

**FIBERS FROM COTTON**





# The Utilization of American Cotton

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To tell of cotton one has to use big figures and big statements.

Cotton is man's main reliance for clothing and other textiles. It enters into the daily life of more of the world's peoples than any other product except salt.

Practically the entire cotton crop is used as raw material for manufacturing, and that industry is one of the largest industries in the United States and the most important based on an agricultural commodity.

Our modern machine age had its beginnings in the efforts during the eighteenth century to spin and weave cotton mechanically. During the past 200 years, the history of western Europe, the Orient, and America has been shaped to a great extent by the ability of countries to produce the fiber and process it, and by their need for using it.

Cotton became King Cotton when Eli Whitney invented the cotton gin in 1783. The gin, which pulls the cotton fibers off the cottonseed, did away with the tedious hand-separating job required until then. Cotton production in the United States immediately began the upward march that made this country the main source of the world's supply. Production climbed from 4,184 500-pound gross bales in 1791 to 10.3

million bales in 1900. It averaged 12.5 million bales annually in 1910 to 1919, 13.1 million bales in 1920 to 1929, 13.2 million bales in 1930 to 1939, and 12 million bales in 1940 to 1949. The 1949 crop of 16.1 million bales, the fourth largest in history, was followed in 1950 by one of only 9.9 million bales.

World production of cotton reached its peak just before the Second World War. The 1935 to 1939 annual average was 31.7 million 500-pound gross bales, of which 18.6 million bales was grown outside the United States. The world total declined to a low of 21.1 million bales in 1945, but went up to 31.2 million bales in 1949. Of the 1949 total, the United States produced 16.1 million bales; India and Pakistan, 3.3 million bales; the Soviet Union, 2.7 million bales; China, 1.7 million bales; Egypt, 1.7 million bales; Brazil, 1.6 million bales; and Mexico, 1.0 million bales. Some 40 other countries grew the remaining 3.1 million bales.

The world output of 31.2 million bales in 1949 weighed 7.5 million net tons. Spun and woven into fabric, that would be enough to make 19 million miles of 40-inch-wide sheeting, or enough to provide nine shirts or house dresses, or three sheets, for every person in the world.

COTTON is to textiles what iron is to metals. Although there are perhaps 700 plants that have been used by man for fibers, only a few have proved suitable, in qualities and cost, for large-scale economic development. Cotton is the giant among them. It alone accounted for more than half the 25.5-billion-pound world production of the principal textile fibers in 1949. There are

two reasons for cotton's hold on world fiber markets: Cotton has an excellent all-around combination of properties that makes it technologically suitable for a wide range of clothing, household, and industrial products. It can be grown in large quantities at relatively low costs. The end uses of other textile fibers are more or less specialized, but there are few end uses in the entire textile field where cotton is not a factor.

Other fibers, in order of quantities produced, are jute, rayon, wool, the hard fibers, flax, hemp, nylon, and silk. Jute, grown in Pakistan and India and used throughout the world mainly for bags and bagging, accounted for 12 percent of the world's production of fiber in 1949. Wool, used for clothing, upholstery, blankets, carpets, and similar articles, accounted for another 9 percent of the total. Rayon, used mostly in clothing but with some household and industrial uses, accounted for 11 percent. World production of rayon climbed rapidly from 457 million pounds in 1930 to a peak of 2,817 million pounds in 1941, with most of the increase in Germany, Japan, and Italy. It declined during the Second World War to a low of 1,398 million pounds in 1945, but since then has been reviving rapidly and was up to 2,690 million pounds in 1949. Hard fibers—abacá (Manila), sisal, and henequen—are used almost entirely for cordage and twine. Flax, once the most important vegetable fiber, is used mostly for household linens and clothing. Hemp is used mainly for cordage, twine, and bags. Silk, the most expensive fiber in common use, has given way somewhat to rayon and nylon. Nylon is growing rapidly in importance, first for women's hosiery, and now for many other things, but the total production was still relatively small in 1950.

