

Cotton Manufactures: textile fabrics composed of cotton and the processes by which they are produced. The fiber of the cotton-plant is well adapted for the production of yarn or thread, and thus for employment in the fabrication of woven cloth. Each fiber if left to itself acquires a twist which adds to its tensile strength; and it is by twisting many fibers of cotton around one another that the strength necessary to its usefulness as the material of a textile fabric is imparted to it. The spinning of cotton yarn and the manufacture of coarse cotton cloth have been practiced in many parts of the world from a period of remote antiquity. The arts were established in Egypt, India, and China centuries before the Christian era. They are found to be practiced by some tribes of Central Africa who have only lately been brought in contact with modern civilization. They were known to the nations of Mexico, Yucatan, and Peru long before the Spanish conquests in the sixteenth century. But the application of machinery to the preparation, the spinning, and the weaving of cotton dates back little more than a hundred years. In the homes of its origin the manufacture has remained to a certain extent what it has always been—a handicraft in which human labor availed itself of none but the rudest implements. The enterprise of modern commerce carries the cheap product of modern machinery to ever more remote corners of the earth, and will soon render extinct the hand-spun and clumsily woven cloth of the native. The development of the cotton manufacture began with the last process in the making of cloth, and the cycle of fundamental improvements was completed by the invention of a device for removing the seed from the raw material as it comes from the field. The fly-shuttle was invented about 1750. By means of this improvement the efficiency of the hand-loom was much increased. About ten years later James Hargreaves, an illiterate Lancashire weaver, made an invention for the carding of cotton, which was quickly improved by another unknown inventor, and thus the principle of the carding-machine of to-day was introduced. In 1767 Hargreaves invented the spinning jenny, by which he was enabled to produce eight threads at once. In this machine we find partially developed the principles

which are fully exemplified in the mule. Richard Arkwright patented in 1769 a spinning frame, or “throstle,” called at first a “water-frame,” the chief and most useful novelty in which was a device for spinning with rollers. The “roving,” or slightly twisted material, passing between two pairs of rollers, the forward pair revolving at a much higher speed than those behind, draw out the roving, and make it finer and more regular before it receives the final twist which converts it into yarn. Arkwright adopted in this machine the principle now known as the flyer, by which the yarn is twisted and wound upon the bobbin at the same time. Samuel Crompton in 1779 combined the ideas of Hargreaves and Arkwright in the mule jenny. In 1785 Dr. Edward Cartwright, a clergyman, invented the power-loom. Two things remained to render possible the gigantic expansion of the cotton industry which this century has witnessed—a quick and inexpensive method of separating the fiber from the seed, which up to that time had been a slow and laborious process, and a new mechanical force to drive machinery at a high speed. The cotton-gin of Eli Whitney supplied the first, and the steam-engine the second, taking them in the order here mentioned; but the first steam-engine set up in a cotton-mill, in 1785, antedated by seven years the great invention which made possible the production on a large scale of cotton in a condition fit for manufacture. The progress made in machinery during the nineteenth century has been rapid, and has resulted both in an enormous saving of labor and in a most wonderful increase in the product resulting from a given expenditure of power. For example, the speed of the spindles used on Arkwright’s “water-frame,” so called because it was usually driven by water-power, was but 3,000 or 4,000 turns a minute, whereas the speed of a modern spindle is fully 9,000 turns. In no other industry does the keenness of competition require so extensive and so frequent changes of machinery to keep a factory up to the requirements of the times. Improvements are made constantly, and old machinery must be replaced with new long before it has worn out. The chief processes in spinning are directed to the following objects: (a) opening and cleaning; (b) laying the fibers straight and parallel; (c) making the continuous bundle of fibers which is to form the yarn exactly even in size and strength; (d) drawing the “sliver”—the bundle of fibers just mentioned—down to the required size, when it is known as roving; (e) giving the roving the necessary twist and winding it upon the bobbin. The first machine is the opener, or picker. Loose cotton from the bale is fed into this machine evenly, and is subjected to the action of a beater. This machine separates dust and other impurities from the cotton, which is delivered at the end of the machine in a uniform layer, called a lap. A lapping-machine comes next. It is fed with three laps at once, and the three layers are drawn out to the thickness of one. The object is to neutralize the irregularities of each lap by averaging them with the irregularities of two others. It may be remarked that this principle of doubling and drawing for the purpose of reducing irregularities is followed at every step of the process down to the spindle. After the lapping-machine the cotton goes to the card, by which the fibers are first laid exactly parallel to each other, in a thin, gauzy film, upon teeth covering a cylinder, and then stripped off by a vibrating comb, and drawn together in what may be called a flat, untwisted rope. The strands are next doubled and drawn in a drawing frame. In the manufacture of sewing cotton, however, and in the production of fine yarns for weaving, there is an intermediate process, the combing, by which the short staple is removed; and in the manufacture of all fine yarns the “sliver,” as the product of the carding and combing machines is called, passes several times through the drawing frame. There are next three machines, known as the “slubbing frame,” the “intermediate frame,” and the “roving frame,” through each of which the sliver passes, being in each drawn out and slightly twisted. It has now become “roving,” a soft, light twisted cord, and it passes to the last process, the spinning. The improvements in spinning during recent years have been numerous and important. The superiority of the modern automatic mule over the flyer frame for spinning fine yarns was so great that it superseded frame-spinning to a large extent, particularly in England, where a large part of the yarn produced is yarn of high counts, which is ultimately to be loaded with “sizing,” and thus increased in weight but not in strength. But the invention of the “ring frame,” in which the work formerly done by the “flyer” is performed by passing the yarn through a bit of curved wire, known as a “traveler,”

