spinning process, comprising carding, drawing, and roving machines, were taken out Dec. 16, 1775, by Arkwright; and these, together with the water frame, as Arkwright's roller spinning invention was termed because of its being operated at Cromford by water, made it possible for the first time to make cotton yarn strong enough for warp, and thus did away the linen yarn generally used for the purpose.

In the mean time the spinners in different parts of Lancashire watched with considerable anxiety the increased production of the labor-saving devices which they thought threatened their livelihood, and finally, in 1779, stoned a mill that Arkwright had built in Chorley, and smashed every carding and spinning machine for miles about, sparing only spinning jennies of twenty spindles or less, because they could be worked by hand.

Infringements of his patents sprang up on all sides, but could not affect his prosperity, for his capital and mills enabled him to overcome all obstacles. He sued nine of his competitors for infringements in 1781, and at the trial of these suits the principal defendant produced as witnesses Thomas High and Kay to combat Arkwright's claims to his patent rights, and the suits resulted in 1785 in the annulment of the patents.

This lowered the bars to the industry, and the enormous profits brought unprecedented influx of capital to the whole trade. It had little effect, however, upon the prosperity of Arkwright, because the number of his mills and the amount of his capital now enabled him to meet all the competition. He had the greatest confidence in his own machinery and ability, and made light even of questions of taxation, remarking that his machines would enable him to pay the national debt.

His improvements in the textile industry attracted the favorable comment of the king, and in 1786, on the occasion of his presenting an address as the sheriff of his

county, congratulating the king on his escape from the knife of Margaret Nicholson, he was knighted. His industry was prodigious. Often he worked from five in the morning till nine at night, and, to prevent the wasting of time, he generally travelled at rapid speed with four horses to his coach. He died at Cromford, Aug. 3, 1792, leaving a fortune of almost two million dollars and an incompleted castle at Willersby, England.

SAMUEL CROMPTON

The early inventors had made practical the spinning at one time of a number of threads sufficiently strong, however, only for the weft. Arkwright worked out the water frame so that a coarse warp thread could be spun. It remained for Samuel Crompton to further perfect the spinning process by combining the Hargreaves spinning jenny and Arkwright's water frame in the machine called at first "the muslin wheel," then the "Hall-in-the-Wood wheel," and finally "the mule," because it was a "cross" between the spinning jenny and Arkwright's spinning frame. Until the invention of this machine, muslins were imported from India because Europe could not make yarn fine enough; but the muslin wheel, or mule, for the first time made it possible to spin yarn equal in fineness to the production of Hindu spinners.

Crompton, who was born Dec. 3, 1753, at Firwood, near Bolton, came of a family which, like others of Lancashire, farmed, carded, spun, and wove. The eccentricities of the family cropped out to a lesser degree in the characteristics of Crompton.

The family soon after his birth took up their residence in the portion of an ancient mansion in the woods near Bolton, called "Hall-in-the-Wood," and soon after the father died, leaving the son to be brought up by the widow and her peculiar brother-in-law, Alexander Crompton.

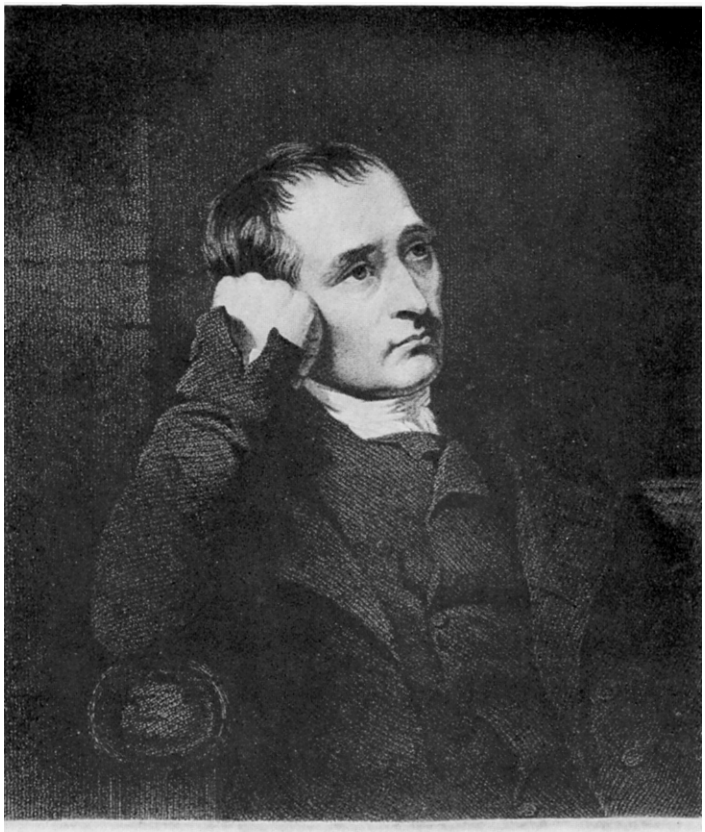
Crompton's mother was wont to beat him, not for any particular fault, as she told him, "but because she loved him so." When a young child, she set him to work trampling the dirt out of the washed cotton, and when he was sixteen, after receiving an ordinary education at Bolton Day School, she set him to spinning at home. In fact, he had begun to assist his mother at her loom as soon as his feet could work the treadle. She was noted for her excellent honey and elderberry wine, but she was hard and exacting, demanding a certain amount of work each day from Sammy. His uncle was so lame that he could not leave the room in which he slept at Hall-in-the-Wood. He, too, wove fustian on all days but Sunday. At the sound of the church bells he would put on his best coat and slowly read the service, concluding about the time church was dismissed. And he went through a similar ceremony at the time of the evening service.

Crompton was reserved, industrious, and studious, very fond of music, and he made a violin upon which he became so proficient that he was able to play in the orchestra of the Bolton Theatre.

The yarn being soft and constantly breaking on the Hargreaves jenny upon which he spun, his mother scolded him because he thus lost time in joining threads. His thoughts, therefore, early turned toward an improvement of the machine. It may have been that he desired more time for his violin or for his pleasures. As he attended night school and was studying mathematics, his work kept him from his books and also the violin, so that he was more and more driven to invent some improvement that would lessen the time of his work.

From 1774 to 1779, or from the ages of twenty-one to twenty-six, he was engaged upon the mule, his only leisure being after his day's work or during hours taken from sleep.

"My mind was in a continual endeavor to realize a more



SAMUEL CROMPTON

Saml. Crompton

perfect principle of spinning," said he, "and, though often baffled, I as often renewed the attempt, and at last succeeded to my utmost desire at the expense of every shilling I had in the world."

All his spare cash and more had gone for tools and materials, and, when the Bolton Theatre opened, he was glad to earn eighteen pence a night, playing the violin in the orchestra. He worked secretly, not even his mother and uncle knowing what he was doing until the noise of his night work aroused their curiosity. The lights and strange noises at unusual hours, heard by the neighbors, soon made them think that the hall was haunted, and their curiosity finally became so great that they would climb up to his attic windows to watch his work.

His first mule was made of wood and iron secured from a near-by smithy, and the point of his invention was that his spindle carriage was so adjusted that the thread had no strain upon it until it was completed. As it was described, "The carriage with the spindle could by a movement of the hand and knee recede just as the rollers delivered out the elongated thread in a soft state, so that it would allow of a considerable stretch before the thread had to encounter the strain of winding on the spindle."

"How did Crompton make that yarn?" was the universal question of the buyers of yarn in the market-place, who were surprised by the fineness of his thread.

It became possible at once to make East India muslins at home, and Crompton's prosperity began. He married, and hired a cottage near the Hall, continuing to weave and to retain his work-room in the Hall. Orders for his yarn at his own price poured in on him, and great was the desire to know how he spun. All kinds of plans were used to ascertain it. Some climbed to the windows of the work-room, and peeped in, so that he was obliged to set up a screen to hide his machine, and one of the manufacturing neighbors even climbed into the loft over Crompton's

workshop, and watched him for several days through a gimlet hole he had cut in the ceiling.

When Blackburn spinners commenced smashing Hargreaves's jennies, Crompton took his machine apart, and hid it in a loft near a clock in the Hall. He realized, as he had no money for a patent, that he must either destroy his machine or make it public. He therefore set about raising a subscription as a reward for making known to the manufacturers his improvements in spinning, and secured fifty-five subscriptions of one guinea each and sixty-seven of six shillings and sixpence, less than the cost of one mule. He realized scarcely anything from this, however, as most of the subscribers failed to meet their subscriptions.

Removing to Oldham, he continued to farm and spin to such perfection that his yarn was the best and finest in the market. It was thought that he must have made some improvements in his machine, and, to discover what these were, efforts were made to bribe his servants. Sir Robert Peel offered him a large salary and prospective partnership, which he refused. Gentlemen of Manchester raised about five hundred pounds for him, which he promptly sank in the development of his business.

About 1780 he invented a carding machine which was not practical. In 1800 he rented the top story of a Bolton factory, and installed two mules and the necessary preparatory machines, but he could not keep his workmen, as others hired them as soon as he had trained them.

A grant of ten thousand pounds sterling by Parliament to Cartwright, who invented the power loom, led Crompton in 1809 to make a similar appeal. He visited all the manufacturing districts, receiving much attention at Glasgow. The manufacturers wanted to give him a dinner, but his shyness shattered the plans.

"Rather than face up," said he, "I first hid myself and then bolted from the city."

His case, however, was not laid before Parliament until later; but, as Parliament was slow to act, he wrote to Mr. Giddy, who was pushing his claim, that there would be no difficulty in getting rid of him. "The only anxiety I now feel is that Parliament may not dishonor themselves. Me they cannot dishonor. All the risk is with them. I consider it to be the greatest honor I can confer upon them to offer them an opportunity of doing me and themselves justice."

He said, further, his friends and family would be ashamed, had he come begging or demanding, as he "only wanted a fair hearing and dealing according to merit."

Spencer Perceval, the prime minister, took up the matter, and was ready to suggest that Crompton be granted twenty thousand pounds, but, before he could recommend it, he was assassinated in the House of Commons, 1809, by John Bellingham, and Crompton was allowed only five thousand pounds. He invested this in a small bleaching establishment, where he spent much time in devising new patterns for fancy muslins, which his neighbors stole, and undersold him by manufacturing cheaper fabrics.

So prosperous became the weaving fraternity through the invention of the mule that it was the practice of Manchester weavers to walk the streets with five-pound notes stuck in their hat-bands, smoking long church-warden pipes; and they would allow no other handicraft men in the rooms which they happened to be occupying in the public house. By 1812 4,600,000 spindles were at work on mules using 40,000,000 pounds of cotton annually, and employing 500,000 operatives.

Crompton was a man of much sensitiveness. He believed in spiritualism and witchcraft, and was an excellent musician. He had physical strength and much personal beauty. One of his feats was to take a sack of flour by the end and toss it on to a cart. He is described as wearing corduroy breeches, woolen stockings, dark gray or black

coat, colored neck-cloth, and always a clean shirt and clean shoes. If any one on the Manchester Exchange ventured to offer him lower than he asked for his yarn, he would wrap up his samples and refuse to show them again. Once, when a foreign count called at Bolton to see him, he sent back word that he could not be seen, as he had gone to bed. The friend replied that the count would then visit him in his bedroom, to which Crompton answered that, if he did, he would hide under the bed.

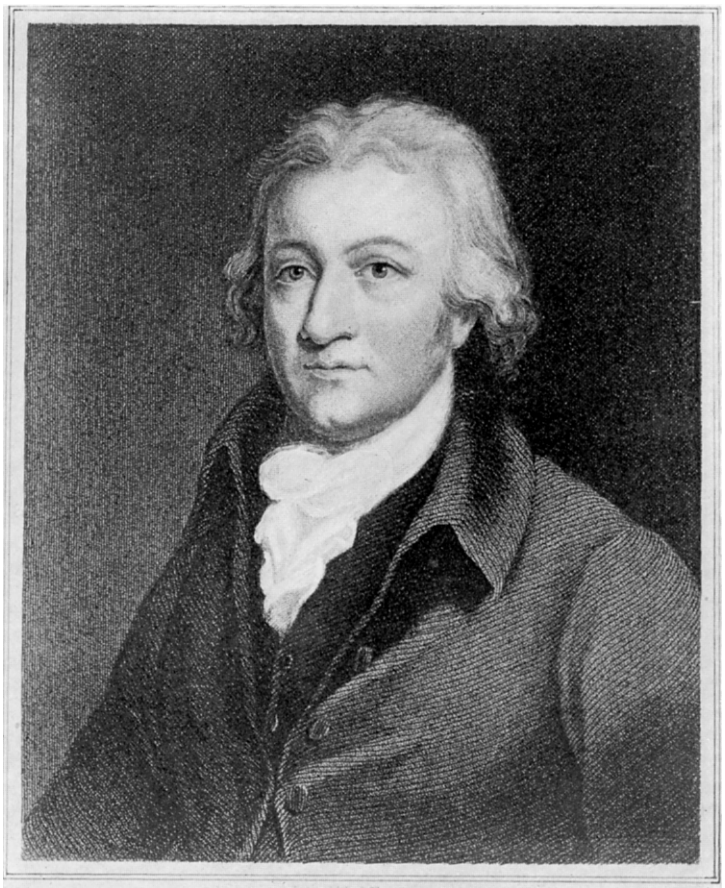
He was not a success as a business man. In 1824 some friends helped him out with an annuity of sixty-three pounds, while in 1826 another attempt was made to secure aid from Parliament. He finally died, June 26, 1827, at Bolton.