Also, there is a limited production of other new man-made fibers, such as glass fiber; Saran, Vinyon, Orlon, and Dynel made of synthetic resins; and Vicara and Ardil, made of corn protein and peanut protein, respectively. Asbestos, the only important natural min-

eral fiber, is used for such products as brake linings, pump packings, and fire-resistant clothing. A matter of interest, more than economics, is the use of metal yarns, raffia, thin strips of bamboo, leather, and many other materials by hand weavers and fabric designers.

COTTON IS AS IMPORTANT as a farm crop as it is as a textile fiber. It is grown on 1.2 million of our 5.9 million farms. Except from 1945 to 1947, when wheat outranked it, cotton has been the most important cash crop of the entire United States. In 1949 it returned to farmers a total income of 2.6 billion dollars. For more than a century it has been the South's dominant agricultural commodity. This single crop was the source of more than half of the South's cash farm income in 1929, and 36 percent of it in 1949. Even in California, far west of the traditional Cotton Belt, cotton brought in more dollars than any other crop in 1947, 1948, and 1949—more even than oranges and grapes. That does not mean that cotton is as valuable a source of income as livestock, or as important a crop as corn, the bulk of which is fed to livestock. Cotton's contribution to farm income is particularly significant because cotton lint is not used for food or feed, and thus does not compete with other crops for those markets. Its market is not bounded by the human or animal stomach; it is our most important farm crop from an industrial standpoint.

In its raw state cotton cannot meet the needs of man. It must first pass through a series of processing and marketing steps.

The first step in its progress from plantation to mill is its transportation by wagon or truck to one of the 8,000-odd active cotton gins scattered through the Cotton Belt. Here the lint fibers are torn from the seed, compressed, and baled. Lint cotton and cottonseed follow different processing and utilization paths from the gin. For every pound of lint cotton produced, there is an output of 1.7 pounds of cottonseed, which moves into a wide

range of food, feed, and industrial products. Cottonseed by itself is the United States' eighth most important cash crop, with receipts totaling 256 million dollars in 1949, compared with 2,380 million dollars for cotton.

After cotton has been ginned, it enters a marketing system which grades, classifies, compresses, stores, insures, transports, finances, and delivers it in even-running uniform lots to the cotton mill. These tasks involve the efforts of large numbers of people, but they are performed so efficiently that the total price spread between farm and mill for cotton grown near Abilene, Tex., and delivered in South Carolina was 2.8 cents a pound in October 1950. Cotton may follow many marketing routes between farm and mill, but the dominant pattern is: Producer to local buyer; local buyer to cotton market; market to mill through mill buyer, or to foreign importer.

AT THE TEXTILE MILL, cotton begins its processing in an industry that calls for more big figures and big statements. The industry accomplishes the stupendous task of ordering into a usable arrangement the 90 million to 340 million fibers present in every pound of cotton, each one of which is different from all the others. The fibers vary in softness, color, luster, and other properties, depending on their variety, where they were grown, the care taken in picking and ginning, and other factors. They range in strength from 60,000 to 120,000 pounds to the square inch, compared with 50,000 to 80,000 pounds to the square inch for steel wire. If they were increased a thousand times in size they would appear as collapsed, flattened tubes ranging from  $\frac{1}{3}$  inch in diameter and 200 feet in length, to  $1\frac{1}{3}$  inches in diameter and 40 feet in length, with some 18 to 36 twists every 10 feet.

Three principal operations are involved in cotton manufacture: The fiber is processed into yarn and the yarn into fabric; the cotton goods are bleached, dyed, and finished; the fin-

ished goods are cut up and sewed into end-use products. This is the dominant pattern, but there are many variations.

Some cotton yarn is made into knit goods, and some cotton goods are not bleached, dyed, or finished. In England, yarn is usually manufactured in mills that do not weave. In the United States, most fabric is made in integrated mills. A trend has grown in the textile industry during the past few years toward integrating all manufacturing processes under single organizations, but most cotton goods still pass through two or more ownerships in their manufacture.

