sun test, of course, is the time necessary for making it.

3. *Friction Test.* Rub the surface of the fabric to be tested with a white cloth which is slightly damp. If the color rubs off, it is not fast to friction and is said to “crock.”
4. Perspiration Test. The best test is to sew a sample to an undergarment so that it will come into direct contact with the perspiration from the body. Often perspiration will discolor fabrics that are fast to both laundering and sunlight. Silks are apt not only to be discolored by perspiration but also weakened by it, especially if weighted.

**TEST FOR SHRINKAGE**

Testing for the amount of shrinkage is very important in many wash fabrics. A sample of material, preferably as large as 4 by 3 inches should be cut, the outline of it drawn on a sheet of paper, the sample washed and ironed, and then compared with the original outline. The amount of shrinkage in warp and filling can be measured and the number of inches per yard computed. If a sample of the material cannot be spared, a certain number of inches may be marked off with thread or pencil on the wrong side of the fabric and this portion saturated with water. When dry, the portion marked off can be measured and the amount of shrinkage determined.

**DETERMINING PRESENCE AND QUALITY OF FINISH**

**Tests for Sizing or Dressing.** The finish of cloth given by dressings or sizings and pressing may be tested by friction or washing. This type of finish is given to most cottons and to some linens, silks, and rayons (page 53), not to wools. Most of these finishes are temporary in nature. Since they often make a cloth appear better than it is, it is advisable to wash a fabric finished by such means before applying tests to determine the content or quality of the fiber. Simple tests to detect dressing or sizing follow.

1. **Light Test.** Hold the fabric toward the light. If dressing has been added to a cloth of loose weave, it can often be seen between the yarns.

2. **Rubbing Test.** Rub the surface of the fabric with a dark cloth, pressing hard. The dressing will sift out and look like a white powder.

3. **Tearing Test.** Tear the cloth, and the dressing will fly out in the form of a white powder.

4. **Laundry Test.** Wash a sample in hot water, using much friction. Sometimes boiling is necessary to completely remove the dressing. After drying; compare the sample with the original fabric. This is a more accurate test than the ones listed above. In the laboratory, chemicals and boiling are used in removing dressings; the sample is carefully weighed.
before and after the treatment in order to determine the percent of dressing present.

**Test for Metallic Weighting in Silk.** See Fig. 43, page 66, for the process of weighting silk with metal. The burning test described on page 66 is the simplest test to determine whether or not silk is weighted. In the laboratory the sample is weighed accurately, burned in a crucible at a high temperature until only the metal is left, then this residue is weighed and the percentage worked out. Occasionally a weighted silk gives very good service, but it is always a risk.

**Tests to Determine Durability of Nap.** The process of napping (page 56) if done carelessly will wear away and weaken the body of the cloth, giving the false impression of weight. Broadcloth and flannel, for example, may be weakened in this way. The pulling and tearing tests described on pages 75 and 76 should be applied to determine this condition.

In regard to the durability of the nap itself the appearance should indicate something about its permanency. A long, thin nap nearly always is a risk. A short, close nap is much more apt to give service. Wet the thumb and rub it over the surface of a napped fabric with a circular movement. If the nap separates easily and rolls into a ball, it is a sign of weakness. If it keeps its position, it is durable. Pulling the nap to see how easily it may be removed also is a test for its durability.

**Test for Water-Spotting.** The tendency of silks to water-spot is a cause of much annoyance and dissatisfaction on the part of the consumer. There seems to be little understanding of the real cause of water-spotting, some manufacturers attributing it to one cause, some to another. Testing a sample of the fabric by sprinkling water on it will indicate whether or not it spots. Temporary spotting, thought to be due to the removal of the sheen given by the final finishing processes in the manufacture of the cloth, usually can be removed by rubbing the spotted surface with a piece of the same fabric, with the hand, or with a clean coin. Sponging, laundering, or dry cleaning will remove temporary spotting and sometimes prevent further spotting. If the spotting has affected the color, redyeing is the only thing that can be done to cover the defect.
Some wool materials also spot; sponging is the remedy for this.

**Tests for Shininess in Worsted.** Worsted fabrics (page 61) made from tightly twisted yarns are very apt to grow shiny with use, regardless of quality. The shininess results from wearing away the surface fuzz and polishing the wool fibers. Women should take this possibility for granted when purchasing worsteds. The remedy consists of raising a slight nap on the shiny surface. This may be done by brushing with a stiff brush while steam is passing thru the fabric, by brushing the surface lightly with a wire brush such as is used for cleaning suede shoes, or by rubbing lightly with very fine sandpaper. In raising a nap care must be taken not to wear away the body of the cloth. These remedies are only temporary, however. There seems to be no prevention or cure for shininess in worsteds made of tightly twisted yarns which receive hard wear.