EDMUND CARTWRIGHT

These improvements of the spinning machines so increased the output of yarn that there was almost a glut of the market, and more and more imperative grew the demands for a loom that would handle the production on a greater scale, as the old hand loom proved so totally inadequate.

The problem of the power loom, therefore, received consideration in many quarters. The one who succeeded in working out a practical plan for power weaving, and who did for the old hand loom what Paul, Wyatt, High, Arkwright, and Crompton had done for the spinning machine, was Edmund Cartwright, a minister of the Church of England.

He knew little about mechanics when a chance conversation in a public house directed his attention to the problem of power weaving. As Cartwright himself described it, "Happening to be at Matlock in the summer of 1784, I fell in company with some gentlemen of Manchester, when the conversation turned on Arkwright's spinning machinery. One of the company observed that, as soon as



Dr CARTWRIGHT

Arkwright's patent expired, so many mills would be erected, and so much cotton spun, that hands never could be found to weave it. To this observation I replied that Arkwright must then set his wits to work and invent a weaving mill. This brought on a conversation on the subject, in which the Manchester gentlemen unanimously agreed that the thing was impracticable; and in defence of their opinion they adduced arguments which I certainly was incompetent to answer, or even to comprehend, being totally ignorant of the subject, having never at any time seen a person weave. I controverted, however, the impracticability of the thing by remarking that there had lately been exhibited in London an automaton figure which played at chess.

"Some time afterwards a particular circumstance recalling this conversation to my mind, it struck me that, as in plain weaving according to the conception I then had of the business, there could be only three movements which were to follow each other in succession, there would be little difficulty in producing and repeating them. Full of these ideas, I immediately employed a carpenter and smithy to carry them into effect. As soon as the machine was finished, I got a weaver to put in the warp, which was of such material as sail cloth is usually made of. To my great delight, a piece of cloth, such as it was, was the production.

"As I had never before turned my thoughts to anything mechanical, either in theory or practice, nor had even seen a loom at work, or knew anything of its construction, you will readily suppose that my first loom must have been a most rude piece of machinery. The warp was placed perpendicularly, the reed fell with a force of at least half a hundred weight, and the springs which threw the shuttle were strong enough to have thrown a Congreve rocket. In short, it required the strength of two powerful men to work the machine at a slow rate, and only for a short time.

Conceiving in my great simplicity that I had accomplished all that was required, I then secured what I thought a most valuable property by a patent, April 4, 1785. This being done, I then condescended to see how other people wove; and you will guess my astonishment when I compared their easy mode of operation with mine. Availing myself, however, of what I then saw, I made a loom, in its general principles, nearly as they are now made; but it was not till the year 1787 that I completed my invention, when I took my last weaving patent, August 1st of that year."

Cartwright had thus accomplished what had seemed to be impossible,—he had made a loom which could be automatically stopped upon the breaking of a thread, and which made practical the production of fabrics by power machinery.

That Cartwright, a complete stranger to the textile industry, should have been able to accomplish what mechanical geniuses in the industry itself had worked in vain to attain is but another illustration of the truth which crops out so repeatedly in the history of invention, and even in the merchandising of goods,—that some of the most remarkable inventions have sprung from, been evolved and worked out by, men who, when they first conceived of an improvement in the required machine, were strangers to the occupation which the invention benefited. It is also true of business that some of the most successful plans of merchandising or of marketing goods have come from a man who was not engaged in the business that the idea helped.

Edmund Cartwright was born at Nottingham, April 24, 1743, and was the fourth son of William Cartwright, who came of an established family. Cartwright was educated at the Wakefield Grammar School, and was particularly proficient in mathematics. He entered Oxford at fourteen years of age. Here literature attracted his

attention, and he wrote verses and book reviews for the *Monthly Review*. He married, settled in the rectory of Goodby, Marwood, Leicestershire, and later obtained a prebend in the cathedral of Lincoln. He devoted himself to his calling and literature. He had already published "The Armine and Elvira," a legendary poem, and also "The Prince of Peace."

As described by his friend Crabbe, the poet, "Few persons could tell a good story so well, no man make more of a trite one. I can just remember him, the portly, dignified, old gentleman of the last generation, grave and polite, but full of humor and spirit."

The manufacturers to whom he showed his loom gave him little encouragement, and finally, in order to bring out his invention, he set up a factory of his own at Doncaster, a bull at first supplying the power, which was replaced by a steam-engine in 1789. In the same year he took out a patent for a wool-combing machine. In 1792 he invented a machine for making rope. The enterprise at Doncaster failed of success because of Cartwright's ignorance of business details and the malicious jealousy of other manufacturers, who were now beginning to realize the value of his inventions.

He had already in 1786 commenced improvements on the steam-engine, patents for which he took out in 1797, alcohol being used for fuel. He had pronounced scruples about using other men's ideas, and therefore did not look at other inventions of engines, lest he unconsciously borrow an idea. For this reason his work was quite original. It is said that he assisted Fulton in his steamboat experiments. The main bent of his inventive mind was constantly at work upon textile problems, and his idea bore further fruit in the invention, in 1789, of a machine which was even more original than the power loom.

The prejudice shown by the spinners and weavers against inventions turned toward Cartwright in 1790, when a mill

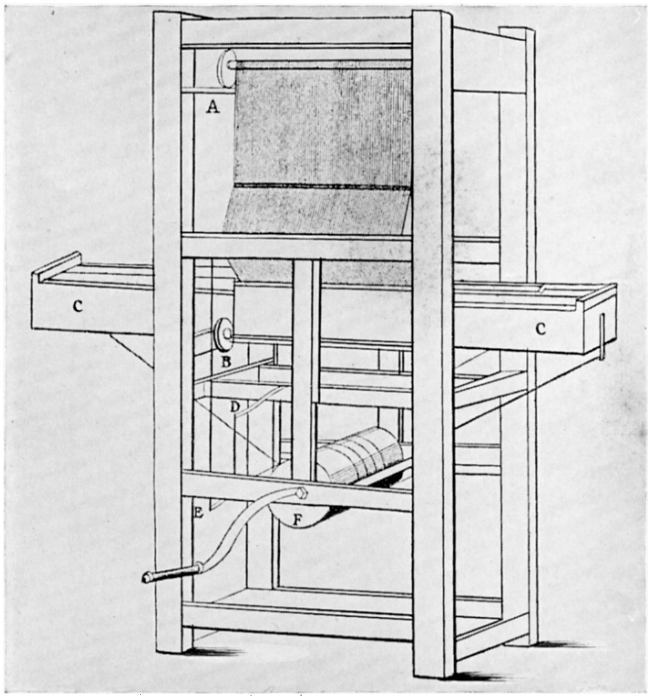
which had been erected by Messrs. Grimshaw, of Manchester, and which contained four hundred of Cartwright's looms and was operated by steam, was set on fire and burned to the ground by the working-people. This was such a blow to Cartwright's purse and spirits, as other manufacturers failed to install his machines, that soon after he gave up his Doncaster mill, and became a member of the Society for the Encouragement of Arts and Manufactures.

As has been the experience of other manufacturers, he, too, was obliged to wage suits in protection of his patents, and finally, discouraged, turned his attention to the invention of agricultural implements, inventing in 1803, while in charge of the Duke of Bedford's experimental farm, a three-furrow plough and other improvements. At last he attracted the attention of the government, which in 1809 granted him a reward of ten thousand pounds with which he bought a farm at Hollonden, Kent. Here he lived until his death, Oct. 30, 1823, making implements and improvements in agricultural methods.

INVENTIONS OF KNITTING MACHINES

It is supposed that knitting was known to the ancients, although there is no direct evidence, the first historic mention being about the time of Henry IV. of England. In ancient times the leg was generally left uncovered, and, when stockings were first worn, they were cut with scissors from cloth of linen, woolen, or silk, and sewed together. Knitting probably began at an early date in the history of England, for woven woolen caps were worn by the peasants of England and Scotland as far back as the Norman conquest; and knitted caps came into general use among the poorer classes in England some time prior to 1488.

The price was then fixed by an act of Henry VII. at



CARTWRIGHT'S LOOM

(According to the Patent Specifications, April 4, 1785)

A, the warp beam; *B*, the cloth beam; *C*, the boxes containing the springs that throw the shuttles; *D*, a lever having a corresponding one on the opposite side for elevating the reed, or comb; *E*, a lever having a corresponding one on the opposite side for reversing the threads; *F*, the cylinder which gives motion to the levers.

N.B.—The warp is kept to a due degree of tension by the counteraction of either a weight or spring. The web is made to wind by the like power, though in an inferior degree, and is prevented as the strike of the reed, or comb, brings it down from unwinding by a ratch and click.

two shillings, eightpence. By 1530 the word "knit" was a common term in England, and there are many references to the knitting of bonnets and hose, and the practice of knitting soon became a domestic employment.

The first attempt to knit stockings by machinery is supposed to have been made by the Rev. William Lee, of St. John's College, Cambridge, who was born at Woodborough, near Nottingham, and completed his invention before the beginning of the seventeenth century. As one story goes, Lee was deeply in love with a young townswoman of his, but, whenever he courted her, she seemed more interested in her knitting than in the attention of her suitor. This piqued Mr. Lee, and he determined to make a machine that would turn out work enough so that hand knitting would be a profitless employment, accomplishing his design about 1589. He taught his relatives to work under him, and for some time carried on his work at Calverton, England. Oliver Cromwell investigated the machine-wrought hosiery trade, and granted it a charter June 13, 1657.

It is said that Lee's invention was brought to the attention of Queen Elizabeth, who, while she expressed her admiration for the ingenuity of the inventor, was much disappointed because, instead of the fine silk hose she had expected, the output was coarse worsted stockings which had only eight needles, or wales, to the inch width. A patent was sought for Lee from Queen Elizabeth by her kinsman, Lord Hunsdon, but, in refusing the request, she said:—

"My lord, I have too much love for my poor people who obtain their bread by the employment of knitting to give my money to forward an invention that will tend to lead to their ruin, by depriving them of employment and thus make them beggars. Had Mr. Lee made a machine that would have made silk stockings, I should, I think, have been somewhat justified in granting him a patent for that

monopoly, which would have affected only a small number of my subjects, but to enjoy the exclusive privilege of making stockings for the whole of my subjects is too important to be granted to any individual."

And no patent was ever granted Lee. Spurred by the queen's remarks, however, Lee set about constructing a machine for making silk stockings, and, aided by his brother James, succeeded in 1598 in making a machine on which he was able to produce a pair of stockings which he presented to Queen Elizabeth, who was greatly pleased with their beauty and elasticity. They brought him, however, no money or patent. Discouraged and disappointed, he accepted an invitation from Henry IV. of France to establish himself in that country, and was presented by Sully to the French king. The assassination of King Henry, however, by Ravaillac, while Lee was waiting at Paris for a grant of privilege to manufacture at Rouen, ended Lee's prospects, and he returned to Paris, where he died in want in 1610.

His machines were brought back to England by his brother, who established the industry there. And early in the seventeenth century the trade association of the London Frame Work Knitters was formed to regulate conditions of work and prices. Knowledge of the crude stocking frame little by little leaked out of England, though for a long time England had almost an exclusive manufacture of machine-made hose. No marked improvement, however, was made until Jedediah Strutt, Arkwright's partner, became interested in the process.

Strutt was a farmer at Blackwell, and had married the sister of William Woollett, a hosier. His brother-in-law having called his attention to the stocking frame and the need of improvement so that ribbed hose could be made, Strutt, after much study, succeeded in compassing his ribbed stocking frame, and in 1758 took out his patents. He removed to Derby, and with his brother-in-law estab-

lished his well-known mills for making hosiery. When he died in 1797 at Derby, his mills were the greatest in England.

IPSWICH MILLS

The largest manufacturers of knit goods in America to-day are the Ipswich Mills of Ipswich and South Boston, Mass., and Belmont, N.H. This industry at Ipswich began in 1818, when a number of knitters from Nottingham, England, immigrated to Ipswich and established the industry which they had mastered at Nottingham. The same year the first stocking machine was imported, secreted in the hold of the ship, and packed in a cargo of salt, as there was a fine of five hundred pounds sterling for exporting stocking machinery from England. It was not brought to Ipswich until 1822, when it knit the first pair of stockings in the kitchen of a private dwelling. Other machines were secretly imported, and in 1824 Augustine Heard, a resident of Ipswich, established the industry.

The building used by Mr. Heard's company was shortly before 1868 bought by Mr. Amos A. Lawrence, and transferred to the Ipswich Mills.

The industry was a new one, the machinery crude, and the labor unskilled. And, as America did not realize that hosiery could be made in this country, women refused to buy anything with the American mark, so that the industry first travelled a far from easy road.