Raw cotton is converted into yarn and fabric by some 1,200 mills, which in October of 1948 employed some 525,000 workers. The industry has 90,542 carding machines, where the cotton (after it has been opened and formed into a roll or lap) is brushed out into a thin mistlike sheet, then shaped into a round rope called a sliver. If intended for particularly fine goods, the sliver goes to one of the industry's 7,067 combing machines, where the short fibers are combed out. Whether or not this sliver is combed, it next goes through a series of intermediate operations, which draw it finer and finer into thick roving, suitable for spinning. The industry has some 3,825,000 slubber, intermediate, speeder, and jack spindles for the operations.

In the spinning process, the cotton strand, or roving, is drawn out still farther, the necessary twist is inserted, and the product, now yarn, is wound on bobbins. A total of 20,758,000 spindles were active on cotton in October of 1950. After two or more preparatory processes, the yarn is woven into fabric on one of the 366,584 looms used for cotton goods in the United States.

COTTON MILLING was a pioneer industry of the United States. Like many others, it was first centered in New England, where it continued to expand until the First World War, reaching its maximum cotton consumption in 1917 and its maximum active spindleage in

1921. Since then, the equipment in New England has dwindled as obsolete machinery has been junked under pressure of competition from the South and as the amount needed to meet the Nation's textile requirements has declined because of increasing efficiency and longer hours of operation.

The South had a few cotton mills before the Civil War, but the real growth in manufacturing there began after 1880. By 1905, southern mills were using more cotton than the mills in New England, and after 1925 the South had more spindles in operation. The southern textile industry became concentrated in the foothill areas of North Carolina, South Carolina, Georgia, and Alabama. An estimated 63 percent of the country's cotton-spinning activity is within 200 miles of Clinton in South Carolina. Probably the key reason for the movement of the industry there was the availability of an abundant labor supply. The cotton-textile industry requires a high proportion of unskilled labor, which was available in the South from the farm population and because of the lack of opportunities in other industries.

By moving south, the cotton mills came closer to their raw-material supply, but for many years now the supply in their immediate areas has been inadequate and they have had to look farther west. Because they are on one of the main rail routes between the more westerly cotton-growing States and the population centers of the Eastern Seaboard, the southern mills have been at no disadvantage in this regard.

Mills in cotton-growing States used 91 percent of the total cotton consumed in the United States during the year that ended July 31, 1950, compared with 7 percent in New England and 2 percent elsewhere. New England's proportion of the country's cotton spindles declined from 52 percent in 1920 to 19 percent in October 1950, while the percentage in the cotton-growing States climbed from 43 to 79.

More than 92 percent of the total cotton consumption is by cotton mills.

The rest goes to manufacturers of knit goods, processors of rayon and silk, makers of woolen and worsted goods, and other industries.

Of the cotton going through cotton mills, the gross waste loss is 12 percent in making carded goods and 28 percent in making combed goods. Much of this waste, however, is thrown back into the hopper to make the same or different goods. All but 7 percent of the raw cotton, it is estimated, is eventually used in textiles. Most of the rest goes into battings, felts, toy stuffings, oil filters, and other nontextiles.

To classify, handle, and steer cotton waste to its best use, a substantial trade has grown up. Just as packing houses are said to use all but the pig's squeal, so cotton mills put practically all their waste to good use, throwing out very little on the dump heap. All cotton mills, of course, try to keep as much cotton as possible from falling into the classification of waste.

Returning to the main stream of cotton utilization, roughly 93 pounds of cotton yarn was produced in 1947 from every 100 pounds net of raw cotton consumed. Of this yarn, about 6 percent went into thread, twine, tire cord, and crochet yarns, 84 percent into woven fabrics, and about 8 percent into knit goods. About 2 percent was exported.

