the story of cotton

Consumer and Marketing Service U.S. Department of Agriculture

brief history of cotton

by W. H. Fortenberry

Cotton has been grown for its fiber for many centuries. The oldest record of cotton textiles, dating back about 5,000 years, was found in the Indus River Valley, now part of Pakistan. Excavations in Peru have uncovered cotton cloth identified as being at least 4,500 years old. Cotton fabrics have also been located in pre-historic ruins of the Egyptian civilizations.

The army of Alexander the Great found cotton widely used in India in the third century B.C. Alexander introduced it into the countries located on the eastern and southern borders of the Mediterranean Sea, and from there it spread to Europe. When Columbus reached the West Indies, he found the natives wearing cotton clothing. Cortez, a short time later, found cotton production and manufacture well developed in Mexico. Pizarro found the same in Peru when he reached that country.

Cotton did not become a major factor in American life until nearly 300 years after the Spanish conquests. Efforts were made to grow cotton in Virginia and the Carolinas by the colonists shortly after they landed, but production expanded slowly because the varieties grown in Central and South America were not suited to the soil and climate of North America. The method used at that time for separating the fiber from the seed by hand labor was far too slow and expensive for large-scale production. The British also discouraged the manufacture of cotton in the colonies since it would compete with their home textile industry.

Two important events after the American Revolution made it possible for large-scale production of cotton in the United States. One was the building, by Samuel Slater in 1790, of the first successful textile mill in the United States. The other was the invention of the cotton gin by Eli Whitney in 1793. Slater's mill provided the basic principle for large-scale processing of cotton into fabrics and Whitney's gin eliminated the slow and costly method of separating the fiber from the seed by hand.

The production of cotton, originally confined to the southeastern States—Virginia, the Carolinas, Georgia, and Florida—expanded steadily during the 19th century, moving westward into Mississippi, Arkansas, Louisiana, Oklahoma, and Texas. During this century, it has also become an important crop in southeastern Missouri and in New Mexico, Arizona, and California.

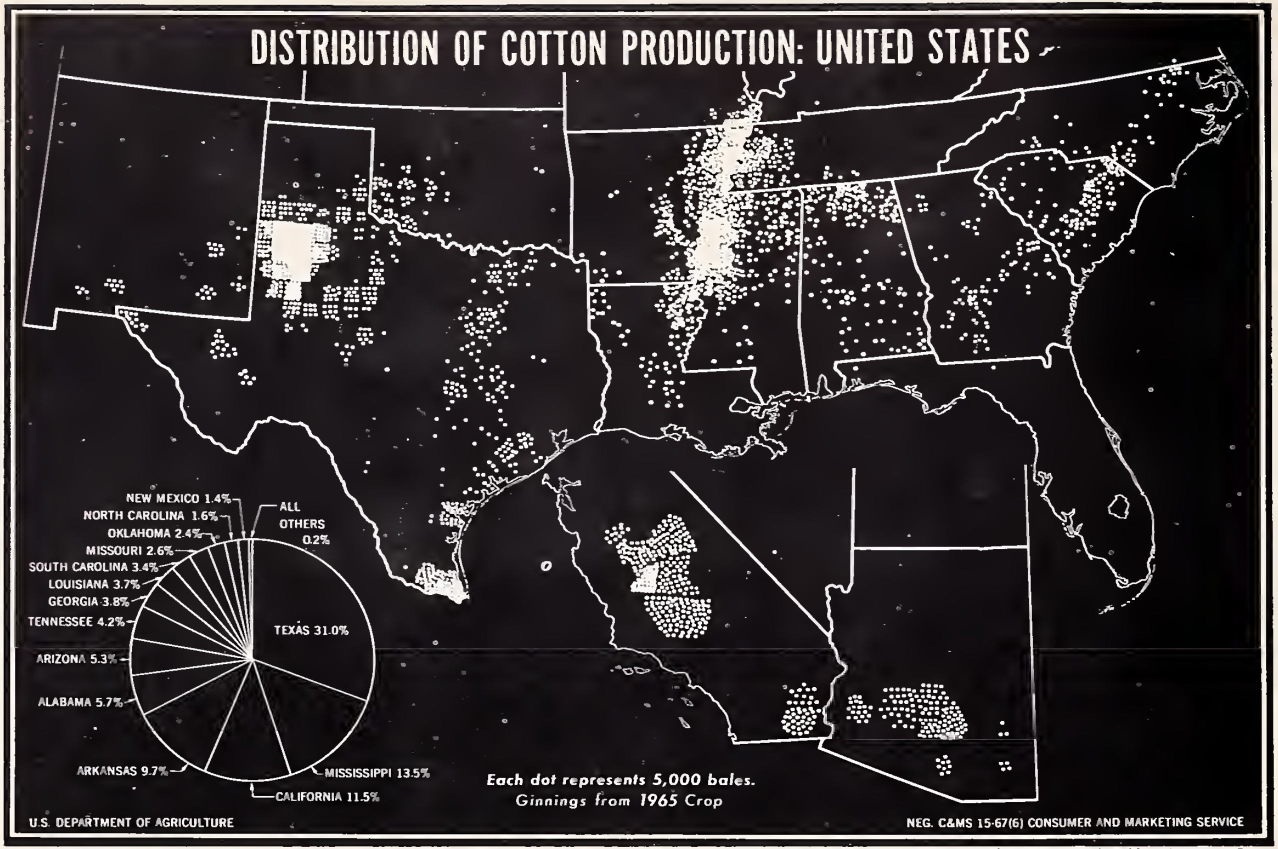


Figure 1 Distribution of Cotton Production in the United States, Crop of 1965.

cotton production

Cotton is one of the most important crops produced by American agriculture. Grown on about 500,000 farms in 19 Southern States stretching from the Atlantic to the Pacific Oceans, the average size of the crop is about 14 million bales of cotton and about 6 million tons of cottonseed. The value of this crop exceeds $2.5 billion annually and several million persons are engaged in the production, marketing, and processing of the crop.