Mr. Lawrence in January, 1868, wrote: "I am starting up my mill at Ipswich again, which has been stopped for a few weeks. This attempt to manufacture cotton stockings by machinery, so that they can be sold at $1.50 per dozen, has caused me to lose not less than $100 a day for eight hundred days,—$80,000,—yet I am not discouraged, though I feel the loss very much."

The persistency with which the pioneer mill was handled, the ingenious invention of machinery, and competition have

made it possible to place on the market stockings of better and better value at continually lower prices. The result has been that this part of our wardrobe is constantly growing less expensive.

JOSEPH MARIE CHARLES JACQUARD

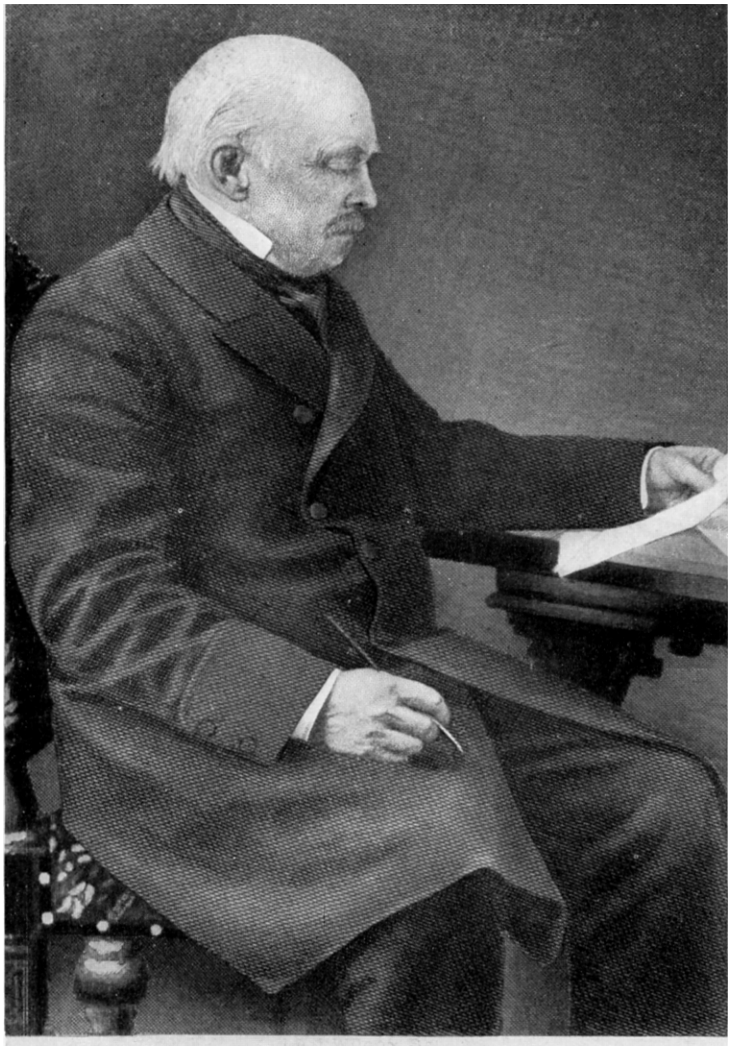
The last of the great inventions which have accomplished such wonders for the textile industry was that of the Jacquard loom. It made it possible to weave into fabrics of all kinds the most intricate and beautiful designs.

Its inventor, Joseph Marie Charles Jacquard, was born July 7, 1752, at Lyons. His father was a working weaver, while his mother is said to have been a pattern maker.

Thinking that Jacquard could better develop his physical powers in the pursuit of a trade, his father gave him little or no education. When he was about twenty, his father died, leaving him a small house and hand loom, and he turned his genius to improvements in weaving. He was unsuccessful, however, and sought other occupations, working first in a plaster quarry at Bresse, near Lyons, afterwards at cutlery, type founding, and weaving in Lyons. He served during the Revolution of 1792, his son being killed while defending Lyons against the army of the Convention.

Soon after he attracted the attention of the Council of Lyons, which gave him access to an experimental loom for the development of weaving improvements in the Palace of Fine Arts, with a stipulation that he should teach scholars without charge. He was thus engaged when the Society of Arts in London offered a reward for a machine for making fishing nets. On the 2d of February, 1804, Jacquard received three thousand francs and a gold medal from the London Society for a machine which he had perfected and exhibited to the Conservatorium of Arts and Trades.

This brought him to the attention of Napoleon Bona-



faithfully Yours
Amos A Lawrence

parte, who sent for him. He was received by Napoleon and his great minister, Carnot.

"Are you the man who can do what God Almighty cannot,—tie a knot in a taut string?" he was asked by the Emperor.

"I can do not what God cannot, but what God has taught me to do," was the reply.

He was given a position in the Conservatorium of Arts, where he had not only an opportunity to improve his own weaving machine, but had also the chance to study the work on textile machines of Bouchon, Falcon, and Vaucanson.

Vaucanson's machines and automatons, one of which was said to have been a duck that would waddle, quack, swim, eat, and digest food by mechanical process, surely furnished ideas to Jacquard. Afterwards in 1804 he returned to Lyons where he finished his loom. It combined the best parts of those of his predecessors, together with those of his own improvements, and was the first machine to do practical design weaving.

The Jacquard loom had ingeniously arranged weighted strings which passed over a pulley and fell into perforated cards. Each motion changed the position of these strings, and allowed some of them to go through the holes and thus draw up the warp thread so that it was skipped by the warp; while others would strike the card, and leave their strands in place to be regularly woven. In this way the weaver could pass his threads over, under, or through the warp, as the design required.

Napoleon Bonaparte in 1806 granted him an annuity of three thousand francs with the understanding that he should transfer his invention to the city of Lyons, as well as any further improvements he might make.

His experience was like that of all other great inventors,—so violent was the opposition of the weavers to the introduction of his loom that the Conseil des Prudhommes broke up his machine in the public places, and Jacquard was com-

pelled to flee to save his life. Little by little, however, the looms were adopted, and proved to be of the greatest value, establishing Lyons as the art centre of the textile industry.

Jacquard died Aug. 7, 1834, at Oullins, France, having attained the ripe old age of eighty-two, and having lived long enough to see over thirty thousand Jacquard looms in operation in the city of Lyons.

MACHINES FOR SPINNING FLAX

The inventions of Kay, Hargreaves, Arkwright, and Crompton, were principally applicable to cotton and wool, and made little improvement in the hand methods of spinning flax, because the raw flax was too brittle to stand the strain of the tension that the spinning machine could with safety put upon cotton. The impetus given, therefore, to cotton manufacture proved most disastrous to the linen industry. The demand for linen fabrics fell off, and the trade which had been the life-blood of villages and whole provinces disappeared, and to a much lesser degree took refuge in the more remote rural localities where it was able to resist the encroachments of the power loom. In these localities, such as in parts of Ireland, linen still continues to be spun and woven by hand, and the skill shown by hand spinners and hand weavers is not excelled by the most intricate machinery of to-day.

In 1725 machinery of a crude nature had been applied in Ireland to the spinning industry without success. English inventors had before this, however, set to work upon the problem of spinning flax, and the first practical machines were the inventions of John Kendrew and Thomas Porthouse, of Darlington, England, who in 1787 took out patents upon a mule, or machine, constructed upon a new principle, for spinning hemp, tow, flax, and wool. These machines, with many improvements and modifications, have led to the perfect system for spinning flax now in use.

JAMES WATT.

The progress made in textile machinery in England would have been handicapped by a lack of motive power to drive the machines, had it not been for the improvements made in the steam-engine by James Watt, the Scottish engineer. The amount of water power was limited, and the supply during the course of the year, owing to rainfall, was irregular and often inadequate. Watt's improvements in the steam-engine came at a time when England needed steam to drive the wheels of the great industry, the output of which her inventors had so greatly increased.

The steam-engine when Watt's attention was attracted to it in 1764, by being called upon to repair a model of the crude engine of Thomas Newcomen that was a part of the scientific apparatus at Glasgow College where Watt was mathematical instrument maker, was used solely to pump water from the mines at Cornwall. Watt perceived its enormous waste consumption of steam, and began an investigation to learn the cause and the remedy. This he was enabled to do quite as much by his training as by his inventive genius.

He was born at Greenock, Jan. 19, 1736. By the failure of his father, who was a small merchant, he was thrown upon his own resources, and went to London at the age of nineteen. He apprenticed himself to John Morgan, a philosophical instrument maker, but, his health breaking, he returned home, and through acquaintances in the Glasgow College he secured his position in the college.

He found that Newcomen's engine consumed enormous quantities of steam and coal because of the alternate heating and cooling of the cylinder, owing to the use of water in chilling it and its faulty construction. Watt cased the cylinder in a non-conducting material and introduced a steam jacket, or layer of steam, between the cylinder proper and an outer shell.

He took out his first patent in 1769. As he had needed

money to carry on his experiments, he had formed a partnership with Dr. John Roebuck, who had iron works at Carron. Roebuck became involved in financial difficulties, and for a number of years Watt was occupied with civil engineering which entailed canal digging and harbor dredging. In 1768 he met Mathew Boulton, head of the Soho engineering work at Birmingham. The two formed a partnership, and in 1775 applied for a renewal of Watt's patents which he received for twenty-five years.

Watt from this time on devoted himself to perfecting and developing the steam-engine. He took out a number of patents, and soon the perfected engine had driven Newcomen's from the Cornish mines. His last patent was taken out in 1784, when he had completed the steam-engine so that it was applicable to power-driving of all sorts. It was practically the engine as it has been in use to within a few years. He found it a steam-pump, slow working, cumbrous, and excessively wasteful of fuel. His patent made it economical in working, powerful, and efficient, but it was still only a steam-pump. His later inventions adapted it to driving machinery of all kinds, and made it particularly applicable to use in textile mills. He retired from business in 1800, and his business was carried on for years by his two sons and a son of Boulton. He died on the 19th of August, 1819.

By 1811 the process of making cloth had reached such perfection in England that, according to "The Book of Days," Sir John Throckmorton, of Berkshire, could wager a thousand guineas that he would at eight o'clock on a particular evening sit down to dinner in a well-woven, well-dyed, well-made suit the wool of which formed the fleece on a sheep's back at five o'clock on the same morning. Mr. Coxetter, of Greenham Mills at Newbury, was put in charge of the work.

He had at 5 A.M. on the 28th of June two South Devon sheep shorn. "The wool was washed, carded, stubbed,


Eli Whitney

roved, spun and woven; the cloth was scoured, fulled, tented, raised, sheared, dyed and dressed. The tailor was at hand and made up the finished cloth into garments, and at a quarter past six in the evening Sir John Throckmorton sat down to dinner at the head of his guests in a complete damson-colored suit that had thus been made,—winning the wager with an hour and three-quarters to spare."

ELI WHITNEY

The improvements in spinning and weaving machinery soon brought cotton manufacturing to a pass where its demand for raw material outran the supply, and ways and means for increasing the raw cotton available became a pressing necessity.

As the industry about Manchester had grown, new fields for the production of cotton were developed. The original source of supply was India, other parts of the East, and Egypt. It was indigenous, however, to the West Indies, and soon these islands became a source of supply. About 1770 West India cotton was transplanted to Georgia and later to North and South Carolina and other parts of the South, and it readily took growth and large crops were raised, which materially augmented Manchester's supply.

Although the production of cotton was thus increased, the separation of the cotton from the seed and boll was slow and tedious, owing to the work being done by the hand labor of the large slave population of the South. It was largely the work of colored women, who separated the seed and cleaned the cotton from the boll with their finger-nails, and it took a negro a day to pick a pound of cotton from the boll and separate it from the entangled seed. All that could be produced in the year 1792 was 138,324 pounds.

The invention of the cotton gin, perfected in April, 1793, by Eli Whitney, a graduate of Yale, revolutionized the industry, and enabled a negro to clean five thousand

pounds of cotton a day, thereby greatly increasing the supply of American cotton. Indeed, within a few years of the invention of the gin the production had grown from the one hundred thousand and odd pounds to many millions of pounds of cotton a year, and had stimulated the cotton industry so greatly that the production of cotton goods led all others.

Whitney's early environment and training gave his mind the mechanical bent which facilitated his inventive genius. At his father's farm at Westboro, Mass., where he was born Dec. 8, 1765, being one of a family of thirteen children, there was a machine shop in which the elder Whitney made wheels of various kinds and used lathes for turning tools and chair posts. In this shop Eli, when a boy not yet in his teens, was wont to make things, and soon became quite skilful in the handling of machinery.

"What has Eli been doing?" asked his father one day, upon a return from a trip, of the woman who kept house for his motherless children, as his wife was dead.

"He has been making a fiddle," was the answer.

"Ah! I fear Eli will have to take his portion with fiddles," replied the father, but the fiddle was very well made. And such a knowledge had Eli obtained through its construction that the whole countryside was soon coming to him to mend fiddles. At another time when Whitney, the elder, was at church, the younger took his father's watch apart and successfully put it together again.

When he was only thirteen, he made the first machine for manufacturing nails, the supply of which was cut off during the Revolution by the English blockade, and for three years previous to 1781 he was engaged in supplying the large demand that sprang up.