**Tests for Reworked Wool.** In the manufacture of wool cloth two types of fiber are used: virgin wool, or new wool which has never been used before; and reworked wool, usually called shoddy, consisting of fibers obtained from old wool rags and waste products in the wool industry.

Reworked wool plays an important part in increasing the supply of wool materials available and in reducing the cost of wool fabrics. In most cases virgin wool is stronger than reworked wool, but since both new wool and shoddy vary greatly in quality, we cannot praise all fabrics made from new wool nor condemn all those made from shoddy. The best grade of reworked wool may be superior to the poorest grade of new wool.

Since all wool has the same chemical nature regardless of whether or not it has been used, it is very difficult to detect the presence of shoddy in fabrics. It is well to remember that, due to the method of manufacture, shoddy will not be found in worsteds. The compound microscope is valuable in determining the nature and quality of the fibers in wool yarn, and if the fibers appear to be broken, irregular, have scales missing, and are of various colors (due to previous dyeing), the presence of shoddy may be indicated. However, the microscope cannot give the percentage of reworked wool present. The best tests to apply
are those which indicate such points as strength, firmness, and flexibility of the finished fabric (page 75). After all, the important point is not a question of whether virgin wool or shoddy has been used in making the cloth but rather of the actual quality of the fabric in relation to its use and price.

Sometimes flocks, that is, very short wool fibers consisting of wool lint and the clippings from woolen cloth, are fulled into the fabric to add weight. If added carelessly or in too great a quantity, they work out in the form of excessive lint and the cloth becomes sleazy. Their presence may sometimes be recognized by brushing the back of the fabric with a stiff brush and noting if a large amount of lint is removed.

**PART V—THE COST OF TEXTILES**

One is inclined to wonder why cloth costs so much as it does when the raw materials are relatively so cheap. To appreciate the reason for the prices of any finished product, it is necessary to understand some of the costs that are involved in its manufacture and marketing.

**Cost of Raw Material.** The first factor entering into the ultimate cost of a fabric is the cost of the raw material. The length of time and the handwork necessary in producing and refining the fiber, the risks involved, the cost of the machinery used, and the countries in which the fiber is produced, all affect this cost. The last point has two different aspects. Labor, especially that done by hand, is much cheaper in most other countries than it is in the United States. On the other hand, import duties often wipe out a considerable part of the money saved in labor costs.¹

¹Until 1929 no general revision of the tariff act of 1922 had been attempted. In 1928 an average $100 worth of silk and silk goods paid $56.56 import duty; of wool and wool manufactures, $49.64; of cotton manufactures, $40.26; and of flax, hemp, jute, and their manufactures, $18.16. Cotton manufactures from cotton waste paid only $5 per $100, while cotton gloves, including embroidered, paid $66.80. In the case of cotton and silk goods the prominence of high-duty items raised the 1928 average.
Cotton is a comparatively cheap fiber to produce, but it is subjected to many risks during growth, such as the boll weevil and other insect pests, drouth and floods, which make the output uncertain and the price fluctuating. The fact that the United States produces about two-thirds of the world's output of cotton and imports a comparatively small amount contributes to its cheapness.

Flax requires very rich soil, which means frequent rotation of crops. Considerable hand labor is necessary in its cultivation and in the preparation of the fibers, and the processes are tedious. Linen is as cheap as it is only because it is produced in Russia, Belgium, Ireland, Czecho-Slovakia, France, Italy, Germany, and the Netherlands, where hand labor is much less expensive than it is in this country. Until satisfactory machinery is invented to replace handwork, the production of flax for fiber will not be an important industry in the United States.

The problem of finding adequate grazing land for sheep and the dangers to which they are subjected add to the cost of wool in this country. More than half of the wool used in the United States is imported, chiefly from Australia, Argentina, and Uruguay. Not only does the cost of shipping it such distances add to its price, but import duties also are a very large item in its cost to us.

Silk production involves an almost unbelievable amount of work in the care and feeding of the silkworms. Altho a large amount of silk cloth is manufactured in the United States, all of the raw product is imported, chiefly from China and Japan. The price of silk would be prohibitive if the raw material were produced in this country.