ONE POUND OF COTTON goes a long way in the cotton-manufacturing industry. It is enough to produce from 2 to 6 square yards of the goods used for shirts and house dresses and even 15 or more square yards of tobacco cloth or cheesecloth. The industry converts the huge quantities of cotton it uses into enormous quantities of fabrics, as well as the other products I have mentioned. The output of the 10 principal groups of cotton broadwoven goods, exclusive of tire fabrics, totaled 8,287 million yards in 1939, 11,108 million yards in 1942, 9,646 million yards in 1948, and 8,512 million yards in 1949. These groups are subdivided into about 140 types of cotton

fabrics and again into many hundreds of diversified constructions.

Cotton duck, the heaviest kind of cotton goods, is one of the 10 main groups of cotton textiles. It is used for awnings and tents, among other things, and is much needed in time of war. Narrow sheetings and similiar goods are medium to heavy fabrics used for bags, pocketings and shoe linings, tickings, diapers, coated fabrics, and bookbindings. Next come the print-cloth yarn goods, a group of mediumweight and lightweight fabrics, including print cloth, bandage cloth, tobacco cloth, cheescloth, and carded broadcloth. Colored yarn goods include fabrics like gingham, seersuckers, and denims, which are made of yarns that have been dyed before weaving. Wide cotton fabrics consist mostly of bed sheetings and other wide sheetings for industrial use.

Fine cotton goods differ from the others in that they are made at least partly of yarns that have been combed as well as carded. They include broadcloths for shirts, handkerchief fabrics, lawns and organdies for dresses, typewriter ribbons, and tracing cloth. Napped fabrics include flannels, mole-skins and suedes, blankets, and the headlinings for car interiors. Towels and towelings need no explanation. Specialties and other fabrics include bedspread, drapery, and tapestry fabrics, luggage fabrics, corduroys, and plushes.

Besides the many woven fabrics, cotton yarns also are made into a wide variety of knit goods. They reach the consumer largely in the form of underwear, polo shirts, gloves, sweat shirts, hosiery, mosquito netting, and meat coverings.

To make the wide range of cotton goods, the industry uses a wide variety of raw cottons. Unless you have studied cotton, all cotton may look alike to you. Actually, however, there are wide differences in degree of whiteness, amount and kind of trash, fiber fineness, staple length, basic fiber strength, cohesive ability, and other properties,

which greatly affect the suitability for different types of end products. Cotton mills are sensitive to these differences, so much so that in October 1950, they were paying 55.7 cents for cotton having a staple length of  $1\frac{1}{4}$  inches, as compared with 42.8 cents a pound for the same grade of cotton having a staple length of 1 inch.

Why do not cotton farmers grow more long-staple cotton? In recent years the average staple length of American cotton of the upland type has increased, but, because of some law of nature, the growing of long staples is usually accompanied by a lower acre yield, so that most American growers have found it more profitable to stick to medium-staple cottons.

Nearly 98 percent of the cotton used by mills in the United States is American cotton of the upland type, which is medium in staple length (mainly from  $1\frac{3}{16}$  to  $1\frac{1}{8}$  inches) and of medium fineness. For towelings, gingham, denims, bag fabrics, and other carded fabrics, mills use mostly cotton that is Middling to Low Middling in grade and  $\frac{7}{8}$  to  $1\frac{1}{2}$  inches in staple. For tire cord, Middling and Strict Low Middling cottons of 1- to  $1\frac{1}{16}$ -inch staple have been employed. Knitting yarns require cotton of medium to high grades, because they must be relatively free of imperfections. Long-staple cottons,  $1\frac{1}{16}$  inches and longer, are usually spun into combed yarn; the shorter, into carded yarns. Very long staple, high-grade upland cotton finds its way into thread and fine combed fabrics, such as broadcloth and shirtings, lawns and organdies, and airplane and balloon fabrics.