His father desired him to go to college, but it was not until he was eighteen that he made up his mind to do it. Although skilled as a mechanic, he lacked the knowledge and the means necessary to go. Accordingly, he set about

preparing himself by working for seven dollars a month and board in the towns about Worcester, Mass., by studying at spare moments, and attending, when he could, the neighboring academy. He added also to his income by selling bonnet pins and walking-sticks.

At Yale, which he entered when twenty-three years old, he made mathematics his favorite study. When the astronomical apparatus broke down during some experiments, so expert had he become that he was able to repair it. Upon his graduation he decided to study law, and, to secure the means, obtained a position as tutor to the son of a South Carolina gentleman at eighty guineas a year. Small-pox delayed his sailing, and he fell in with the party of the widow of General Nathanael Greene, who was also waiting to sail. The father of his prospective pupil, becoming discouraged by the delay, engaged another tutor, and through the aid of Phineas Miller, another Yale graduate, Whitney obtained a position as tutor in Mrs. Greene's family at Mulberry Grove, near Savannah.

One day some gentlemen were discussing, under the live-oaks and magnolias at Mulberry Grove, the slow manner of extracting the cotton seed from the cotton boll.

"Why don't you go to work and get something which will do it?" it is said Mrs. Greene exclaimed.

"Your good husband, though he cleaned the red-coats out of Georgia, could not clean the seeds from the cotton," was the retort.

"Apply to my young friend here," answered Mrs. Greene, referring to Whitney. "He can make anything. He has repaired my children's toys. My tambour frame was all out of kilter, and I could not embroider with it at all, because it pulled and tore the threads so badly. Mr. Whitney noticed this, took it out on the porch, tinkered with it a little, and—there, see what he has done with it,—made its frame as good as new."

"As for cleaning cotton seed," Mr. Whitney is reported

to have said, "why, gentlemen, I shouldn't know the seed if I saw it. I don't think I ever saw cotton or cotton seed in my life."

The next day he made it a point to see some cotton, and then set to work on a machine to pick it, Mrs. Greene giving him a room in which he could secretly carry on his experiments.

He had observed old negro mammies clawing the seed off with their nails, and with this idea in his mind he set to work on a cylinder covered with the teeth of a wire comb. He placed the rollers with the teeth so near the cotton, which projected from an upper hopper of iron mesh, that the teeth would claw away the loose fibres from the cotton bolls. Caught by the saw-like teeth, the fibre dropped the seeds through the openings of the gratings of the hopper which held the cotton. The brushes of the second roller travelled in an opposite direction, so as to remove the cotton from the first cylinder.

The invention was completed some time in April, 1793, for in November, 1793, Whitney wrote Thomas Jefferson, then Secretary of State: "Within about ten days after my first conception of the plan, I made a small, though imperfect model. Experiments with this encouraged me to make one on a larger scale; but the extreme difficulty of procuring workmen and proper materials in Georgia prevented my completing the larger one until some time in April last."

The attention of the South was at once aroused. Crowds that were denied admission to the invention until it was patented broke open the house in which it was, carried away the model, and reproduced it, so that thousands of planters commenced using it without even as much as "by your leave" to Whitney. And even associations arose to protect users against Whitney's prosecution. As there seemed to be little chance of manufacturing in the South, Whitney returned to New Haven, and commenced

the manufacture with Phineas Miller, who May 27, 1793, had entered partnership with him. The planters of the South showed no intention of admitting Whitney's right to his invention, and for a number of years Whitney and Miller sought in vain to secure returns for their work.

A formidable obstacle was the belief by English mill owners that the cotton gin ruined the cotton fibre by making it too brittle, and it was with great difficulty that this belief was overcome. It was not until after 1800 that Whitney was able to obtain a recognition from the Southern planters of his rights, and finally he secured a grant of fifty thousand dollars.

North Carolina and Tennessee both fixed a tax of two shillings, sixpence, on every saw for ginning cotton for five years, the annual collection being paid to Whitney, but the government refused to renew his patent in 1812, so that he never realized the amount to which his invention entitled him.

His partner died a disappointed man, and in 1798 Whitney turned his attention to the manufacture of firearms, establishing a plant for the purpose of making a lathe and all the necessary machinery on the shores of Lake Whitney. The government encouraged him with an order for ten thousand muskets and advanced him twenty thousand dollars. It was not until 1817 that Whitney saw the end of his financial troubles. He married the youngest daughter of Judge Edwards, of the United States Circuit Court, who was a direct descendant of Jonathan Edwards, and died in New Haven, at the age of sixty years, on Jan. 8, 1825.

IMPROVEMENTS OF THE BASIC MACHINES, AND FURTHER INVENTIONS.

Cartwright's loom was the last of the basic inventions which wrought such a change in the textile industry. Most of the machinery used in the textile mills to-day involves

the principles of these early inventions, though many of the details have been improved and modified and additional parts have been added that have greatly increased the labor saving as well as the productive capacity of the machines.

Owing to the opposition of the English workmen who thought that invention would deprive them of their livelihood and also the necessity of stopping the loom to dress the warp, it was some years before Cartwright's loom was put into much use. The best authorities are of the opinion that power looms were adopted at first more rapidly in Scotland than in England, because in 1811 they were in use in Scotland; while it is quite certain that in 1813 power looms had not been much adopted in England.

In 1794 a power loom was invented by John Bell, of Glasgow, which was soon abandoned, and June 6, 1796, Robert Miller, of the same city, took out a patent for another loom, which John Monteith adopted in 1801, and equipped a mill at Glasgow with two hundred looms. Still another loom was invented by Mr. Toad, of Bolton, in 1803. The loom which William Horrocks, of Stockport, England, patented in 1803, 1805, and improved in 1813, was the first to come into general use, and was known as the crank, or Scotch, loom. It was probably the kind that Francis C. Lowell, of Boston, saw, and which led to his working out later the first practical loom in America, the story of which is told later. As early as 1806 T. M. Mussey had built a loom at Exeter, N.H., which would weave, but was not practical commercially.

The dressing machine, out of which grew the dandy loom, that was necessary to the economical operation of the loom, was worked out by Thomas Johnson, of Bredbury, an ingenious weaver in the employ of Messrs. Radcliffe and Ross, of Stockport, England. William Radcliffe, who was alarmed by the exportation of cotton yarn, conceived that the only way to prevent the exportation

DISTAFF SPINNING

(From an old sketch)

was for the English to excel in weaving. He finally, on Jan. 2, 1802, called about him a number of his workmen, among whom was Thomas Johnson, an ingenious but dissipated young man, and explained to them his needs. So versatile were Johnson's expedients to compass the required invention that his fellow-workmen called him the conjurer. Johnson's ability and Radcliffe's perseverance produced the ingenious dandy loom, by which the warp could be dressed before it was put on the loom, and provided for the taking up of the cloth and drawing forward of the warp, so that the loom did not have to be stopped for the cloth to be moved on. The warp was thus brought within play of the shuttle.

Radcliffe and his partner, Ross, in 1803 and 1804 took out patents for taking up the cloth by motion of the lathe, and also for new methods of warping and dressing. The patents were taken out in the name of Johnson, their employee, who received a bonus of fifty pounds. English manufacturers were slow to take up the loom. Little by little, after Horrocks's invention, power looms were gradually adopted. In 1806 a factory for steam looms was built at Manchester, according to Guest, and soon after two others were erected at Stockport, while in 1809 a fourth was completed at West Houghton. In 1818 at Manchester and the neighborhood there were but fourteen factories, containing about two thousand looms, and in 1821 thirty-two factories, containing 5,732 looms.

It is impossible to more than briefly indicate the other improvements since the day of Crompton. The later improvements and many of the most essential modifications have been the work of American inventors, who with true Yankee ingenuity took the basic English machines, eliminated their weak points and strengthened their good ones, adding a part here and a part there, until the automatic power loom, as finally worked out in the Northrop loom under the direction of the Draper Company, became an

accomplished fact and is the last word in the history of textile machinery.

James Davenport, an American mechanic, received, Feb. 14, 1794, on his carding and spinning machines the first patent in the United States for any kind of textile machinery. He established at the Globe Mills, at the north end of Second Street, Philadelphia, one of the earliest manufactories for weaving flax, hemp, and tow by water power. The labor was supplied by boys, who were able to spin in a day of ten hours 290 feet of flax or hemp, and one boy could deliver fifteen to twenty yards of sail cloth a day.

Davenport went in 1797 to Boston to sell machinery, but was not successful, and died soon afterwards. The Globe machinery was sold in such small lots it was impossible to put it together again. The looms said to have been used preceded, it is claimed, by many years any other efforts to turn out a practical power loom.

One of the most important improvements worked out in this country is that of the Compound Gear, by which Mr. Asa Arnold, of Rhode Island, succeeded in combining the train of three bevel wheels so as to regulate the variable velocity needed for winding the filaments of cotton on the bobbin of the roving frame. Although the invention was put in operation in 1822, the patent was not taken out until Jan. 21, 1823. A model of this invention was taken to Manchester in 1825, and an Englishman, Henry Houldsworth, Jr., appropriated it, taking out his own English patent for the English Equation Box. It was not known for some time that Arnold was the real inventor, and he did not, therefore, secure the pecuniary advantage that should have been his.

The Danforth, or cap, spinner was the invention of Charles Danforth, of Paterson, N.J., and he secured patents Sept. 2, 1828. Here, again, an Englishman, John Hutchinson, of Liverpool, appropriated the idea in 1830 by patent-

ing it, and the invention came into wide use in England and Europe, particularly for spinning the weft, or filling, before the later improvements in the self-acting mule. The Taunton speeder, so called from its place of origin in Massachusetts, was the work of George Danforth, of Massachusetts. This, which was also known as the tube frame, was patented Sept. 2, 1824. English patents for the same thing were taken out for a Mr. Dyer, of Manchester, in 1825. The Taunton speeder was adopted to a considerable extent in England in place of the fly frame.

Gilbert Brewster, of Poughkeepsie, N.Y., invented another roving frame in 1829, in which a temporary twist was given to the roving during the passage from rolls to spools by passing the roving between two leather bands, or belts, moving in opposite directions. This was known as the Eclipse Speeder, and was used for some time because of the small cost of the machine and the large amount of work it could produce. It gave place to the roving frame with the "equation box" or "compound" movement, either in the form of the "fly frame" or "speeder," the latter name being applied to those frames in which the arms of the flier are connected at the bottom and are independent of the spindle. This, too, was introduced into Manchester with great success in 1835, and there was known as the Eclipse Roving Machine.

In 1829 Addison and Stevens, of New York, took out a patent for a traveller, or wire loop, sliding around on a single ring, and from this the present form of ring spinning has been derived and has been adopted by all large makers. To America was also due the invention of the plate speeder. The stop-motion in the drawing-frame was invented by Samuel Batchelder in 1832. By it loss of time was prevented by stopping the machine to fix breakage of the thread, and the speed of the machines could be greatly increased. No patent was taken out for it in this country, but the inventor derived some benefit from one taken

out in England by Henry Houldsworth. The ring spinner was worked out by John Sharp, of Providence, in 1831, and with later improvements came into extensive use.

To Mr. Paul Moody, who, we shall later learn, was one of those that helped to start the first complete cotton mill in America, is due the distinction of the introduction at Lowell in 1826 of the use of leather belts in place of iron gears for transmitting motion to the main shafting of a mill.

Other improvements have from time to time been added to the textile machines. The last of importance was that of the Northrop loom. The problem of an automatic shuttle changer had long engaged the attention of George Draper & Sons, the predecessors of the Draper Company, of Hopedale, Mass. In July, 1888, one of the firm investigated an automatic shuttle changer at Providence, R.I. Concluding that it was not practical, the firm set aside ten thousand dollars, and started an inventor, Mr. Alonzo E. Rhoades, on the task of devising a practical shuttle-changing loom. Mr. Rhoades by Feb. 28, 1889, had a loom ready for operation. A few years prior to this time Mr. James H. Northrop, an expert English mechanic, had come to this country and had secured work at Hopedale. He invented the Northrop spooler guide and other improvements in cotton machinery, but later left this employment to become a farmer. As farming was not congenial, he again entered the Drapers' employ and noting the work on the Rhoades machine, remarked one day in February, 1889, that, if given a chance, he could put a shuttle changer on a loom in one week's time that would not cost over a dollar. On March 5, he showed, set up in the hen-house at his farm, a rough wooden model of his idea. This so pleased the Drapers that Mr. Northrop was set to work on his idea, and by July 5, 1889, he had completed a loom, and on October 24 of the same year a Northrop loom was in operation at the Seaconnet Mill in Fall River; and by

April, 1890, several filling changing looms of the same kind were at work in Seaconnet Mill. It was soon found, however, that the ordinary plain looms were not sufficiently uniform to be adaptable for the new attachments, and the Drapers set about designing a new loom that would incorporate a warp stop-motion with the filling-changer. This entailed several years' delay, so that it was not until early in 1895 that complete Northrop looms were started in mills of customers.

The Northrop loom is said to be the first commercial loom to supply filling automatically; the first loom to automatically supply a bobbin or cop skewer to a shuttle and automatically thread the same, either commercially or experimentally; the first loom to incorporate a practical warp stop-motion for general weaving application; and the first loom to automatically supply itself with filling before exhaustion of the running supply. As a whole, it is the first to do away with the right and left hand system, and the first to generally adopt the high roll take-up.