Large quantities of cotton are grown in other countries, too—chiefly the Union of Soviet Socialist Republics, China (mainland), Mexico, United Arab Republic, Brazil, India, Pakistan, Turkey, Sudan, Peru, and Syria. Cotton from these countries differs in quality to some extent from that grown in the United States. Most of the world's supply of extra long staple cotton, 1⅜ inch or over in staple length, is produced in the U.A.R., Sudan, Peru, U.S.S.R., and the United States. Most of the very coarse, short-fibered Asiatic cotton is grown in Pakistan and India.

Botanically, two principal groups of cottons are of commercial importance in the United States. Those types of cotton native to Mexico and Central America *(Gossypium hirsutum)* are known as upland cottons and generally vary in staple length from about ⅞ to 1¼ inches. Most of the cotton grown in the United States is included in this group. The second group—of early South American origin *(G. barbadense)*—is generally of longer staple and includes Egyptian, American Egyptian and Sea Island cottons and some of the Peruvian and Brazilian varieties. Only a small amount of American Egyptian cotton is produced in the United States.

Cotton grown in the United States varies considerably as to variety and

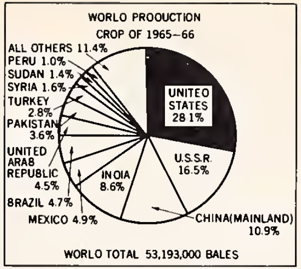


Figure 2 World Cotton Production, Crop of 1965.

Figure 3 Planting cotton with a four-row shaper planter.

quality. A large proportion of the U. S. crop falls into the medium staple-length group, ranging from 1 inch to $1\frac{3}{32}$ inch in length. The short staple varieties shorter than 1 inch are grown mostly in the high plains of Texas and Oklahoma. The long staple and extra long staple varieties ranging from $1\frac{1}{8}$ inches to $1\frac{1}{2}$ inches are grown mostly in the southwestern and western parts of the Cotton Belt.

Usually about two-thirds of the crop grown in the U.S. is processed into yarns and fabrics by cotton mills in this country. The remainder is exported chiefly to Japan, India, Canada, England, and continental Europe.

The planting of cotton begins in February in the southern parts of the Cotton Belt, and moves northward. At the northern edge of the belt, and at higher elevations, planting usually is completed by the early part of June. As the pictures suggest, cultivating, harvesting, and handling cotton in the United States is mostly mechanized. Rapid strides have been made in mechanization since 1950 and most cotton grown in the high production areas is produced and harvested with very little hand labor. A great deal of progress has also been made in cotton production through improved varieties, better fertilizers, and insecticides, and greatly improved methods of land preparation, weed control, culture practices, and water use.

The use of such equipment, materials, and methods has resulted in greatly increased yields of cotton per acre, in lower unit cost of production, and in a reduction in cost of cotton. The national average yield per acre rose from 156 pounds in 1909 to 527 in 1965, and the average staple length increased from slightly over $\frac{7}{8}$ inch in 1928 to $1\frac{1}{32}$ inch

Figure 4 Cultivating a field of cotton with a four-row cultivator.

Figure 5 Spraying a field of cotton for insect control using a tractor outfit.

Figure 6 This airplane is spraying a cotton field to control the boll weevil.

in 1965. Fiber and yarn strength, two other important factors of cotton quality, have also improved significantly during the last 20 years.

In recent years mechanical harvesting has been used extensively in most areas of the Cotton Belt. In 1965 slightly over 85 percent of the total U.S. crop was picked or harvested by machines, compared with 23 percent in 1955. Prior to the development of the mechanical picker, hand pickers of all ages were in great demand for picking from August through December.

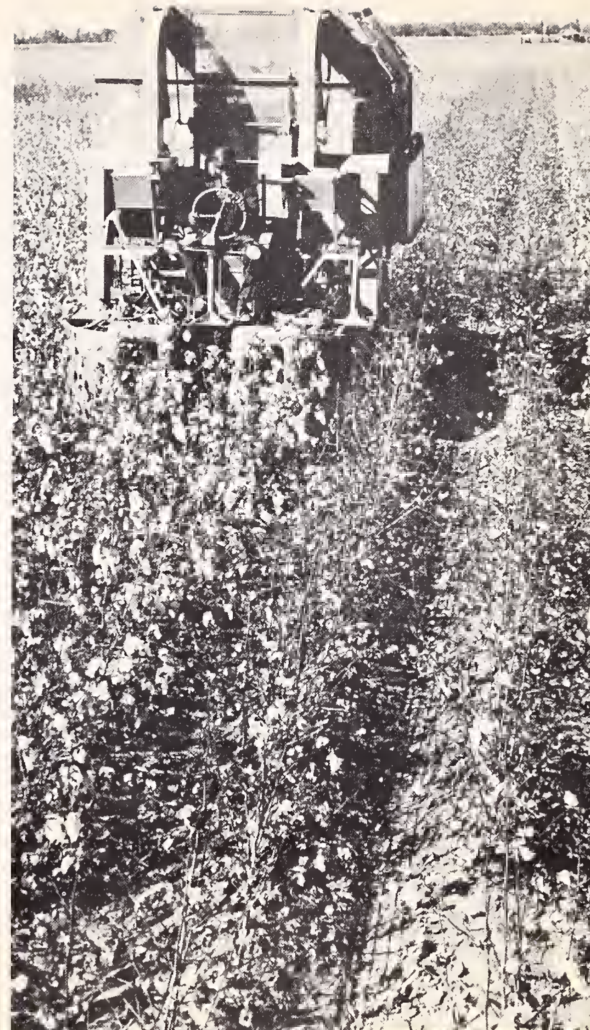


Figure 7 Picking cotton with a 2-row mechanical spindle picker.