DESPITE THE HUGE PRODUCTION of cotton in the United States, there are some requirements for which mills have had to look outside the country. For instance, they used 100,000 bales of Egyptian cotton and 15,000 bales of Peruvian cotton during the year that ended July 31, 1950, because of the shortage of domestic cotton having staple lengths of  $1\frac{7}{16}$  to  $1\frac{9}{16}$  inches.

These cottons, like long-staple uplands grown in the United States, were used for sewing thread and fine combed fabrics. Before the First World War, 100,000 bales of sea-island, the finest of all cottons, with staple lengths of  $1\frac{1}{2}$  to 2 inches, was grown along the coast of Georgia, South Carolina, and Florida but, because of the boll weevil, very little of this cotton is now grown there. In Arizona, Texas, and New Mexico, production of the American Egyptian cotton having a staple length of  $1\frac{3}{8}$  to  $1\frac{9}{16}$  inches climbed to 92,561 bales in 1920 and again to 73,808 bales in 1942. Only 4,000 bales was grown in 1949, but production climbed to 59,300 bales in 1950, when this cotton, unlike the upland crop, was not under acreage controls.

American mills also use about 100,000 bales annually of short-hair cotton from India. This very coarse cotton, less than  $\frac{3}{4}$  inch in staple length, is used for blankets, mattresses, upholstery, filters, and the like. No cotton of this type is produced here.

Except for about 7 percent (which is woven from dyed yarns), cotton cloth is grayish as it comes off the loom and hard to the touch, with occasional fragments of leaf, seed, or other materials that have survived the manufacturing process. The 7 percent of colored-yarn goods and another 23 percent of gray goods are used as they come from the loom. The gray goods go into products like bags, laminated plastics, belting, and tobacco cloth, where appearance is secondary. The other 70 percent of cotton goods undergo one or more of the chemical processes of bleaching, dyeing, and finishing. About half of the goods are bleached and finished white; another one-fourth are plain-dyed and finished; and the rest are printed with various designs and finished.

Many cotton mills have their own finishing departments, but most cotton goods are finished by independent concerns on a contract or commission basis. The 600 finishing plants in the United States employed 92,000 workers at the beginning of 1949. Cotton was the

major fabric processed, but rayon and wool were produced also. This industry is mainly in New England, the Middle Atlantic States, and the Carolinas. The present trend is toward greater concentration in the South. The treatments applied to cotton fabrics by the finishing industry include: Singeing, to eliminate loose threads; bleaching, to make cotton white; mercerization, to add luster and make possible brighter dyeing; dyeing, to impart color; printing, to put designs on the fabric; pre-shrinking, to keep the fabric from shrinking when laundered; and the application of synthetic resins, to wrinkle-proof and to increase wear. By the application of these processes, cotton goods are further specialized and adapted to specific end uses.

**THE FINAL MANUFACTURING OPERATION** in making a usable textile product sometimes takes place in the textile mill. Such articles as knitted outerwear and underwear, hosiery, sheets, towels, bedspreads, and blankets are usually sent directly from the textile mills to wholesalers or retailers. Most end-use cotton products, however, are made by the cutting trades, which cut and sew the fabrics into shirts, dresses, and many other items. Rough estimates indicate that in a usual peacetime year, 40 to 50 percent of the cotton fabrics goes to cutters, 20 to 30 percent to shoe manufacturers, bookbinders, and makers of similar products, and 20 percent to household consumers as piece goods. The remaining 5 to 10 percent is exported, or sold to such buyers as hospitals and hotels.

Fabricated clothing and household products, as well as piece goods for household use, traditionally have moved to the ultimate consumer by the usual wholesaler-to-retailer-to-consumer route, but more and more frequently in the last 25 years they have been sold directly from the manufacturer to the retailer.

Of the dollar the consumer paid before the Second World War for apparel and household goods made of



cotton, it has been estimated that 7.5 cents went to the farmer, 0.7 cent to the ginner, 2.1 cents to the cotton merchant, railroad, and warehouseman, 17.2 cents to the cotton mill, 4.2 cents to the dyer and finisher, 30.9 cents to the manufacturer of the goods, 4.9 cents to the wholesaler, and 32.5 cents to the retailer.