BLEACHING

The use of machinery in the manufacturing of textiles had an immediate effect upon bringing about improvements in bleaching, dyeing, and printing. The old and slow methods used in these chemical processes could not keep pace with the increased output of goods turned out by the new methods of manufacturing, but soon improvements in the process of bleaching, dyeing, and printing enabled this branch of textile making to meet the output of the manufacturing processes. The agents by which the improvements were effected were powerful chemicals, and the use of cylinder printing in place of the old hand block method which was so long in use.

The Chinese and Hindus understood bleaching, and through the Arabs and Phœnicians it was passed on to the

Egyptians. For centuries the Phœnicians were famous for their purple dyes, and the tombs of the Egyptians attest the knowledge which they had not only of bleaching, but of dyeing and printing. According to Pliny different plants and ashes of plants were used as cleansers. The East and Egypt passed the knowledge on to the Greeks and Romans, though of their processes little is known, as the records of their skill in this respect were lost when the barbarian hordes in the early centuries of the Christian era overran the Roman Empire and Europe.

It is impossible to see just where the industry first developed in Europe, for it is probable that in Germany, Holland, and France it was known at a very early date. The Dutch, prior to the seventeenth century, had a monopoly of bleaching; and Haarlem was a great bleaching centre. Brown linen made in Scotland was sent in March to Holland to bleach, and returned about the end of October.

Bleaching had begun in England prior to the beginning of the sixteenth century. At Southwark, near London, there was a bleachery about 1650. Shakespeare speaks of the "whiting time" or "bleaching period," and those described in the process were called "whitsters." The old method of bleaching was using first sour milk and cows' dung, then steeping the linen in waste lye and for a week pouring boiling hot potash lye over it. In some parts of India the acid of lemons was used instead of sour milk, and in other parts buffaloes' milk was used. The linen was then taken out and washed and put into wooden vats of buttermilk, in which under pressure the goods lay for five or six days. The linen was then spread on grass and kept wet for several months, exposed to sunshine and rain. This steeping in lyes was called bucking, while the bleaching on the grass was called crofting.

The work was carried on in the open air, principally in the summer time, and under the old method it was often from six to eight months, especially if the weather was un-

HANDICRAFT CARDING, ROVING, AND SPINNING BY THE HAND WHEEL

(*According to Richard Guest*)

The cotton after being combed or carded between the hand cards (Figure 1) was scraped off them in rolls about twelve inches long and three-quarters of an inch in diameter. These rolls, called cardings, were drawn out into rovings on the hand wheel. In Figure 2 the cardings are represented lying across the knee of the rover. From the spindle of Figure 2 the rovings were taken to Figure 3, to be spun into weft. In Figure 3 the roving lies in the lap of the spinner. On the spindle of Figure 3 the weft was finally prepared for the weaver. In roving, the cardings were drawn out in an angle of forty or forty-five degrees from the point of the spindle. In spinning, the rovings were drawn out nearly in a right angle. The hand wheel was first used in the woolen manufacture.

favorable, before the bleaching was completed. The custom of outdoor exposure gave rise in England, and in parts of the Continent, to much stealing of the linen thus exposed, and stringent laws to prevent it were passed from time to time.

An enactment of George II. reads, "Every person who shall by day or night feloniously steal any linen, fustian, calico, or cotton cloth; or cloth worked, woven, or made of any cotton or linen yarn mixed; or any linen or cotton tape, inkle, filleting, laces, or any fabric laid to be printed, whitened, crofted, bowked, or dried, to the value of ten shillings, or shall knowingly buy or receive any such wares stolen, shall be guilty of felony without benefit of clergy," which was punishable by death. In Switzerland, in order to prevent the material from being stolen, they still go so far as to protect it at night with dogs, whose small houses are placed here and there about the bleaching-yard.

The final step of exposing linen to the sun and rain is still practised in Holland, Ireland, and Switzerland and other parts of the Continent, where the spinning of flax and the making of the best linen is yet a handicraft. No chemical process has yet been found that will bring about the purity of whiteness obtained by the natural methods of exposure.

Scotland early gave its attention to bleaching. In 1728, in response to the proposal of James Adair, of Belfast, to the Scottish Board of Manufacturers, a bleaching-field was established in Galloway, and a premium of two thousand pounds for the establishment of other bleaching-fields throughout the country was granted. In 1732 a method of bleaching with kelp was introduced by R. Holden from Ireland, and a bleaching-field was set out near Dundee, which used the process.

An improvement in the souring of cloth was made by Dr. Francis Home, of Edinburgh, to whom the Board of Trustees of the Board of Manufacturers paid one hundred

pounds for his experiments in bleaching. This was the discovery that sulphuric acid could be used to great advantage, instead of sour milk, in the acidulating of the water. It accomplished the souring in a few hours, while the old method occupied days and weeks. Although sulphuric acid worked admirably, bleachers were afraid of the corrosive effects of this souring process, and for some time in Ireland it was against the law to use it, although in 1774 Dr. James Ferguson, of Belfast, had received a premium of three hundred pounds from the Irish Linen Board for the application of lime in bleaching linen.

The greatest improvement in the process was the discovery in 1774 by C. W. Scheele, the Swedish chemist, that chlorine destroyed vegetable colors. This discovery was due to his accidental observation of the bleaching of the cork of the bottle which contained his chlorine, a gaseous substance contained in salt. The fact attracted the attention of the French chemist, Claude Louis Berthollet, who applied chlorine with great success to the bleaching of fabrics. Berthollet read a paper before the Academy of Science in Paris, April, 1785, which was published in the *Journal de Physique*, in which he gave the result of his success in bleaching cloth.

He showed the experiments in 1786 to James Watt, the inventor, who was also a chemist and who instituted similar experiments in England. Watt used chlorine on the bleach-field of his father-in-law, Mr. Macgregor, near Glasgow in March, 1787, and this was probably the first time that the chlorine process was used in England. The process was made known by Professor Patrick Copeland, of Aberdeen, to Gordon, Barron & Co. of that city, and was used with success by them.

The first use of chlorine was attended by serious disadvantages, owing to the injurious and obnoxious odor to which the process gave rise. One of the first improvements was the use of eau de Javel, which was first used at the

Javel works near Paris. Finally, a solution of potash, one part in eight of water, until effervescence began, was used. Scheele and Berthollet had used muriatic acid and manganese in the production of chlorine. Watt used common salt, black oxide of manganese, and sulphuric acid, with which he impregnated water confined in air-tight wooden vessels lined with tar.

Unaware of the experiments that Watt had carried on, Thomas Henry, of Manchester, began experimenting with chlorine, and was so successful that in 1788 he bleached a half-yard of calico before the Manchester bleachers. So great was the impression made on the bleachers that a Mr. Ridgeway, of Horwich, near Bolton, asked to be instructed in the process, and the improvements effected by Mr. Ridgeway and his sons marked the beginning of the modern methods of bleaching in England. Mr. Henry and Mr. Tenant both used lime for depriving the liquid, which Watt used in bleaching, of its obnoxious odors, and Mr. Charles Tenant finally evolved a saturated solution of chloride of lime which worked perfectly as a bleaching agent, this removing this difficulty.

After much opposition he obtained a patent in 1799 for saturating slack lime in a dry state with chloride, and the large manufacturing of the article which he started soon brought it into extensive use. From that time on the process of bleaching has been an improvement and simplification of the old method, and primarily follows that worked out by these Englishmen. Many minor improvements have come from Germany, which, with France, has adopted many of the English and American inventions.

Wool, before bleaching, is thoroughly washed with soap and soda to remove the grease for the actual bleaching, and the wool or the scoured yarn is treated either with sulphuric acid or hydrogen of peroxide. Cotton and wool can be bleached in a very much shorter time than can linen, which requires about six weeks.

DYEING

Having accomplished the bleaching, the fabric is ready to be either dyed or printed. As a rule, wool and silk are dyed, while cotton is printed. The process of dyeing, like others of the textile industry, is prehistoric, for fugitive stains, juices of fruits, decoctions of flowers, leaves, barks, and roots, and later on the use of different kinds of earths which contained iron and aluminum by which the stains were made permanent were in use before man thought of commemorating his deeds. It was originally a home industry, being practised with more perfection in Persia, India, China, and Egypt than elsewhere at the beginning of ancient history.

It was introduced into Egypt by the Arabian and Phœnician traders. We know that the Phœnician purple was a royal color in the Biblical days and even farther back than this, for it is to be found in the earliest tombs. Pliny tells how Egypt, in the first century, carried on the process, and shows that the use of indigo was understood by the Egyptians. The Alexandrians and Phœnicians exported their dye-stuffs to Greece and Rome. But history is not clear as to what degree the Greeks and Romans understood the art of dyeing, because the barbaric hordes which overran Europe at the beginning of the Christian era destroyed the records.

At the beginning of the mediæval era the art had sprung up in Italy, and was due to the importation of Oriental products by the Venetian merchants. From Venice the art spread to Florence, for we find the Florentine Rucellai, about the thirteenth century, had rediscovered the ancient method of making purple dye from certain lichens of Asia Minor. The first European book to contain an account of the process in use in the Middle Age was published at Venice in 1429 under the title "Mariegola dell' arte de tentori."

The Italians taught the process to Germany, France,

Switzerland, and Flanders; and from Flanders England secured the beginning of its knowledge, for Edward III. procured dyers from Flanders, and in 1472 incorporated the Dyers' Company in London. The discovery of America in 1492, and the early voyages of the French, Portuguese, and Spaniards to East India by way of the Cape of Good Hope, introduced new dyestuffs, and the trade in these goods was soon transferred from Italy to Spain and Portugal for the East Indian products which came by way of the Cape of Good Hope and for the American products, such as cochineal, that came from Central and South America.

With the spread of the knowledge of dyeing, the cultivation of dye-plants soon began in Europe, particularly in Holland, France, and Germany. These countries began the cultivation of dye-plants in 1507. Spaniards in 1518 began importation of red cochineal from Mexico and Peru. The Dutch chemist Drebels' discovery in 1630 of a method of dyeing wool scarlet with cochineal led to the spread of scarlet dyeing through Europe. It was carried on with much success by the Gobelin Dye Works at Paris in 1643, and at the dye works in Bow, England, in 1662.

The Royal Society of London printed in 1662 the first English account of the dyeing processes, under the title "An Apparatus to the History of the Common Practice of Dyeing to Assist Dyers." In 1672 Colbert, minister of France, published instruction in dyeing for the use of woolen manufacturers in France. The French government appointed noted French chemists to study the dyeing processes and also the problem of manufacturing, and from 1700 to 1825 many French scientists commenced work on the problem of dyeing, the most famous of these being Dufay, Hellot, Macquer, Berthollet, Board, and Chevreul.

Prussian blue was worked out in 1770; Saxony blue, or indigo extract, 1740; sulphuric acid, 1774; murexide, in 1776; picric acid, in 1788; carbonate of soda, in 1793; and bleaching powder, in 1789.

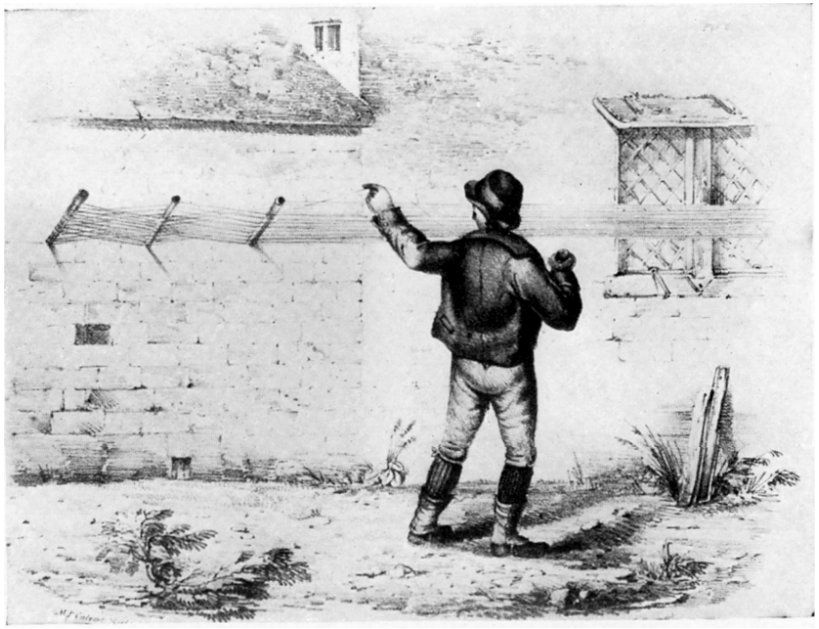
The practical side of dyeing was being worked out by a number of men who were evolving the machinery for its proper handling. These were Thomas Henry, Home, and Bancroft in England; and in France, Dambourney, Confraville, and others. The aniline process quite revolutionized methods of dyeing, and was due to the discovery in 1834 by a German chemist, Runge, who noticed that an aniline product distilled from coal tar gave a bright blue coloration under the influence of the bleaching powder.