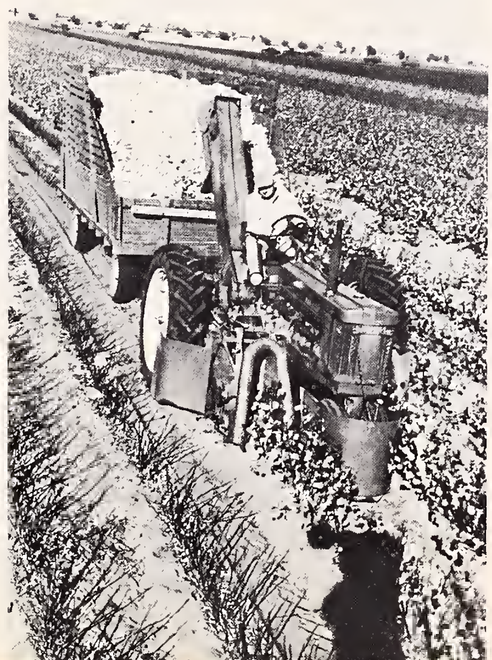


Figure 8 Harvesting cotton with a 2-row mechanical stripper.

cotton marketing

After cotton is harvested, it is transported by truck or trailer to the gins where the seed cotton is conditioned and cleaned and the fibers are separated from the seed. The fibers after being separated from the seed are called lint. In a single pound of cotton there may be 100 million or more individual fibers. The lint cotton is pressed and packaged into bales at the gin for convenience in handling and the seed is loaded into trucks or freight cars for shipment to oil mills. In 1965, almost 5,000 cotton gins in this country were operated through a season ranging from 3 to 6 months. Many of these gins located in the high production areas operate on a 24-hour, 7-day-week basis. Modern cotton gins are equipped with improved machinery for drying and cleaning the seed cotton and for cleaning the lint after it is ginned and before it is packaged into bales.

After the ginning process, the lint cotton and cottonseed enter separate trade channels. The lint starts on its way through marketing channels to a cotton mill, where it is processed into yarns and fabrics, or to a port for export. Most of the seed starts on its way to the cottonseed oil mills to be converted into such products as cottonseed oil, meal, cake, hulls, and linters. A small percent of the seed produced each year is saved, either by individual farmers or by commercial seed dealers, for planting purposes.

When the lint comes from the gin it is packaged into bales that weigh about 500 pounds each. These bales are weighed and identified by a gin tag at the gin. Bales of lint cotton are then "sampled" either at the gin immediately after ginning or at a warehouse as the bales are placed in storage. Sampling is usually done by cutting the bale covering with a sharp knife on each side of the bale and removing at least 3 ounces of

Figure 11 Testing cotton for fiber length and strength.

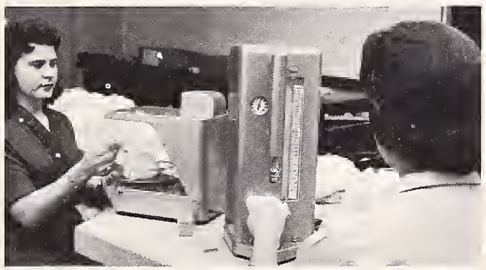


Figure 12 "Miking" cotton in classing office for fiber fineness.

Figure 10 Sampling a bale of cotton.

Figure 9 Trailers loaded with seed cotton at the gin.

cotton from each side, but some sampling is done by automatic samplers installed at the gins. These samplers take portions of lint cotton at specific time intervals during the ginning process and the bale covering does not have to be cut.

Samples from baled lint are then sent to a Cotton Classing Office of the U. S. Department of Agriculture for classification. This service is provided by USDA's Consumer and Marketing Service. Cotton classification, or classing, is a means of describing the quality of cotton in terms of grade and staple length. For grade, classification is based on appearance, and is done chiefly through the sense of sight by combining the three factors of grade—color, leaf, and preparation. For staple, classification is based on sight and feel, and is the normal length of a typical portion of fibers.

All cotton classed for producers for grade and staple length is now also "miked"—measured for cotton fiber fineness by means of an airflow instrument. The measurement obtained by the instrument is referred to as a "mike" or micronaire reading—measurement of fiber fineness and maturity which, together with grade and staple length, helps producers in marketing their cotton.

As a marketing aid, C&MS provides classing and market news services without cost to groups of cotton producers under the Smith-Doxey Program. More than 95 percent of recent cotton crops has been classed under this program and a large portion marketed on this classification. This has resulted in considerable savings in marketing costs, encouraged quality improvement, facilitated efficient marketing practices, and placed the producer in a sound bargaining position to sell his cotton on the basis of quality.