which moves around the spindle on a ring, has revolutionized spinning. The spindle itself has been meanwhile greatly improved. Inasmuch as the production of yarn is substantially in proportion to the speed of the spindle, it follows that the new spindles are much more economical as well as more efficient. For the modern spindles make 9,000 turns a minute—as against a maximum of 7,500 turns only so lately as 1870—and they run so much more easily that the same power moves 25 per cent. more of them at the higher speed than of the old ring spindles at the lower speed. All the fundamental improvements of the ring frame and of the ring spindle are of U. S. origin, and the reintroduction of frame-spinning has made much greater progress in the U. S. than it has elsewhere. By far the largest part of the yarn spun is woven into plain cotton cloth; but considerable amounts are sold for use as warps in woollen and worsted goods, or for knitting into underwear; and a large part of the produce of sea-island cotton, after being spun into yarn, is converted, by doubling and twisting, into sewing thread. In the U. S. the whole manufacture, from raw cotton to woven cloth, or to sewing thread, and sometimes from raw cotton and wool to the condition of woven mixed textiles, is ordinarily carried on by one and the same establishment. In Great Britain and on the continent of Europe spinning and weaving are almost universally separated. See Loom and WEAVING.

Cotton manufacture has its chief seat in Great Britain. In 1787 the total importation of raw cotton into Great Britain was 22,800,000 lb. In 1890 the amount consumed in the mills of the United Kingdom was 1,656,000,000 lb., and the value of cotton goods exported reached the enormous amount of £74,400,000. Of late years the expansion of the cotton industry on the continent of Europe and in India has been much more rapid than it has been in Great Britain. The number of spindles in operation in 1875 and in 1890 is shown by the following:

COUNTRIES.	1875.	1890.
Great Britain.....	39,000,000	43,750,000
Continent of Europe.....	19,440,000	24,575,000
India.....	1,100,000	3,270,000
United States.....	9,500,000	14,188,103

The first successful cotton-factory in the U. S. was that of Samuel Slater, established at Pawtucket, R. I., in 1790. For many years the progress was slow. In 1810 the whole consumption of cotton in the country was no more than 10,000 bales. The consumption reached 90,000 bales in 1815, the war of 1812 having cut off foreign manufactures and compelled the production of goods at home. Under the stimulus of favoring legislation the increase was rapid. But the greatest development has been in the last half of the nineteenth century. The total value of all products of the cotton manufacture, according to the census, beginning with 1840, has been as follows:

1840.....	\$46,350,453	1870.....	\$177,489,739
1850.....	61,869,184	1880.....	210,950,383
1860.....	115,137,926	1890.....	267,981,724

Inasmuch as this increase in gross value has been accompanied by a steady and a very great reduction in the average price of yarns and cloth, the actual growth of the industry has been vastly larger than is indicated by the figures above given. The magnitude of the manufacture is fully exhibited by the following facts obtained by the census of 1890:

Number of spindles.....	14,188,103
Number of looms.....	324,866
Bales of cotton consumed.....	2,223,347
Pounds of cotton consumed.....	1,193,584,341
Square yards of woven goods produced..	3,002,761,037
Total value of product.....	\$267,981,724
Capital employed in the industry.....	\$354,020,843

NUMBER OF PERSONS EMPLOYED AND AMOUNT OF WAGES PAID.

Men.....	88,837	Wages....	\$33,797,517
Women.....	106,607	29,165,086
Children.....	23,432	3,061,935
Officers and clerks..	2,709	3,464,734
Total.....	221,585	Total....	\$69,489,272

The chief seat of cotton manufacturing in the U. S. is New England, which according to the census of 1890 contained 76 per cent. of all the spindles in the country—a ratio which has remained nearly constant during the whole history of the manufacture. Among the States of New England, Massachusetts is very far in the lead. In 1890 it had 41 per cent. of all the spindles in the U. S. The greatest

concentration of the manufacture is in the city of Fall River, Mass. The two adjoining counties of Bristol, in Massachusetts (in which Fall River is situated), and Providence, in Rhode Island, contain 30 per cent. of all the spindles in the U. S. The decade from 1880 to 1890 witnessed an extraordinary growth of the cotton manufacture in the Southern States, particularly in North Carolina, South Carolina, and Georgia. The number of spindles in the Southern States increased threefold during the ten years.

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