Whether or not rayon eventually becomes the cheapest of the five major fibers, it should at least be the most stable in price since it is a manufactured fiber and not subjected to the caprices of nature.

Manufacturing Costs. It is difficult to give any conception of the labor involved in converting the raw materials into cloth without going into the details of the numerous processes thru which each fiber passes before it becomes finished cloth. Most of the manufacturing is done by automatic machinery which is
THE TEXTILES WE BUY AND USE

marvelously intricate and efficient. Since this machinery is very expensive and the other expenses of factories are heavy, it is not surprising that the cost of manufacturing textiles is greater than that of producing the raw materials. The investments for the machinery used in manufacturing the various fibers do not vary as widely as the costs of labor, on account of different degrees of skill needed.

Changing Styles an Item in Cost. Much waste and much of the high cost of textiles is the result of fluctuations in demand caused by constantly changing fashions. Altho the blame for this is often laid at the door of the consumer, this is not where all of it belongs. Industrial interests cultivate changes, since changes lead to greater consumption, and so to greater profits. Offsetting the advantages of rapid change in styles there are several disadvantages. Quick and expensive changes in machinery are necessitated, and periods of delayed production and unemployment are followed by high-speed production and overwork. Poor goods often result. The out-of-style goods may be sold at a loss or, as in the case of wool, remanufactured into another type of cloth—all of which involves much additional time and expense. Good material is discarded before it is worn out. The consumer pays for all this because prices must be set high enough to cover possible losses to manufacturers and dealers thru goods going out of style before being sold.

Selling the Finished Product. If the cloth is completely finished in the factory where it is woven, it goes directly from the manufacturer to the jobber or wholesaler and thence to the retailer, thus taking a very direct route to the consumer. This is the most economical way for cloth to reach the user. If, however, the finishing processes, such as bleaching, dyeing, or mercerizing, are not given in the mill where the cloth is made, it is sent to a concern called the "converter." The converter in turn sends the cloth out to the bleacher, to the dyer, or to whatever agency will apply the finish needed. The cloth then passes thru the hands of the jobber or wholesaler, who deals in one or at most a few types of cloth and buys and sells in bulk; thence to the retailer, who buys smaller quantities of a great variety of goods for sale to the public.
The selling process adds more to the cost of cloth than either the production of the raw fiber or the manufacture of the cloth, because in addition to the reasonable profit each agency must make that handles the cloth, there are such items as wages, depreciation of buildings and equipment, rent, repairs, delivery, credit, office expenses, insurance, taxes, and advertising to be covered. Furthermore the producer and retailer both take the risk of having unwanted goods left on their hands when they fail to guess exactly what the public will buy and how much it will buy, and the price must be placed where it will cover possible losses when the guessing is incorrect.

Advertising, that is, bringing a commodity to the attention of the consumer in a way to make him want it, is a great stimulus to demand. As a result, the cost of advertising is more than compensated for by lower prices made possible through increased sales.

**How Demand and Supply Affect Prices.** If the supply of any article is greater than the demand, the price goes down. If the demand is greater than the supply, the price goes up. For example, there may be 1,500 yards of satin in a city. This is the supply. Perhaps customers will buy only 1,000 yards at the price asked. This is the demand. Since the supply is greater than the demand, the retailer will have to reduce the price of the unsold satin to a point where it will attract buyers if he wants to sell. He may still make some profit or he may have to sell at an actual loss, but that is better than a complete loss. If, on the other hand, the demand for this satin is greater than the supply, the dealer will be able to sell all of it at his original price. Demand is reflected all the way back to the manufacturer and even back to the grower of the fiber, and prices are affected by it.

**Effect of Competition on Prices.** Competition tends to lower prices and keep them fairly stable. The effort of rival business houses to attract patronage leads them to offer more advantageous terms than any one of them would be likely to offer were it the sole agency for the commodities it handles. A store, for example, may be selling sheeting for 40 cents a yard. In order to attract trade, another store offers the same grade for 35 cents. The first store, in order to keep its trade, reduces its 40-cent
sheeting to 35 cents. Efforts to interest patrons continue, and the public benefits so long as the competition is fairly conducted.

PART VI—HOW WOMEN MAY DEVELOP BETTER TEXTILE SERVICE

As the chief buyers of textiles women exert a greater influence upon the production and quality of fabrics and garments than they usually realize. Thru intelligent selection and cooperation with merchants and organized agencies for textile improvement women have opportunity to make their influence felt.