For many industrial cotton goods sold in large unit quantities direct to the user, the farmer's percentage of the consumer's dollar is somewhat higher because of lower marketing costs. It is believed that the division of the consumer's dollar was about the same in 1950 as before the war, although cotton fabrics averaged more than three times higher in price.

Farmers often wonder why they receive so little of the final price and whether the charges made by the processors and marketers between him and the consumer are not excessive.

It should be pointed out that much must be done to raw cotton before it is suitable for meeting human needs, and that the various in-between manufacturing and merchandising steps are characterized by as intense a competition as will be found in any section of the American economy. There is room for gains in efficiency in these steps, of course, but the gains are likely to be small and occasional, rather than large and frequent.

About 42 percent of the cotton used in the United States goes into clothing uses, about 22 percent into household uses, and about 36 percent into industrial uses.

Shirts, the most important single end-use product in 1949, accounted for only 6.7 percent of the total consumption, but the 534,330 bales used for that purpose represented a return to farmers that year of about 83 million dollars and was more cotton than was grown in 1950 in all of South Carolina or Tennessee. Sheets, the second most important, accounted for 5.6 percent of the total consumption. Bags were third, with 5.1 percent of the total. Consumption of cotton in tires, for-

merly the most important single use of cotton, declined from 701,090 bales in 1948 to 383,570 bales in 1949 as a result of competition from rayon.

We each used 25.7 pounds of cotton a year in 1905 and 48.8 pounds a year in 1935 to 1939. Consumption per person jumped to an all-time peak of 40.2 pounds in 1942, because of our wartime need for uniforms and other fighting equipment, but declined thereafter to 24 pounds in 1949. In 1950, however, it jumped to 30 pounds as a result of a recovery in business activity and increased demand for textiles arising from the Korean crisis.

Despite competition from other fibers, cotton met about 60 percent of our textile requirements in each decade from 1890 to 1940. During the past 15 years or so, however, cotton has been losing important markets to rayon and paper, and faces greatly intensified competition from them in the future. It also faces competition from nylon and other man-made fibers, which have appeared in quantity since the end of the Second World War. The full effect of competition from these markets was not fully felt during the years immediately following the war because of the huge demand for textiles of all sorts. By 1948, however, cotton's share in the textile-fiber consumption had dropped to 57 percent, compared with 65 percent in 1940 to 1945, and 61 percent in 1930 to 1939.

**RAYON**—one of America's greatest success stories—undoubtedly is cotton's most potent competitor. Production started in 1911, and there have been very few years since that production did not show a large gain over the previous year. The greatest advance has been during the past few years, with consumption increasing from the equivalent in quantity of 1 million bales of cotton in 1939 to the equivalent of about 3 million bales in 1950. This expansion is the result largely of a steady improvement in quality, coupled with a downward trend in price.

At first rayon was a weak, sleazy fiber, but during the past 20 years, thanks to research, it has been greatly improved in appearance, drape, softness, wrinkle resistance, colorfastness, and washability. Poor strength was one of the difficult problems that the rayon industry had to conquer to make rayon a usable fiber. By 1937, rayon had enough strength for many clothing and household uses, but it was still barred from many industrial and other uses dominated by cotton, where strength is important.

Two developments are directly associated with three-fourths of the large production increase since 1939—rayon staple fiber and high-tenacity rayon.

Until about 1936, practically all rayon was in the form of continuous-filament yarn. Then rayon staple fiber, or rayon cut into short fibers, appeared, and ever since it has been increasing rapidly in importance. This development had a dual effect. It opened the door to the vast cotton-spinning industry as a potential user of rayon and, at the same time, gave this industry for the first time an alternate raw material. By using rayon staple it is possible to make fabrics entirely different from those that can be made from continuous rayon yarn—fabrics that frequently resemble very closely standard cotton and wool. In 1950, consumption of rayon staple in the United States—most of it in cotton mills—totaled the equivalent of more than 800,000 bales of cotton.