But nothing was done until 1856, when Sir W. H. Perkins applied the discovery with success to fabrics, and soon the aniline dyes, such as magenta, aniline blue, Hoffman's violet, and others, were worked out. It was found that many of the distillations of coal-tar products, such as benzine, naphthaline, and others, yielded beautiful dyes, and little by little vegetable dyes in Europe were superseded by aniline coloring matter, so that by 1858 aniline colors were largely in use.

Graebe and Lebermann, German chemists, in 1869 secured alizarine, the coloring matter of madder root, from anthracene, the first artificial production of vegetable dyes. Artificial indigo was worked out by Basyer in 1878. Since then many coloring products have been discovered, so the aniline process has largely taken the place of vegetable matters wherever the aniline colors have been found to be permanent. The fugitive nature of aniline dyes has precluded, however, the use of some of them where fast colors have been desired.

During the evolution of the dyeing process, work was under way in the perfection of vats, boilers, and the necessary machinery for dyeing, so that by the time the dyeing process was brought to its present perfection the machinery needed for the proper distillation of dyes was at hand.

The process of dyeing has not been determined positively either as a physical or chemical process. It is based upon



PEG WARPING
(According to Richard Guest)

The threads of the warp were divided by the pegs, each alternate thread going under the centre peg, and the succeeding thread over it. This division of the threads, called the lesse, was preserved during the weaving. At the other end of the warp the threads were passed round two pegs in a similar manner.

the affinity between the fibre of the fabric and the color. Wool is very much more readily dyed than cotton, and silk occupies an intermediate position. In many instances, cotton requires the use of a metallic base to form the agent by which the dyestuff can fix itself to the cotton fabric. When once the dye has become fixed, either in wool, cotton, silk, or linen, the perfection of the process is measured by the degree to which the dye is unaffected either by light or water.

PRINTING

Textile printing originated in China and India; also was practised by the Incas of Peru, Chile, and Mexico previous to the Spanish invasion of 1519. The Chinese used engraved wooden blocks, as did also the Egyptians. To them the process of printing was made known by the Phœnicians and Arab traders.

Textile printing came into Europe in two ways,—by land and by sea. The great caravan routes through Persia and Asia Minor brought it to the southern part of Europe, while the Phœnicians brought the knowledge of the process from the Asiatic shores by way of the Cape of Good Hope. It was introduced into England in 1676 by a French refugee, who opened on the Thames at Richmond what are said to have been the first print works in England, and certainly the first print works of which we have any definite record, although printing was early carried on in France and Germany. A district about Auersburg was famous for its printing of linen. Calico printing spread more rapidly in France, Germany, Switzerland, and Austria than in England. France was noted for a long time for the excellence of its calico printing and the refinement of its designs. In 1738 calico printing was being practised in Scotland. Messrs. Clayton, of Bamberg Bridge, near Preston, established the first plant in Lancashire in 1764.

The oldest process of printing was by hand blocks. It

was originally practised in the East. In some sections it is still in use. It is a method of printing in which a number of wooden blocks of different grains are placed one upon the other, so that the grain of each block runs in a transverse direction to the grain of the upper or lower block. The design is then cut upon the face of this built-up block, each color having a separate design cut in such a way upon the built-up block that, when the printing takes place by means of the different blocks, each color will register with the next. This is the process by which the handicraft printing is still carried on in many sections.

Perrotine printing was originated by Perrot, of Rouen, in 1834. He set his blocks in machines which did automatically the printing formerly done by hand.

Engraved, or plate, printing was discovered by Bell in 1770, and resulted in the use of an engraved color plate for printing instead of wooden blocks, though wooden blocks are in use in some parts of Switzerland. The improved method of printing gave way to roller, or cylinder, printing, which was also worked out by Bell in 1785, and which is the process generally used to-day. Adam Parkinson, of Manchester, evolved a method for keeping the roller in register so that one color could be easily printed upon another, and with slight improvements this is the method by which fabrics of cotton, wool, or linen, are printed to-day.

MERCERIZING PROCESS

The Mercerizing Process, discovered in 1844 by John Mercer, a calico printer of Lancashire, England, is closely analogous to the dyeing process, though mercerizing gives either a crepon effect or the high lustre of silk. It was found by Mercer that, when a piece of bleached calico was immersed in caustic soda, it not only changed in appearance, but became stiff and translucent. Upon being washed in running water it apparently returned to its original

condition. But a more careful examination showed that the fabric was not only stronger, but the fibre had become more rounded, the central cavity smaller, and the fibre had a greater affinity for coloring matter. The process had little commercial success on account of the expense due to the cost of the caustic soda needed and also because of the shrinkage which took place in the cloth. It was revived in 1890–91 to secure a permanent crimp, or "crepon," effect on fabrics. Depoully, a Frenchman, had improved the process in 1884, so that a crimped effect could be given to goods of wool or silk or cotton.

The process was made commercially successful by the discovery of H. A. Lowe in 1889 and 1890 of a method of giving the silk lustre. As he allowed his patents to lapse, Thomas and Prevost repatented his invention in 1895, and the public interest was thereby aroused, although the patents were annulled on the grounds of Lowe's previous patents and the wide commercial use of the process.

The mercerizing process is done in two ways. In one the cotton stretched tight is washed in caustic soda, and while still stretched is washed clean in water. After the required degree of washing has taken place, the cotton is relaxed, and it is found to have acquired a permanent lustre.

In the second method the cotton is first immersed in the caustic soda and is then removed, and, after being stretched beyond its original length, is washed until the tension lessens. In the yarn the best lustre is obtained from the two or multifold long staple fibre. Yarn is mercerized either in the hank or the warp, and in either case is stretched on rollers. When mercerized in the piece, the fabric is stretched before it has the soda bath, and is subsequently sprayed from pipes, dipped into diluted sulphuric acids, and finally washed with water. The lustre seems to be produced by the reflection of light from the lustrous surface of the bands of twisted cotton fibre.

CHAPTER V

AMERICAN INDUSTRY BEFORE THE REVOLUTION

AMERICAN INDUSTRY—EARLIEST TRACES OF THE INDUSTRY—FOSTERING LEGISLATION—FIRST CLOTH MADE AND FIRST MILL ERECTED AT ROWLEY—SLAVE TRAFFIC AND IMPORTATIONS—ENGLISH EFFORTS TO HAMPER THE INDUSTRY—FIRST WORSTED MILL—SKILL ATTAINED IN TEXTILE WORK—BOUNTIES AND MONOPOLIES TO STIMULATE THE INDUSTRY—THE SPINNING CRAZE—APPROACH OF THE REVOLUTION—IMPROVEMENTS IN ENGLISH TEXTILE MACHINERY—CONDITION OF THE MARKET IMMEDIATELY AFTER THE REVOLUTION—AMERICAN EFFORT TO SECURE ENGLISH MACHINES—ENGLAND AND COTTON—STARTING OF COTTON CULTIVATION IN THE SOUTH—ORIGIN OF SEA ISLAND COTTON AND BEGINNING OF ITS CULTIVATION IN THE SOUTH.

In America the textile industry began almost as soon as the first settlers landed. Its rapid development was due to the fact that many of the first settlers came from a part of England where a knowledge of spinning and weaving was known in every rural household, and not a few who came to New England brought spinning wheels and hand looms. The distance from the old country threw the New England settlers largely upon their own resources, and the severity of the climate necessitated the warmest clothing, so that the colonists early instituted the industry of spinning at home.

The religious persecutions which had so much to do with the settlement of the Plymouth Colony continued for twenty years, and thus kept up a constant stream of immigration to the colonies; but, when the Long Parliament in 1640 stopped these persecutions, the intercourse with the mother country not only decreased, but the importation

by the colonies, of goods, particularly textiles, diminished, and the settlers were obliged to provide for their own wants. The wool used by the settlers came from Bilboa or Malaga or was grown upon the few native sheep, the forbears of which were brought from England soon after the first settlers arrived. In all the colonies there were but one thousand sheep in 1642.

EARLIEST TRACES OF THE INDUSTRY

In 1638 spinning wheels were valued at three shillings. One of the earliest records in the Probate Court of Suffolk County of Massachusetts speaks in 1639 of four yards of home-made cloth at six shillings, twopence. We have further evidence in Peter Branch's inventory in 1639, where home-made cloth is specifically mentioned, that spinning and weaving had begun thus early. And at this early date mills for grinding grain, driven by water or wind, and which were to furnish the site for many a fulling mill and spinning or weaving establishment, dotted the lands of Plymouth, the Bay Colony, and Connecticut. Trade was opened about 1636 with the West Indies for cotton and rum, in exchange for which the Massachusetts settlers sent Indians, and later negro slaves.

One of the first ships to bring a large supply of cotton to the colonies was the "Desire" of Salem, the biggest ship of her time, which landed her cargo in 1638 at the port from which she hailed. The first ship to bring cotton to Boston was the "Trial," and she landed a cargo in Boston soon afterwards, from St. Christopher's Island of the West Indies.

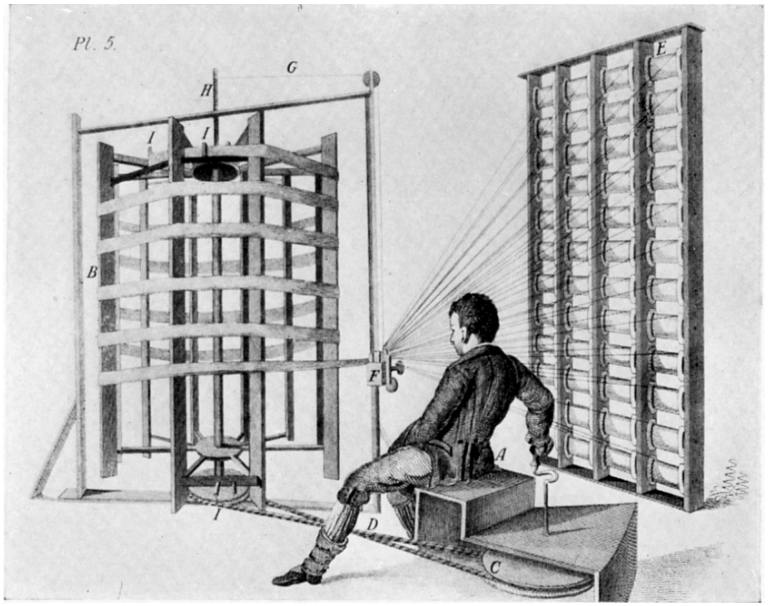
Many other interesting facts relating to this period may be found among the Proceedings of the National Association of Cotton Manufacturers, compiled by its secretary.

FOSTERING LEGISLATION

The colonial legislatures soon gave the industry favorable attention, passing acts compelling the practice of spinning and weaving, directing the planting of flax and the raising of sheep, and offering bounties for the production of fabrics. The governing body of the Bay State Colony, called the General Court then as now, as early as 1640 gave a helping hand to the infant industries by passing two orders. The first was for the purpose of encouraging the manufacture of linen, and directed the towns to see what seeds were needed for the growth of flax, to learn what persons were skilful at breaking and in the use of wheels, and ordained that boys and girls be taught to spin yarn. The second order offered for a period of three years a bounty of threepence on a shilling for linen, woolen, or cotton cloth, if spun or woven, in the first two instances of wool or linen of native growth.

The solicitude of the General Court of Massachusetts Bay for the textile industry is shown in the order dated May 13, 1640, which is thought by the best authorities to be the earliest reference in New England by the General Court to the manufacture of cloth:—

"The Court, taking into serios consideration the absolute necessity for the raising of the manifacture of linnen cloth, &c., doth declare that it is the intent of this Court that there shall bee an order setled about it, and therefore doth require the magistrats and deputies of the severall towns to acquaint the townesmen therewith, and to make inquiry what seed is in every town, what men and woomen are skillful in the braking, spinning, weaving; what means for the providing of wheeles; and to consider with those skillful in that manifacture, what course may be taken to raise the materials, and produce the manifacture, and what course may be taken for teaching the boys and girls in all townes the spinning of the yarn; and to returne



WARPING

(*According to Richard Guest*)

The warper sits at *A*, and turns the reel *B* by the wheel *G* and rope *D*. *E*, the yarn on bobbins; *F*, the slide, which rises and falls by the coiling or uncoiling of the cord *G* round or from the axle of the reel *H*; III, wooden pins similar to those used in peg warping.

to the next Court their severall and joynt advise about this thing. The like consideration would bee had for the spinning and weaveing of cotton woole."

The slowness of the importation of flax led the General Court in 1640 to recommend the gathering of wild hemp, which had been used by the Indians for rope and mat making, and twopence per pound was offered for it by many people. This native hemp had originally been brought from Connecticut by one Oldham, who claimed it was better than English hemp. Although it raised great expectations among the colonists, it failed to fill the place of English hemp, which continued to be a regular importation.

Goodman Nutt and others in 1641 received a bounty of twelvepence per yard for eighty-three and one-half yards of homespun, which was probably a coarse linen, and this is the first mention of cloth made in America. This bounty was repealed the following June. The General Assembly of Connecticut in 1641 ordered that hemp and flax should be sown by each family, and the seed preserved, "that we myght in tyme haue supply of lynnen cloath amongst ourselues"; Governor Winthrop of Massachusetts ordered that runs of stone where corn and meal could be ground be established on all available water sites; and many other steps were taken to make the colonies independent industrially of the mother country.