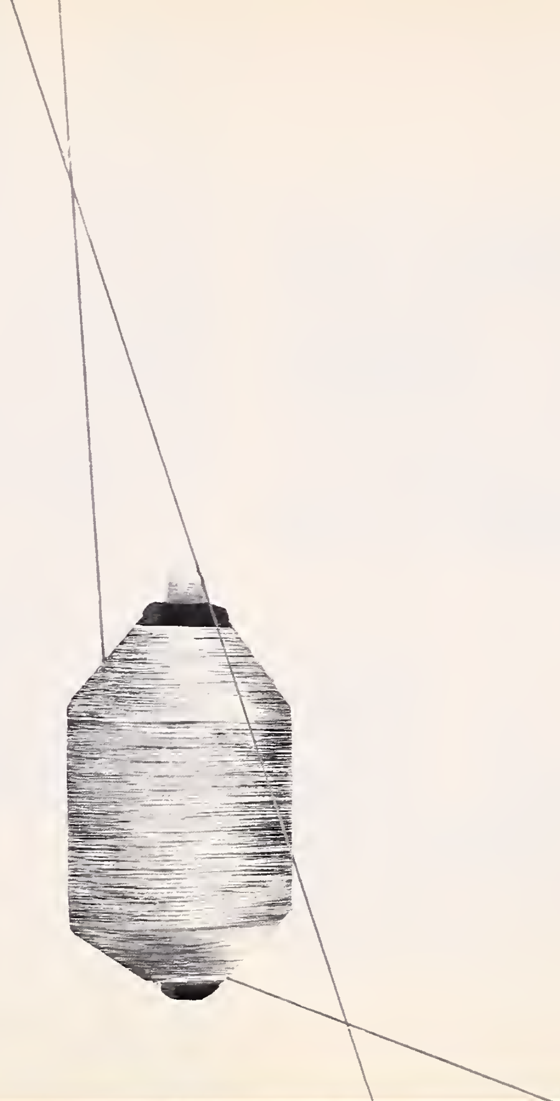
When the farmer receives his classification cards from the C&MS Cotton Classing Office, showing the grade, staple, and mike reading of each bale, he makes the decision to either sell to a local cotton buyer or some other handler of cotton, which in some cases is the local ginner, or to place his cotton under the Federal loan program. The classification cards, together with market news provided by C&MS through radio, TV, and newspapers, provide the farmer with the information needed to make his marketing decision.

Research workers in the U. S. Department of Agriculture, State institutions, and private industry are devoting much effort toward the improvement of our present methods of evaluating cotton quality and the development of more rapid and precise instrument methods for evaluation of cotton for specific end uses. More rapid instruments for measuring fiber length, length uniformity, and fiber strength have been developed recently and are being evaluated at this time, but further research and development are needed before they will be ready for large-scale production use. There is a good possibility that within the next 10 years the U.S. cotton crop will be evaluated for quality mostly by instrument measurements.

Figure 13 Classing cotton.

Figure 14 Storing bales of cotton in warehouse using a clamp truck.

Figure 15 Loading cotton bales for export.



cotton manufacturing

In colonial times, the self-sufficient Southern farm generally produced only enough cotton for family use. Each farm produced a little cotton and each member of the farm family "ginned" by hand enough cotton to fill his own shoe each night before retiring. The women in the family operated crude spinning wheels to spin the raw cotton into yarns. The coarse yarns were made into home-made fabrics which were sewn into garments.

There is no accurate record of the first American plant for spinning and weaving of cotton, but one of the first plants to stay in operation for any length of time was a Philadelphia "Manufactory," established in 1775 and destroyed by the British in 1777. The mill considered to represent the birth of the industry in the U. S. is the Slater Mill—now a museum—built in Pawtucket, R. I., in 1793.

The transition from hand spindles and looms to power machinery was one of the principal factors in the industrial

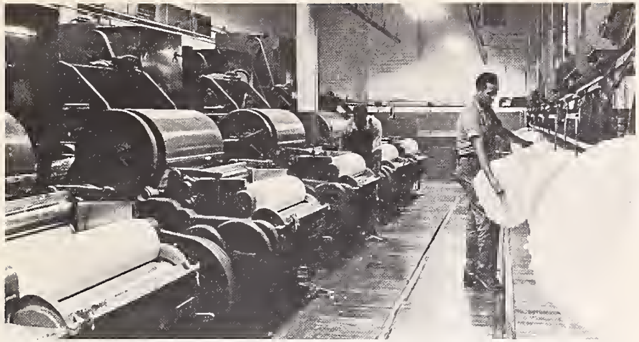


Figure 16 Picking—After bales of cotton have been opened and layers from each fed by turn into the opening machines which mixes, blends and cleans the fiber, the cotton is conveyed to the picker, which further opens and cleans the cotton and forms it into an even, flat sheet which is rolled into a lap about 18 inches in diameter and 45 inches wide.

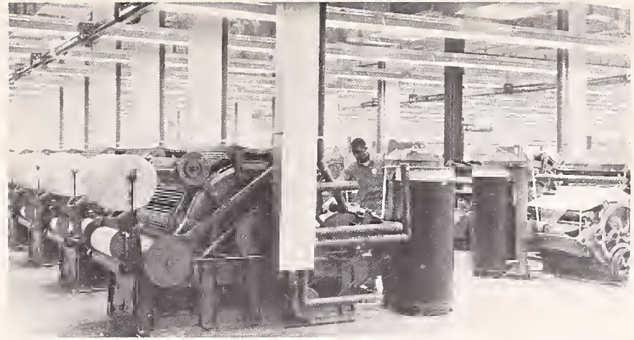


Figure 17 Carding—After the picking process comes carding, which completes the cleaning action, removes short fibers, provides the first step toward bringing the fibers in a parallel order and produces a thin filmy sheet or web which is condensed into a rope-like, but untwisted strand about the size of a broomstick, known as a sliver.