Learning to Select Intelligently

Because the textile field is such an intricate and elaborate one, training as well as experience is needed for intelligent selection. As a background for intelligent selection of fabrics and garments, it is necessary to have a certain fund of information concerning fibers and cloth: knowledge of the properties of the five fibers commonly used for cloth making—cotton, linen, wool, silk, and rayon; appreciation of the problems connected with the production and manufacture of these fibers; knowledge of the uses, characteristics, and approximate widths and prices of the fabrics commonly used for clothing and household purposes; experience in handling and buying materials; and a knowledge of simple, accurate tests for quality and durability.

This manual has attempted to supply information on the foregoing points, with the exception of the matter of widths and prices of staple fabrics. Because there is such a vast number of fabrics on the market, and because widths and prices vary widely from year to year, it is not practical to make definite statements concerning them. The best method by which to gain this information is thru the actual buying and handling of materials.

Buying According to Plan

After acquiring a reasonable background of knowledge concerning fibers and fabrics, the next step is a definite buying plan for textiles and clothing. By means of careful, intelligent planning for clothing and household needs, time and money will
be saved in supplying these needs. It is best to list the new clothing and household textiles required for one or preferably two years and estimate the probable cost. If buying fabrics by the yard, the consumer should know not only the type of material needed, but also the correct amount. The width of the material in relation to the pattern used is important. The waste due to buying more cloth than is necessary is appalling.

After deciding what is needed, the next question is how the articles are to be secured. This involves either home sewing or sewing done by a dressmaker in relation to ready-made garments. This should be decided after considering time available, money saved, nervous energy expended, and results.

Where, that is, from what source the fabrics or garments may best be purchased—department stores, specialty shops, or mail-order houses, must have a place in this buying plan. The location of purchaser in relation to stores as well as the amount of money available will play a part.

When to buy also needs consideration. Fabrics or garments bought at the beginning of a season are apt to be higher in price, but the selection is better. The satisfaction of having what one needs at the time it is needed often compensates for additional cost. More knowledge should be had concerning sales.

Sales include articles that are not in good condition on account of flaws in manufacture or abuse when taken out on approval; merchandise bought at reduced prices because of fire, failure, or overproduction of the manufacturer; novelty goods sold at a high price at the beginning of the season and then reduced to cost or less in order to close out styles that have not been popular; out-of-season goods, goods that are sold before inventory; and goods in season to stimulate business. Naturally some of this material will be good in value, some of it poor. The secret of successful bargain buying is to be able to judge quality and to remember that an unnecessary or unsuitable article is never inexpensive, regardless of how little it costs.

**Using Credit Service Reasonably**

In a buying plan some thought has to be given to the best method of paying for merchandise. Either charge accounts or
cash may be used. There are arguments both for and against charge accounts. They help to establish one's credit in a community and often are valuable in making adjustments for unsatisfactory goods. On the other hand, they tempt some women to buy extravagantly, and unless paid regularly, add to the expenses of stores.

**Developing Standards of Quality**

In connection with the subject of what to buy the matter of brands, that is, exclusive identification names, is of great help to the purchaser.

Probably every woman knows certain brands of sheeting or silk or ready-made garments, such as hosiery, underwear, or house dresses, which she considers dependable. Unfortunately, however, along with reliable branded goods there are some with brand names which have no value. Studies of branded sheeting, for example, have shown that the same brand may vary in quality from year to year, that the same brand may vary in quality in different widths, that one grade of sheeting may be sold under different brand names, and that there is no relation between quality and price. As a result of these studies, efforts are being made to standardize sheeting, that is, to have it sold according to definite specifications as to thread count, tensile strength, and weight. If this is accomplished, a great step forward will have been taken in the selling of textiles, and definite specifications for other fabrics will follow. Intelligent interest of women in this work will be invaluable as an aid to establishing trade names which will signify specific standards of quality in staple fabrics and garments.

**Cooperating With Merchants**

Cooperation with merchants in the matter of securing the quality of goods paid for is one of the most urgent as well as the most practical of the opportunities open to women. Business concerns have learned that the giving of satisfaction is one of the best possible means of advertising. When women—not one woman but many women—consistently and intelligently report back to merchants when fabrics are especially good or
especially poor, more will be done to improve the quality of merchandise than by any other means. Failure to report unsatisfactory merchandise, whether thru indifference or a desire to be tactful, causes honest merchants to suffer by not knowing of the inferior quality.