Shortly after came what one might call the first business panic, for John Winthrop, Jr., says that "corn in 1641 would buy nothing. Many men had gone out of the country, so that no man could pay his just debts, nor merchants make returns to England for commodities, and commerce was at its lowest." It doubtless gave a new impulse to the home industries through the necessity of supplying the colonial demand, as this financial condition of the colony practically precluded trade with England.

According to the author of "New England's First Fruits," written at Boston in 1642, "With cotton wooll (which we

have at very reasonable rates from the islands) and our linnen yarne we can make dimities and fustians for our summer cloathing; and having a matter of 1000 sheepe which prosper well, to begin withal, in a competent time we hope to have wollen cloath there made."

Home spinning impelled by the necessities of the settlers, and encouraged by the enactments of the legislature, in 1643 filled an important place in the Puritan industries, and a segregation of those engaged in the manufacture of textiles had begun, which later was to bear fruit in the great textile centres of Massachusetts.

FIRST CLOTH MADE AND FIRST MILL ERECTED AT ROWLEY

Twenty or more Yorkshire families had settled at Rowley about 1638, and to them belongs the distinction of manufacturing the first cloth in the United States, as well as erecting the first mill.

According to Edward Johnson's book, "Wonder-working Providences of Sion's Saviour in New England," published at London, 1654, "The Lord brought over the zealous-affected and judicious servant of His, Master Ezekiel Rogers, with an holy and humble people, made his progress to the northeastward and erected a town about six miles from Ipswich called Rowley. The people, being very industrious every way, soon built many houses to the number of about three score families and were the first people that set upon making cloth in this western world; for which end they built a fulling mill (1643) and caused their little ones to be very diligent in spinning cotton-woole, many of them having been clothiers in England till their zeale to promote the gospel of Christ caused them to wander."

This mill, built by John Pearson, was the first cloth mill erected in the United States. Rowley's manufactures comprised "cloath and rugs of cotton wool, and also sheeps' wool," showing that thus early cotton, which Columbus

had found was being manufactured into breeches by the natives of the West Indies, was an article of New England manufacture.

Because of the fact that nearly all of the early textile mills were located in the upper part of stone water mills, the corn being ground on the first floor, it is possible to trace back to these water rights the titles of some of the largest textile mills in New England to-day; and many of the old deeds refer to these "runs of stone" as the very beginning of their rights. The proprietors of the locks and canals on the Lowell and Merrimac Rivers maintain to this day a run of stone grinding the grist for the townspeople of Lowell. The stones are in the old grist-mill, corner of Ann and French Streets, and the old locks are near the Lowell machine-shop yard.

SLAVE TRAFFIC AND IMPORTATIONS

One of the reasons for the early commercial relations between the Leeward Islands (especially the Barbadoes, settled in 1623) and New England was that two of Governor Winthrop's sons settled in these islands, one at Barbadoes and one at Antigua. This fact, as well as the mutual needs of the two places, early led to commercial intercourse, and soon a steady trade was in progress. The importation of cotton and rum from the Barbadoes by the Puritans increased, and, when it became difficult to secure Indian slaves, the Puritans brought negro slaves from Africa, and sold them to the West Indians in place of the Indians, so that New England was not only the first to promote the merchandising of slaves in America, but later, when the heinousness of the traffic appalled the New England conscience, New England was also the first to take steps to end the traffic.

The wool used by the early mills, which came from Spain and England, was spun into yarn by the neighboring farmers,

who also raised the sheep that supplied the domestic wool. Efforts were made to raise flax and hemp, but, to meet the colonial demand, it had to be imported in considerable quantities.

The colonies all along the Atlantic coast as far south as Philadelphia, soon after their establishment, realized the necessity of extending production by manufactures which were not indigenous to the country, or the need of what is now known as protection to industry. But this phase of protection took the shape of special legislation by bounties and relief from duties. As late as May 1, 1770, the *Essex Gazette* of Salem printed the following:—

"Last Thursday the premium of four guineas on the best piece of Broad Cloth, bro't to Edes & Gill's Printing Office, in Boston, for sale, of 12 yards long and 7 quarters wide, was adjudged to Mr. Toby, Cambridge & Co., cf Lynn, who from the 1st of June, 1769, to May 1st, 1770, have made upwards of 500 yards of Broad Cloth, and upwards of 3000 yards of narrow cloths from the 1st of June, 1769, to the 1st of April, 1770."

The early bounties for making cloth greatly promoted the growth of the textile industry, and, though the colonial enactments were soon repealed, the industry had become so firmly established by the middle of the seventeenth century that wool was a regular article of merchandise, and statutes were passed by the Bay State colonies prescribing that it should be washed when offered for sale.

ENGLISH EFFORTS TO HAMPER THE INDUSTRY

Oliver Cromwell, the stern "protector" of England from 1653 to 1658, watched with anxious eye the effect of the colonial textile development upon England's own industry, and soon prohibited the export of sheep's wool and woolen yarn from England. This act, which was passed Aug. 22, 1654, for the purpose of encouraging the raising of sheep

in England as well as to prevent the exportation of wool from England, had a preamble which read as follows:—

"Whereas, this countrie is at this tyme in great straights in respect to clothing and the most likeljest way tending to our supply in that respect is the rjsing and keeping of sheepe with our iurisdiction and in detail the exporting of yews is forbidden as well as the injunction that none shall be killed until they are two years old."

One of the results of these stringent restrictions was a marked effect on colonial sheep raising, for in 1660 a report was made by the English consul that the colonies not only had one hundred thousand sheep, but were buying wool from the Dutch. Already trade had begun with Spain for wool in exchange for New England staves and salt fish.

The Massachusetts General Court met the restriction in 1656 with enactments that ordered the commons to be cleared for sheep, rams to be inspected, and hemp and flax seed to be saved and sown. The selectmen in every town were directed to "turn women, girls, and boys towards weaving," and officials were required "to assess each family for one or more spinners or fractional part, that every one thus assessed do after this present year 1656 spin for thirty weeks every year a pound per week of lining cotton wooling and so proportionately for halfe or quarter spinners under penalty of twelve pence for each pound short."

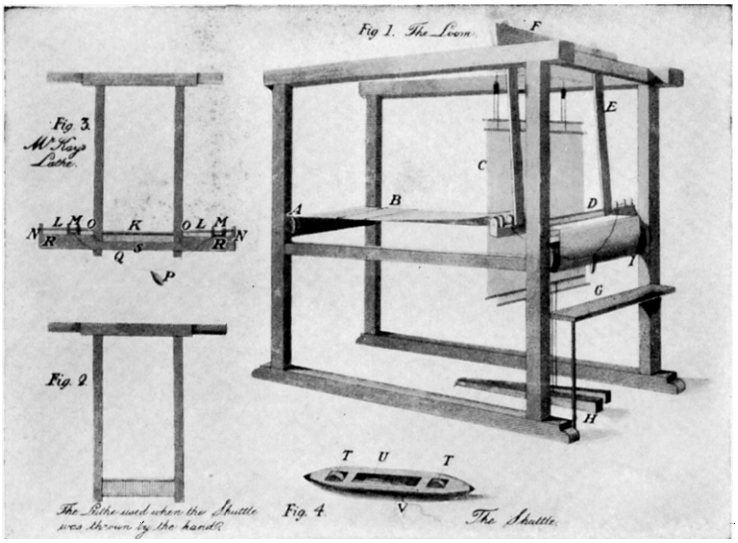
Classes of five, six, and ten in number, under class teachers, were taught spinning. Already in 1655 John Pierpont and others "had sett down a bast mill or under shot where the old mill stood in Roxbury," and the same year he was allowed to erect a fulling mill. The competition in 1660 in this infant industry had reached a condition where cloth was being cheapened by the use of inferior material, and the General Court took cognizance of it by appointing a commission that was empowered to report an ordinance against deceit in making and dressing cloth. Fulling

mills were established at Watertown in 1662, Andover in 1673, Ipswich in 1675, and Barnstable in 1687. Not only was the domestic demand for dresses of tammies and light worsted fabrics as well as that for men's clothing being met by the Bay Colony, but in 1675 wool was exported to France in return for linen, and to Spain and Portugal for wine. The proficiency of the Puritans alarmed the English textile workers, especially as the colonial export trade was beginning to make some inroads upon English exports, and in 1699 Parliament passed a law prohibiting the exportation or movement of wool either within or without the plantations. This very stringent act read in part as follows:—

"No wool, woolfells or shortlings, morlings, wool-fabrics, worsteds, Bay or woolen yarn, cloath, serge, bags, kerseys, says, frizes, druggets, shalloons or any other drapery, stuffs or woolen manufactured whatsoever, made or mixed with wool or wool flax, being the production or manufacture of any of the English plantations in America, shall be laden on any ship or vessel." Nor could same wares be laid upon any horse or carriage to be transported to any place whatsoever.

FIRST WORSTED MILL

The first worsted mill was established in 1695 by John Cornish, a comber, dyer, weaver, and fuller of Boston. He dyed with two furnaces, used two combs, and wove with four looms. His fulling mill was detached from the rest of the plant. The spinning was done by farmers, who on market days called at the mill for the clean top wool from which the noil had been removed and brought back the spun worsted. When Cornish died, serge was in the making on his looms. He left an estate of about twelve hundred dollars. German immigrants had in 1683 and 1689 established the manufacture of hosiery in Germantown, Pa., and also the manufacture of linen.



THE LOOM THAT PRECEDED THE POWER LOOM

(According to Richard Guest)

Figure 1. The warp is wound upon the yarn beam *A;* the lesse is carefully preserved by rods *B;* one-half of the threads pass through one heald, and the other half through the other. The healds *C* are looped in the middle, and the threads of the warp go through the loops. From the healds the warp passes through the reed *D*, which is fixed in a movable frame called the lathe, *E*. A cross-piece, *F*, on the upper part of the lathe rests on each side of the loom, and the lathe swings on this cross-piece. The weaver sits on the seat *G*, and with his foot presses down one of the treadles *H*, which raises one of the healds and each alternate thread of the warp. The weaver holds the picking peg in his right hand, and with it drives the shuttle from one side of the lathe to the other, between and across the threads of the warp. The shuttle passes between the reed and the weaver, and leaves behind it a shoot of weft. By pulling the lathe towards him with his left hand, this shoot of weft is driven close to the cloth made by former casts of the shuttle. The cloth is wound upon the cloth beam *I*.

Figure 2. The lathe used when the shuttle was thrown by the hand.

Figure 3. Mr. Kay's lathe. *K*, the reed; *LL*, iron rods; *MM*, movable slides which work on the rods from *N* to *O*, and are fastened to *P*, the picking peg, by a string *Q; RR*, boxes, and the weaver by a sudden jerk with the picking peg moves the slide from *N* to *O*, and drives the shuttle along the sled, or shuttle race, *S*, into the box on the other side.

Figure 4. The shuttle. *TT*, wheels on which the shuttle moves along the sled. *U*, the weft, fixed in the shuttle upon a skewer. As the shuttle flies across the warp, the weft unrolls from the skewer and runs through a small hole, *V*, in the side of the shuttle.

SKILL ATTAINED IN TEXTILE WORK

There are many records to show that the colonists of New England and New York had attained considerable skill in textile work before the opening of the eighteenth century and were supplying a growing domestic demand.

According to Bishop's "History of Manufactures," America at this time was supplying quite exclusively her own demand for the stouter and coarser kinds of mixed fabrics, particularly those into which linen and hemp thread entered. Cotton, which was being imported from the Barbadoes and occasionally from Smyrna and elsewhere, was being woven with linen into fustian and other fabrics.

Linen, however, continued to be the principal material used in the manufacture of textiles, being employed at this early date where cotton would now be used. Much attention was therefore given to the planting and raising of flax and hemp which the linen manufacture called for in growing quantities. Much of the domestic linen was of a coarse texture, and was combined in various ways with wool into kerseys, linsey-woolseys, serges, and druggets. These comprised the outer clothing of most of the population in winter, while hempen cloth or linen, fine or coarse according to the station of the wearer, was the outer apparel for warm-weather wear.

The domestic industry supplied the shirts and underwear, bed and table apparel, of nearly all classes, but, as the process of manufacture was crude, the finer finish of imported fabrics was little known in America. The fabrics were serviceable rather than beautiful, and the material used was grown upon the farms, or plantations. The various steps in the preparation of the flax, such as the breaking and heckling, were performed by the men, while the lighter forms of labor, such as the carding, spinning, and often the weaving, together with the bleaching and dyeing, were delegated to wives and daughters.

All thrifty families took much pride in the abundance and quality of their linen, and everywhere about the colonies domestic linen was much in evidence. An English visitor, Lord Cornbury, said in 1705 he had seen serge made upon Long Island that any man might wear, and in 1708 he reported "they make very good linen for common use." In 1708 Caleb Heathcote wrote "that three-quarters of the linen and wool used by the Colonists was of domestic manufacture." As early as 1706 Joseph Lewis had a weaving establishment at Waterbury, Conn., and in 1718 Massachusetts laid an import duty on manufactures, and the province, according to the laws of trade, worked wool into coarse cloth, druggets, and serges. Samuel Hall in 1722 was not only making buckram cloth in Boston, but was dealing in it as a retail merchant.