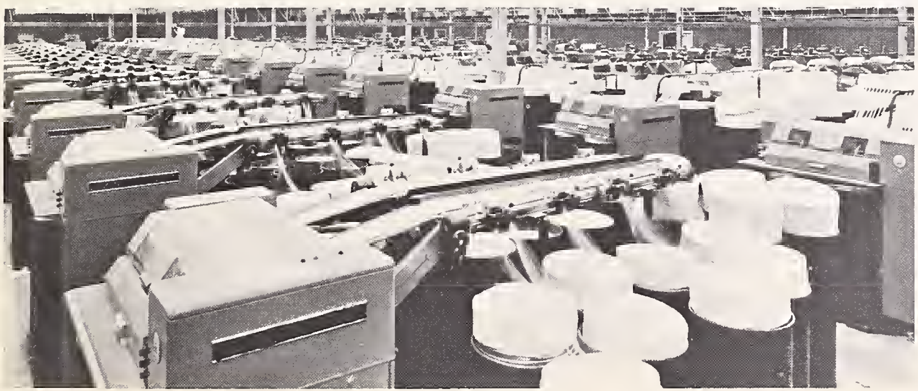


Figure 18 Drawing — The drawing process follows carding except for combed yarns. This process improves the uniformity of the sliver by converging six or eight slivers and passing them through four sets of rolls, each revolving at a different speed, which draws them out without twisting and reduces them to about the same diameter as one of the original strands.

revolution. Some of the basic inventions that have revolutionized the manufacture of raw cotton into yarns and fabrics are: Hargreaves' spinning jenny (1764), Arkwright's spinning frame (1769), Crompton's spinning mule (1779), Cartwright's power loom (1789), the harnessing of Watt's engine to spinning and weaving machinery (1785), invention of the cotton gin (1793), ring spinning (1831), automatic loom (1894), and long draft spinning (1913).

Since 1950, great improvement has been made in all types of cotton manufacturing equipment. The modernization of equipment and applied technology in the last 15 years—through increased speed of machinery, larger packages, and better management—has resulted in a tremendous increase in production per machine and man hour for all phases of processing.

Cotton manufacturing today constitutes a major portion of the U. S. textile industry, which employs nearly a million employees in about 7,500 plants located in 42 States. About 19 million ac-

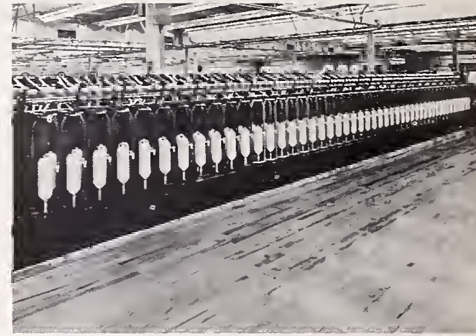
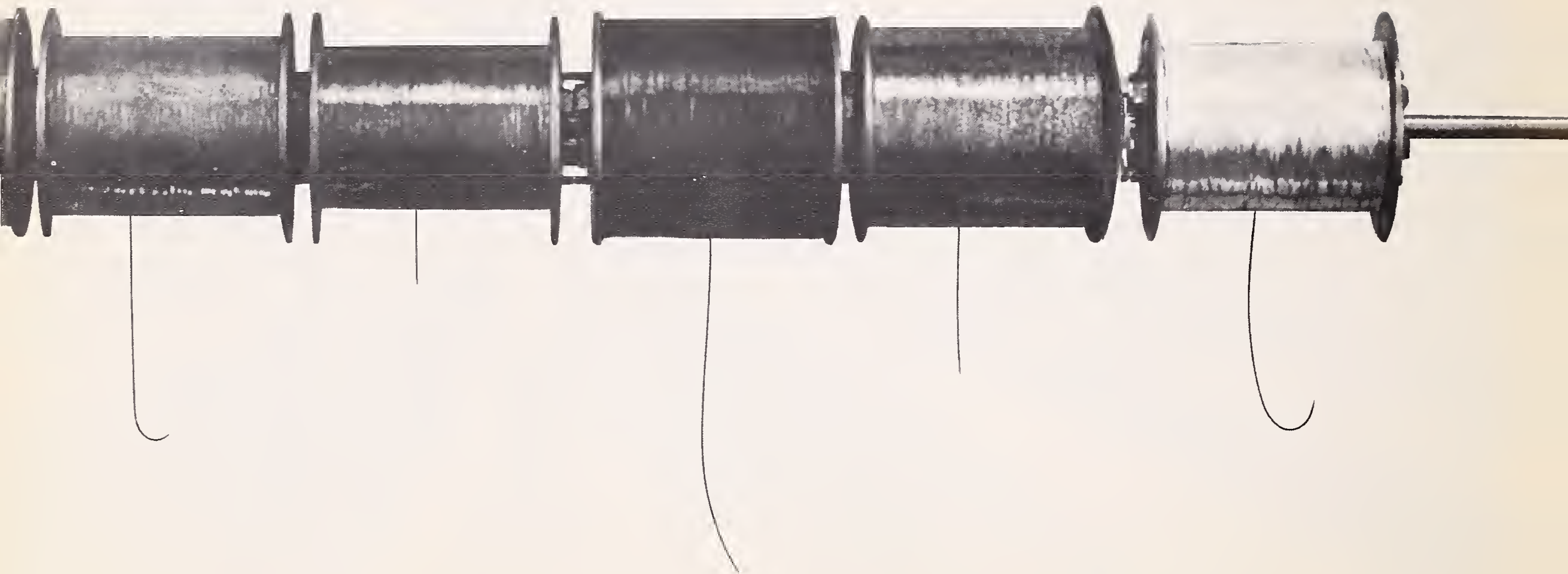


Figure 19 Roving—The roving process which follows drawing is designed to reduce the cotton strand to a progressively smaller diameter, give it a slight twist, and wind it onto bobbins.