With the introduction of high-tenacity rayon—a type 80-percent stronger than the ordinary viscose type used in clothing—rayon cords and fabrics equal in dry strength to cotton cords and fabrics became possible. Production of high-tenacity rayon was expanded tremendously during the Second World War for use in tires; by 1949 it had reached the equivalent of about 650,000 bales of cotton and comprised 29 percent of the total rayon production. Before the war, practically all tire cord was made of cotton, but in 1949 rayon had captured nearly two-

thirds of the market. Because of a tremendous increase in tire production, cotton tire-cord production, nevertheless, was at record-breaking levels in 1946 to 1948. There was a sharp decline, however, in 1949.

From 1920 to 1940, the history of rayon was one of continued reduction in price. In 1940, however, it cost cotton mills only 11.1 cents for a pound of cotton ( Middling <sup>15</sup>/<sub>16</sub> ), as compared with 22.3 cents for a comparable quantity of rayon staple fiber. This difference in favor of cotton was wiped out during the war, and in November 1950 cotton cost the mills 45.3 cents a pound, as compared with 32.9 cents for a comparable quantity of rayon staple fiber. Thus the competitive potential of the rayon industry at the beginning of 1951 was much stronger than prewar, as a result of gains in the quality of its products and a price situation that had changed greatly in its favor.

Until about 1935, rayon, or synthetic fiber made of cellulose, was the only manufactured fiber in commercial production in the United States. Since then, several other synthetic fibers, including nylon, glass fiber, Saran, Vinyon, cascine fiber, and corn-protein fiber, have been introduced.

The combined consumption of those fibers rose from 4.5 million pounds in 1940 to around 90 million pounds in 1949, the latter equal to only about 200,000 bales of cotton, but already greatly in excess of the consumption of silk or flax in this country. Some of these fibers possess admirable qualities for textile use; others appear to be suited only for special purposes. All are priced considerably higher than either cotton or rayon, but prices can be expected to decline somewhat as technical progress is made.

Another important competitor of cotton is paper, which competes directly in such products as bags, towels, handkerchiefs and napkins, window shades, plastics, twine, and draperies. Consumption of cotton in bags, formerly its second most important use,

climbed from 548,000 bales in 1940 to an all-time peak of 820,000 bales in 1943, because of wartime demand and an acute shortage of burlap. But it declined to 383,000 bales in 1948, despite an increased total market for bags. In the meantime, the output of paper for shipping sacks increased from 195,000 tons in 1940 to 667,000 tons in 1948.

Over the years, paper bags have become better and better adapted to users' requirements as a result of an aggressive research program. In addition, paper bags benefited from a lower and lower price relative to that of cotton. Paper bags always have had a lower first cost than cotton bags, but they are nearly worthless after being used once, while cotton bags frequently make several trips or may eventually wind up as someone's house dress or dish towel. After allowing for their second-hand value, cotton bags had a slight advantage in cost over paper bags before the war, were at a decided disadvantage in 1947 and 1948, and regained a slight advantage in 1949. As a result of this, and an extensive campaign to emphasize how second-hand cotton bags can be used again for other purposes, use of cotton bags went up slightly in 1949 while use of paper bags declined.

IN THE LIGHT OF MORE intense competition from synthetic fibers and paper, it is obvious that a real fight must be made on behalf of cotton if its markets are to be maintained on the scale to which the American farmer has been accustomed. Yet there is no reason to view the future pessimistically.

Markets go to the product that offers the consumer the most for his money, quality and price considered. The improvements in quality made by the competitors have been accomplished through continued, large-scale research programs. The same weapon can be used on behalf of cotton, but it must be used on a scale commensurate with cotton's importance if it is to succeed. Total expenditures for research on cotton, from the farm to the end product,

were not more than 4 million dollars in 1948; for rayon (only about one-third to one-fourth as important quantitatively) they may have run as high as 10 million dollars. The cotton industry, however, in 1951 was taking strong action to keep from losing its market through lack of research.