The practice of not reporting poor values harms both manufacturer and merchant eventually, for women who get cheated once are not apt to buy the same article again. The fair and constructive thing to do is to let the merchant know, in a courteous way, the outstanding good or poor points of the merchandise purchased. The progressive merchant always appreciates such cooperation.

Cooperating With Salespeople

In connection with the subject of cooperation with stores, attention should be given to the matter of cooperation with salespeople. As the women who buy demand more knowledge on the part of the people who sell, the information will be given. Some of the larger stores already are giving training in textiles and selling methods. Many individual salespeople have profited by their experience and become authorities along certain lines of merchandise. Customers recognize this and the salesman profits thereby.

There are other points that should be kept in mind in this matter of cooperation with salespeople. It is unfair to take an undue amount of time looking at goods or to make a practice of taking goods on approval and then returning it without buying something in its place. Complaints in regard to the quality should be made to the buyers or to heads of departments, since they rather than the salespersons, are responsible for the quality of goods sold. In the textile field as in every other field "a little knowledge is a dangerous thing," and women should refrain from criticizing and offering suggestions unless they are sure of their information. Much could be done to further the spirit of cooperation between salespeople and those who buy if women would apply the simple rule that courtesy and expressed appreciation for good service always get better results than criticism and patronizing attitudes.
THE TEXTILES WE BUY AND USE

Discouraging Rapidly Changing Styles

The matter of styles is another place where cooperation is needed. Merchants study what people want and this is indicated by what the public buys. When women as a group let real beauty, quality, and suitability of fabrics and garments determine their selection, extreme and rapidly changing styles will be discouraged. A more stable market will result, and the manufacturer, retailer, and consumer will reap the benefit. High prices are placed upon novelty goods, not because of their quality or beauty, but because of the expense involved in designing them and the risk involved in selling them. As a result, price is no longer an indication of the real value either of fabrics or of ready-made garments.

Keeping in Touch With Agencies for Textile Improvement

As yet there are no federal textile laws comparable to the pure-food laws, which require the honest labeling of a product. Many bills have been proposed, but none have actually become laws. Women can help to get desirable textile laws passed by giving such bills their active interest and support.

The government has taken an important step in establishing the Bureau of Home Economics with a Division of Textiles and Clothing. This division makes research along lines that will be of practical help to women and publishes the results in bulletin form.

The United States Bureau of Standards has carried on tests of blankets, sheets, and other textiles, on heat-retaining properties of textiles, and on textile-testing apparatus.

The Simplified Practice Section of the United States Department of Commerce includes textiles in its investigations and reports.

The Domestic Distribution Department of the United States Chamber of Commerce is working on the distribution of costs of textiles, which have increased rapidly and are factors in high prices.

The National Better Business Bureau, an organization for the purpose of increasing honesty in salesmanship and advertis-
ing, is doing excellent work. The address of its headquarters is National Better Business Bureau, Inc., 383 Madison Avenue, New York City.

The American Society for Testing Materials, a national technical society of members from all parts of the United States and Canada and many foreign countries, has a committee devoted to the study of tests and specifications for textile materials. This society publishes valuable technical textile data in pamphlet form. Its headquarters are at 1315 Spruce Street, Philadelphia, Pennsylvania.

The Textile and Clothing Section of the American Home Economics Association is doing an excellent piece of work in the standardization of textiles, with sheeting as a starting point, and is encouraging and coordinating the research work of colleges and universities in textiles and clothing.

The Laundryowners National Association also should be listed among organizations which are doing worth-while textile research. It studies textiles from the standpoint of their cleansing properties, and has been responsible for some excellent publications along such lines.

Other organizations of textile interest are The National Association of Purchasing Agents, National Hotel Association, American Hospital Association, National Retail Dry Goods Association, Cotton Textile Institute, Association of Textile Merchants of New York, National Association of Dyers and Cleaners, Converters Association, American Association of Textile Chemists and Colorists, Bureau of Costume Art, and Association of Knit Underwear.

One of the most recent developments and one of the most significant is the interest business concerns are taking in educational advertising. Many manufacturers are putting out reliable and scientific information in regard to their products. Many of them employ women trained in home economics and science as research workers and demonstrators.
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<td>Wool finishes</td>
<td>60-63</td>
<td></td>
</tr>
<tr>
<td>Wool, Reworked</td>
<td>82-83</td>
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<tr>
<td>Yarns, Novelty</td>
<td>28</td>
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