Figure 20 Spinning—The spinning process completes the drawing out of the cotton roving, gives it the proper amount of twist, and transforms the roving into yarn of the required size.



tive cotton spindles are in operation in these plants. More than two-thirds of the spindles are in the southeastern states of North Carolina, South Carolina, Georgia, and Alabama. New England, which once had the majority of spindles, now has only about four percent of the total. The principal products of this industry are woven cloth, cotton yarns and thread, and waste sold to other industries for batting, wadding, mattress felts, and other uses.

Cotton fabrics vary considerably in weight and construction. The lightest is tobacco cloth and the heaviest is duck, made from very coarse yarn.

Over the years many types of fabric construction have become standardized, and have been given a name based on the type of weave, number of ends and picks per inch, or the size of the yarn. Some of the standard cotton fabrics are airplane cloth, broadcloth, cambric, drill, cheesecloth, duck, flannel, jeans, moleskin, osnaburg, poplin, print cloth, sheeting, sateen, tobacco cloth, and twill.

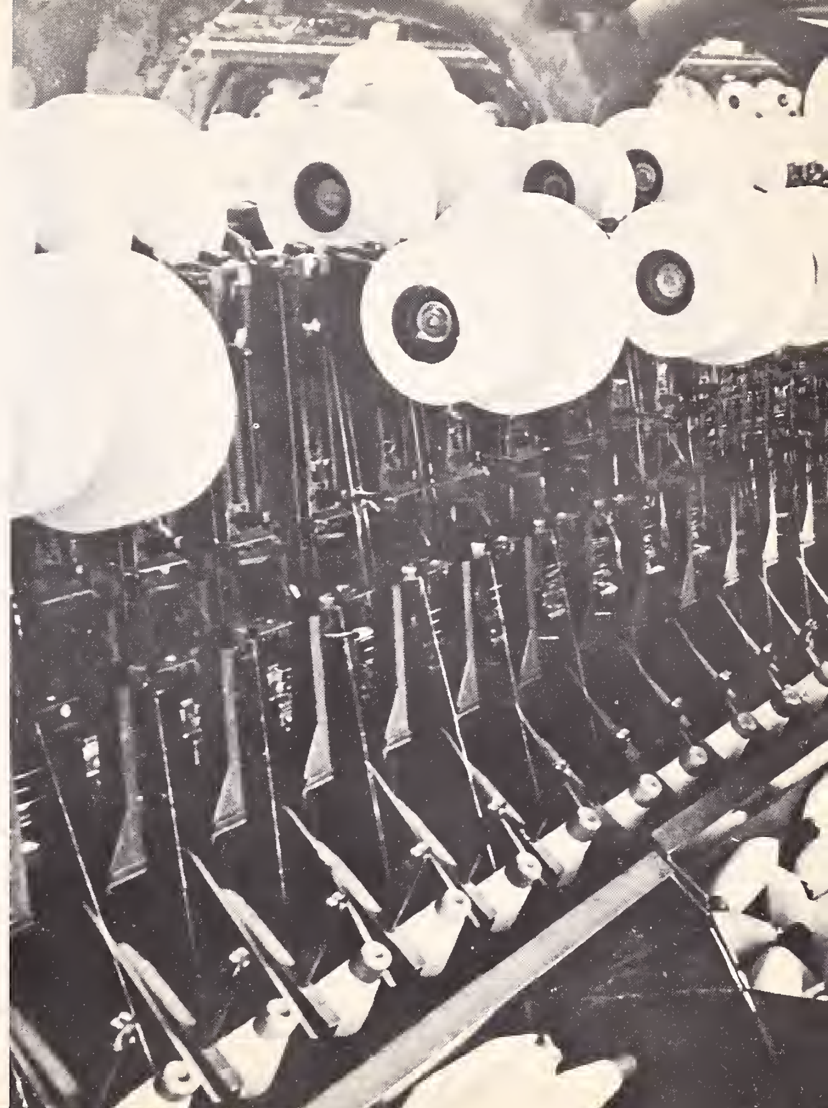


Figure 21 Spooling—In spooling, the warp yarn is rewound from the bobbins to large spools, a preparatory step before warping and slashing.

Woven cloth goes through a finishing process before it is sold to apparel manufacturers. The complete finishing process consists of preparing the cloth, applying color, and finishing into a condition for consumer use.

Knit fabrics also comprise an important part of the world's total textile requirements. Knitting is essential for many fabrics required for man's comfort and convenience—such as underwear, hosiery, and some outerwear.