A SECOND primary factor in cotton's outlook has to do with price. At present the cotton industry is well into its greatest revolution since the invention of the cotton gin. Mechanized cotton production, together with the greatly increased acre yields, means that cotton will be produced at a much lower cost in terms of human effort in the future than it has been in the past. In fact, it appears that cotton can be grown at a far lower cost than seems to be possible, at least yet, for the production of any man-made fiber. For most textile markets, price is a factor of great importance. It is extremely significant, then, that, from all appearances, cotton can undersell its synthetic competitors, if the industry wants to. At the same time, although cotton cannot compete with paper products in lower first cost, it can compete in many markets on the basis of net cost for service rendered.

STILL ANOTHER primary factor has to do with the clothing habits of the American people. The type of clothing we wear was designed for warmth, being brought over by our ancestors from western Europe, where summer temperatures are much milder than they are in most of the United States. At present there is a strong trend toward greater use of lighter, more open sports-type apparel, for which cotton is particularly well adapted.

THUS FAR WE HAVE dealt with the domestic market. Until about 1935 more American cotton was exported than was used in this country, but thereafter our average annual exports declined rapidly from 7.2 million bales a year in 1930 to 1934 to 5.3 million bales in 1935 to 1939 and 1.4 million

bales in 1940 to 1944. Traditionally, our exports of cotton went to such highly industrialized nations as Great Britain, Germany, and France, and more recently to Japan. During the decade that ended with the Second World War, Germany and Japan became the largest producers of rayon in the world, in an attempt to free themselves of the necessity of using American cotton, which required dollar exchange. At the same time, Great Britain and France made strong efforts to grow cotton in their colonies, so as not to use any more American exchange than necessary. This decade also saw Brazil emerge as an important cotton-growing nation.

WITH a rapidly growing world population, there is no question that a need exists for all the cotton that can be produced both in the United States and elsewhere. Per capita consumption of cotton in 1948 was 3.3 pounds in Asia, 2.4 pounds in Africa, 6.2 pounds in Latin America, and 7.5 pounds in Europe, compared to 28 pounds in the United States. The key to the future of American exportation of cotton is the matter of paying for it. The outlook here depends in part on world recovery, on the willingness of the United States to open its doors to foreign goods in return payment, and on how well cotton can compete with our industrial products for the foreign buyer's American exchange. The effect of postwar recovery in other countries and of Marshall Plan aid is seen in the increase of United States exports from 2.0 million bales during the 12 months beginning August 1947 to 5.8 million for the same period beginning August 1949.

One untoward factor in the outlook is the fact that countries like Brazil, Argentina, and India are becoming self-sufficient in providing their own cotton goods from their own cotton, when formerly they bought heavily from Great Britain and Japan, both large users of American cotton. At the same time exports for these countries

have declined and production of cotton outside the United States in 1950 was still less than prewar.

Another factor is the rapidly rising world production of rayon. The recent construction in England of the largest plant under one roof in all Europe to make nylon, which is based on coal and which thus will not require foreign exchange, is significant.

When the United States entered the Second World War, it had on hand carryover stocks equal to an entire year's production. This extra supply served us well, for cotton was called upon to supply around 83 percent of our military needs for textiles, as compared with 11 percent for wool, and 6 percent for rayon. Although one-third of the entire consumption of cotton went into military uses during the war, there was sufficient cotton to take good care of the civilian needs.

A combination of reduced acreage, poor crop yields, and increased domestic consumption bids fair to bring domestic carryover stocks in 1951 down to the equivalent of only 3 or 4 months' consumption, despite the fact that exports for the 1950-51 cotton season have been placed under control. The heavy demand for cotton in the face of reduced supplies has been reflected by the highest prices for cotton since the Civil War. The 1951 situation emphasized again the great importance of cotton for meeting both civilian and military requirements.

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