Cotton accounts for slightly more than half of the poundage of all fibers used by manufacturing plants. Mills use about 9.5 million bales of cotton annually, roughly 60 percent of all cotton grown in this country. Uses for cotton

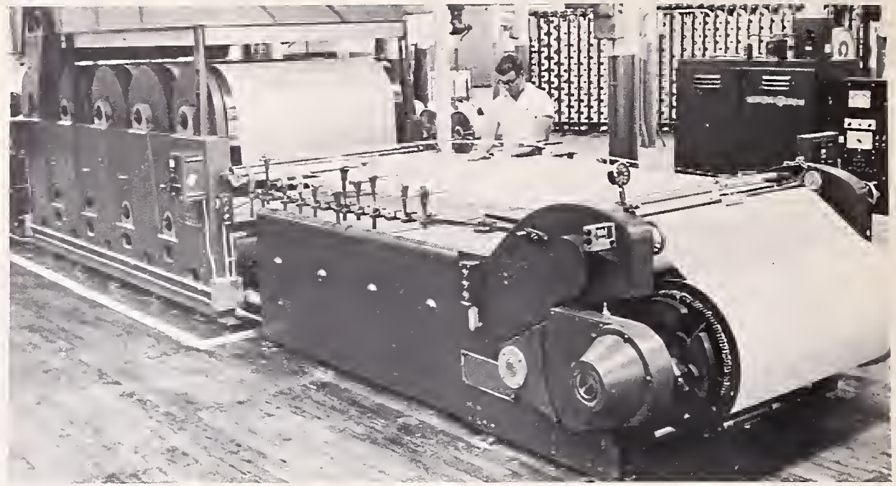


Figure 22 Slashing—After the warping process, which consists of rewinding the yarn onto large warp beams containing several hundred strands, thousands of yards in length, the thread is coated with a thin layer of starch or sizing by a process known as slashing to prevent breaking and chafing of the yarn in the loom.

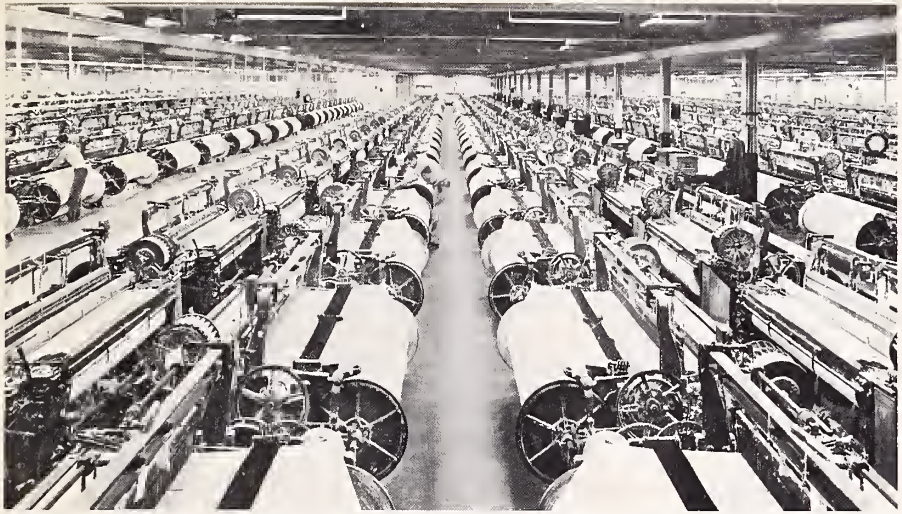
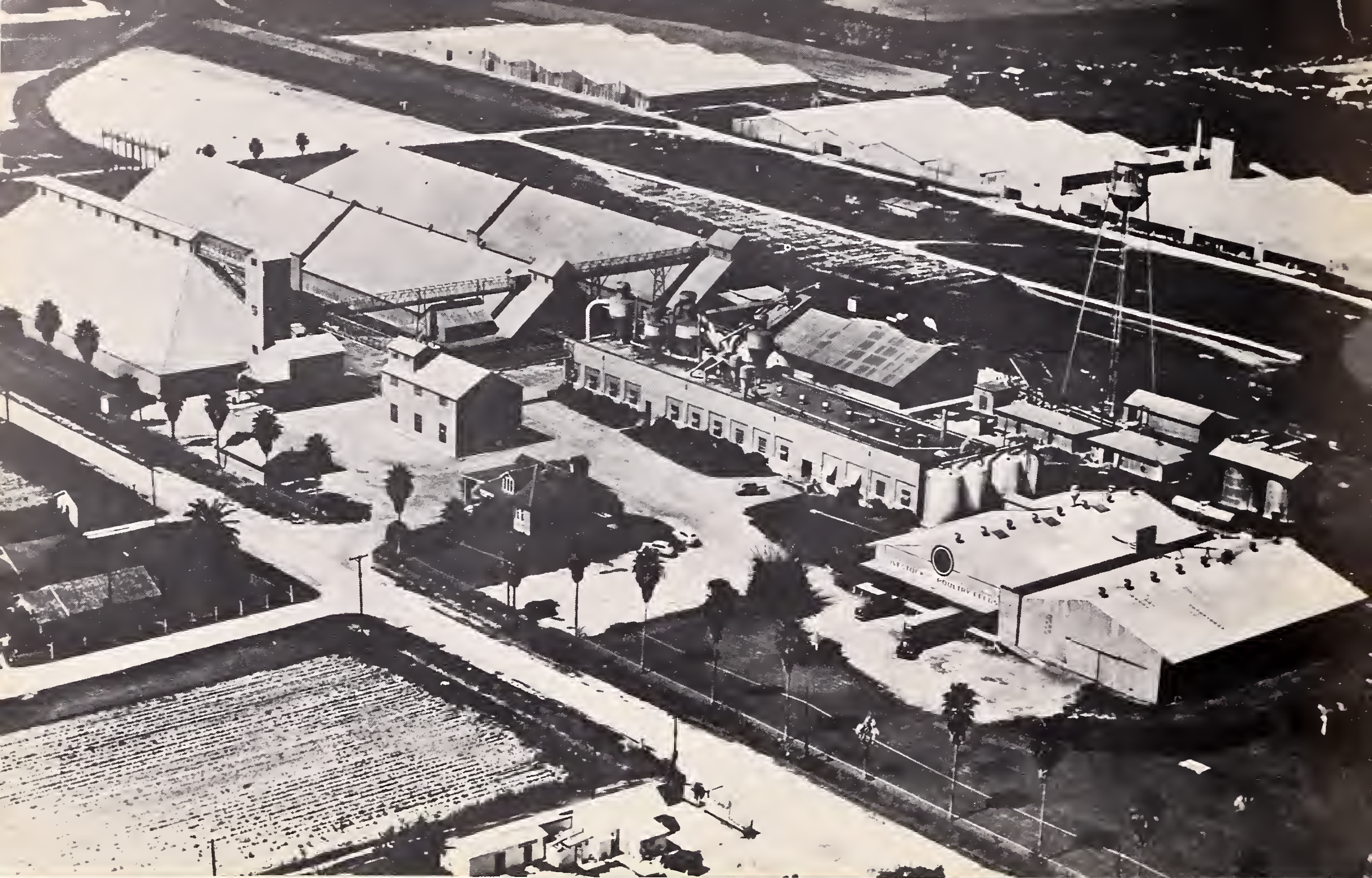


Figure 23 Weaving—The loom is used for weaving yarn into fabrics by interlacing two systems of threads at essentially right angles to each other. The lengthwise threads are called warp yarn and the crosswise ones are the filler or "welt" yarn.

yarn and cloth are many, but most of the principal uses are familiar to us. Half of all cotton consumed by mills in this country goes into fabrics for apparel, a majority of this for men's and boys' wear. Bedspreads, sheets, draperies, slip-cover fabrics, towels, and rugs are some of the household uses of cotton, while automobile seat covers and linings, bags, cordage, twine, industrial thread, awnings, and machinery belting are some of the industrial uses. Items such as parachutes, tents, inflatable hospital buildings, and many other items for military use are made from cotton.

Some of the machinery used in making cloth is shown in the accompanying pictures.



cottonseed

Cottonseed is an important crop in itself—averaging about 6 million tons annually—of which only about 500,000 tons are used each year for planting. Of the rest, most is sold to nearly 150 cottonseed-processing mills, generally called oil mills, for the preparation of cottonseed oil, cottonseed cake, meal, pellets, hulls, and cotton linters.

When marketing cottonseed, the farmer usually sells the seed immediately to the ginner. He may, however, take it home for planting or sell it direct to a local oil mill. The ginner accumulates seed until he has a large lot, which he then sells to an oil mill. At the mills, cottonseed is accumulated in large storage houses from which it is conveyed mechanically, as needed, through the cleaning, delinting, hulling, separating, rolling, cooking, and extracting apparatus.

Figure 24 Cottonseed oil mill.

Cottonseed, as it leaves the gins, still has some fibers attached—enough to interfere seriously with the milling processes—so these fibers are removed from the seed immediately after the seed is cleaned. These short fibers are called cotton linters. Most mills run the seed through delinting machinery twice and produce "first-cut" and "second-cut" linters. The first-cut linters, which are the longer, more resilient fibers removed in the delinting process, usually enter felting uses while the second-cut linters are used principally for chemical production.

First-cut linters are used in the manufacture of absorbent cotton, wicks, twine, gauze, carpet yarns, and batting for use in mattresses and other bedding products and in upholstery for furniture and automobiles. In recent years an increasing volume of first-cut linters is also being used in the manufacture of fine paper.

Second-cut linters, as raw material for the chemical industries, must first be "purified." The resulting linters pulp is practically pure cellulose suitable for use in a wide variety of products. A large volume of linters pulp enters the production of explosives, photographic and x-ray films, and plastics for automotive instrument panels and steering wheels, lighting fixtures, radio cases, flexible pipe, and many other molded products.

Another substantial market for linters pulp is in fibers—viscose fiber used in tire cord and acetate fiber used in clothing, draperies, and other household articles.

After linters are removed from the cottonseed, the seed is run through hulling machinery to separate the kernel or meat from the hulls. The meats are further processed to separate into oil and meal or cake.

Of the four primary products of cottonseed oil mills, oil is the most valuable and is used almost entirely for food —in the manufacture of salad or cooking oils, margarine, mayonnaise, salad dressing, and shortening. A small but increasing quantity of cottonseed oil has, in recent years, been used in a frozen dessert product similar to ice cream in appearance, taste, and nutritive value. While most cottonseed oil is used for food, small quantities enter the production of inedible products, such as off-grade oil or soapstock, a by-product of the refining process.

Cottonseed meal, which may be marketed in the form of cake, meal, cubes, or pellets, is the second most valuable product of cottonseed. It is used chiefly as a feed for livestock, but a small amount is used directly as a fertilizer.

Cottonseed also provides food for man. Some cottonseed cake, made entirely from sound cottonseed, is ground, bolted, and sold as a flour. Most of the cottonseed flour, rich in protein and vitamin B and practically free of starch, is used as an ingredient of bread, cakes, cookies and candies. It is also being used to improve the diets of undernourished people in several countries.

Cottonseed hulls are used primarily as feed for livestock. They are a roughage, however, rather than a protein concentrate. In recent years several industrial uses for cottonseed hulls have been developed. A plastic employing hulls as the principal ingredient has been used in producing several items of equipment for the textile industry. Hulls are often incorporated in mud used in the drilling of oil wells and also in the production of furfural—a selective solvent used in the production of synthetic rubber, in petroleum refining, and in the production of certain types of plastics.

Thus, all contents of the cotton boll are put to use—the lint, the seed, and even the seed hull.

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