In 1724 Richard Rogers, of New London, Conn., was weaving duck on eight looms. He expended one hundred and forty pounds, and in the following year increased it to two hundred and fifty pounds for enlarging his plant, and the General Court gave him a monopoly for ten years. In 1726 the Salem Court awarded Nathaniel Potter thirteen pounds and fifteen shillings for three pieces of linen manufactured at Lynn.

In most of the New England farmsteads and villages spinning wheels and looms for wool were to be found, and by 1746 spinning was an occupation in every household, rich as well as poor, while spinning festivals on the common were holiday pastimes. The great interest in spinning revived the old talk of a town school for teaching it, which finally led to the erection of a brick building for special instruction. A tax on carriages to support this industrial institution was proposed, but was abandoned soon afterward.

In the States of Massachusetts, Rhode Island, and Connecticut the textile industry had become thoroughly established, and the governing bodies were fostering it with lib-

eral bounties. The General Assembly of Rhode Island in 1722 voted William Borden, of Newport, an ancestor of the well-known Borden family of Fall River, twenty shillings for each bolt of duck made of hemp grown in the province equal to good Holland duck. The bounty was to last ten years. But it was not enough, for in response to a petition five hundred pounds was granted him May, 1725, from the colonial treasury, "if there be so much to spare."

He again asked for assistance in 1728, whereupon the Assembly issued three hundred pounds in bills of credit at his expense and loaned the amount to him without interest, with surety that it would be repaid in ten years. By the terms of the resolution he was required to make one hundred and fifty bolts every year of good merchantable duck. In 1731 the amount he should make was changed so that the bounty was granted upon any quantity. Bounties also were given to growers of flax and hemp, to encourage the making of linen. Such progress had the colonies made that by 1732 one-third of the woolens needed were of home manufacture, two-thirds being imported from England.

BOUNTIES AND MONOPOLIES TO STIMULATE THE INDUSTRY

Rhode Island was paying bounties to growers of flax as well as to manufacturers, while Massachusetts in 1726 granted a monopoly for hemp manufacturing to a petitioner and a bounty for "each piece thirty-five yards long, thirty inches wide, of good, even thread, well drove, of good, bright color, being wholly of good, strong, water-retted hemp." Nathaniel Potter in 1726 was granted thirteen pounds and fifteen shillings by the Salem Court for three pieces of linen made at Lynn. Hemp was received in 1739 at fourpence a pound for taxes, and flax for sixpence a pound. In almost every hamlet, by 1746, weaving mills might be found.

The promotion of the textile industry early in 1748 had

attracted such public interest that a movement was started in Boston not only for the promotion of manufactures, which would relieve the province from the drain of sending money to England to meet the excess of imports over exports, to develop domestic manufactures and the immigration of skilled mechanics, but also to afford employment to the poor.

Accordingly, a number of the leading citizens of Boston on March 10, 1748, in order to compass these purposes, organized and subscribed from fifty to one hundred pounds each to promote the linen manufacture. Another meeting was held on the 12th of July, 1750, which seems to have resulted only in further talk of the establishment of a linen manufactory house on the Common, and it was also proposed to open several spinning schools in the town where children might be taught free of charge.

But it seemed difficult for the industry to get a start, and finally the Society for Encouraging Industries and Employing the Poor was organized Aug. 21, 1751, under whose energetic auspices the linen manufactory was finally started. The society is believed to have been the first formed in this country for the development of an industry and to provide employment for the poor. The Linen Manufactory House thus established was not the same as the manufactory house which was built in 1753 on Longacre Street, now Tremont Street, at the junction with Hamilton Place, by the General Court of Massachusetts.

The Linen Men's House on the Common advertised for yarn in 1750. Homespun garments of all kinds, hemp, flax, and wool, were now being made by the colonists, and spinning and weaving seemed to be the one industry that received the patronizing care of the colonial government. The records of the General Court are full of enactments relating to this industry.

Cotton up to this time was largely imported from the West Indies, as the home spinners often filled the flax or

wool warp with a cotton weft, and, as reported in 1756 by Governor Moore of New York, there were two kinds of woolen being made,—one, coarse, of all wool; the other, linsey-woolsey, of linen in the warp and woolen in the woof. Weavers were then wandering all over the country, weaving yarns that had been spun on the household looms.

THE SPINNING CRAZE

The settlement of one hundred Irish families in 1718 at Nutfield, now Londonderry, N.H., on the left bank of the Merrimac, a few miles below Manchester, gave an impulse to the production of linen, and also influenced the starting of what has been termed the Boston Spinning Craze.

These Irish immigrants spun and wove the standard linen fabrics for which Ireland has long been famous, and their skill and industry stimulated the people of Boston to increase the amount and quality of the homespun production by thorough instruction in spinning and weaving. Classes in the industry had been held from time to time on the Common and in the upper part of the old State House, but no steps were taken to teach the art systematically until 1720, when a committee was appointed to see what could be done. They recommended procuring a house and hiring a weaver whose wife should instruct children in spinning flax. Their board was to be furnished for three months by the overseers of the town, and at the expiration of the three months the children were to have their own earnings. It was further recommended that the town should provide twenty spinning wheels, and a prize of five pounds was offered for the first piece of linen spun and woven that was worth four shillings per yard.

The next year the plan was changed to an offer of a loan of three hundred pounds without interest to any one who would start such a school. Other plans were suggested,

but it was not until 1721 that any decisive action was taken. Daniel Oliver then erected the first spinning school on "land below Harrison's Walk," at his own expense, and the school which had begun on the Common had a shelter.

Prizes were offered, and many strutted about in homespun clothes of their own making. The people wore woolen clothing mixed with linen or flax for summer wear, and spinning continued to grow in favor, and soon became popular among rich and poor alike. Justice Samuel Sewall speaks of a spinning-bee on the Common in which five hundred fashionable women took part. Spinning had become an occupation in every household.

At the second anniversary of Boston's Society for Promoting Industry and Frugality on Aug. 8, 1753, the Rev. Samuel Cooper preached a sermon before the society, and a collection of four hundred and fifty-three pounds was raised. Three hundred young women appeared that afternoon on the Common in a procession, accompanied by music, and men carrying a platform on which a weaver was operating a loom, and, seating themselves in three rows, they spun at their spinning wheels. Weavers, cleanly dressed in garments of their own manufacture, were also present.

Some of the enthusiasm may have been aroused by an act passed on the 23d of June, 1753, by the "Great and General Court of his Majesties Province of the Massachusetts Bay in New England," which granted fifteen hundred pounds to encourage the manufacture of linen. It provided that a tax be levied on every coach, chariot, chaise, calash, and chair within the province, to be paid by the owner thereof annually, except the governor, lieutenant governor, the president of Harvard, and the ministers of the province. The money was to be applied to the buying of a piece of land and building or purchasing a suitable house for carrying on linen manufacture.

Accordingly, a lot was bought Sept. 15, 1753, on Com-

HIGH'S JENNY

(*According to Richard Guest*)

Figure 1.—*A*, the spindles, turned by strings from the drum *B*; *C*, the rovings; *D*, the wire loops; *E*, the clove, which rises and falls in the groove *FF*, and is opened and shut by the latch *G*. When the clove is down at the spindles, at *H* it is opened and the drum is turned, which raises the clove by means of the cord *II*, which, passing over pulleys, is coiled round the bobbin *K*. As the clove rises, the rovings slide through it. When the clove is raised five or six inches to *L*, it is shut fast by the latch *G*, the drum is again turned, which sets the spindles in motion and raises the clove by the coiling of the cord round the bobbin. The rising of the clove draws out the five or six inches of roving shut fast between the spindles and the clove into weft. When the clove is raised to *M*, the roving is sufficiently drawn out. The bobbin is then moved by a latch from the lower part of the axle, nearer to the handle where the axle is of less diameter than the bore of the bobbin. The drum is then turned, and the spindles again revolve, giving to the weft the necessary twist. During this twisting of the weft, the clove and the bobbin remain stationary, the axle of the drum turning within the bobbin, and a leaden weight, *N*, counterbalancing the clove. When twisted, the clove is lowered from *M* to *H* by the hand of the spinner, and the weft copped, or wound upon the spindles. The drop rod *O* guides the weft upon the spindles.

Figure 2.—The axle of the drum square at *P*, and round and of less diameter at *Q*.

Figure 3.—The bobbin, which when at *P* turns with the axle, but when at *Q* remains stationary.

mon Street, and a handsome brick building erected, which was later known as the Manufactory House. The west end fronted on Longacre, now Tremont, Street, and on the wall was the sign of its purpose in the form of a female figure holding a distaff. The building was in operation under the auspices of the society until 1758.

An advertisement in the Boston *News Letter* of Sept. 9, 1762, showed that the spinning school was then again opened under the direction of John Brown, who was engaged in the making of linen. John Brown continued in peaceful possession until 1768, when an effort was made to dispossess him in order to use the building as barracks for the British soldiers, who then occupied Boston. When Brown refused to get out, the sheriff and the chief justice proceeded to the house, but Brown locked the doors, and informed them through the window that only an order from the General Court could move him. Next day the sheriff came again with his deputies, and climbed in the cellar window. Brown showed his mettle by immediately declaring the sheriff his prisoner. Then a guard was sent to protect the sheriff, but it was finally called off, and Brown was left in possession; and the soldiers were accommodated elsewhere.

APPROACH OF THE REVOLUTION

The English policy of making the colonies dependent, as far as possible, upon the home country for manufactured goods, particularly textiles, had much to do with hastening the slow approach of the Revolution. But, despite this short-sighted policy, in many different parts of the colonies homespun garments were being made of cotton and wool in greater and greater quantities with more and more skill.

The enactment of the Stamp Act and the approach of the Revolution caused a greater demand for domestic goods, and also brought the social prestige of the leaders of

public opinion to further the spread of the textile industry by their advocacy of a refusal to use English goods.

The desire to promote domestic manufacture caused in New York the formation in November, 1764, of "the Society for the Promotion of Arts, Agriculture, and Economy," the principal object of which was to encourage the manufacture of linen. For a number of years its encouragement took the form of premiums for the largest quantity of linen yarn and linen cloth spun by a resident of the province. In 1767 Governor Moore of that province reported to the British Board of Trade that there was a small manufactory of linen in New York City under the management of a man named Obadiah Wells, which was supported by the society. It used about fourteen looms and gave bread to several poor families. Coarse wool and linsey-woolsey was also, he said, being made in New York.

Providence, R.I., set an example in 1766, when the Daughters of Liberty held all-day sessions of spinning, and, as a result of their influence, the president and the first graduating class of Rhode Island College at Commencement in 1769 were clothed in fabrics of American manufacture. Men's and women's wear now included blue, black, and claret broadcloth. The Senior Class in 1768 at Harvard College, Cambridge, was much commended for agreeing to graduate dressed wholly in native fabrics.

At the opening of the Revolution New England was supplying the demand for cheap clothing; while silk, owing to the encouragement that England, hoping to take this trade from France, gave to this branch of the textile industry, had made a good start in Connecticut, Pennsylvania, Georgia and South Carolina. Silk culture was encouraged all over New England, and there is scarcely one of the New England cities that has not its Mulberry Street, named from the trees which were set out to furnish food for silkworms.

For all the finer cotton and woolen garments, however,

America was still dependent upon England, because English spinners and weavers were more skilful, and also had the advantage of the improvements in textile machinery, the exportation of which England so jealously guarded. Just before the Revolution, efforts were made in America to start manufacturing with machinery, but the absence of artisans who knew how to construct the machines of Hargreaves and Arkwright rendered these attempts futile.

IMPROVEMENTS IN ENGLISH TEXTILE MACHINERY

The great improvements in the textile machinery in England from 1738, when Lewis Paul took out the first patent for improvement in spinning cotton, to 1775, when Arkwright completed his great invention, revolutionized the English industry and promised to give England control of the world's textile market. England, not slow to perceive the great advantage within her grasp, adopted stringent measures to prevent a spread of the knowledge of the various textile machines, and Parliament in 1774, to restrict to England a monopoly of the textile machinery which the inventive genius of her workmen was rapidly perfecting, as well as to prevent the development of the industry in America, prohibited the exportation of the machinery, and attempted to prevent with severe penalties the emigration of textile artisans.

One of the first steps to improve American manufacturing was taken by that far-sighted early Quaker merchant of Philadelphia, Samuel Wetherill, Jr., who, March 16, 1775, entered an agreement of copartnership with a number of others in Philadelphia under the title "The United Company of Philadelphia, for Promoting American Manufactures." It set up the American manufactory for woolens, cottons, and linens in a house rented for forty pounds a year, at the south-west corner of Ninth and Market Streets, about where a part of the post-office now is, and the factory

continued to prosper until the occupation of Philadelphia by the British put it out of business. The yarn was spun upon a spinning jenny made by Christopher Tully and capable of spinning twenty-four threads. He was the first in America to build a machine from a model of Hargreaves. The attempt to use the jenny was not wholly successful, but the manufactory paid a dividend and ran in all about two years.

During the Revolution the imports from England fell off, and the colonies, being thrown upon their own resources, continued to develop the industry which clothed them; and better and better fabrics were turned from their looms. The first to make jeans, fustians, everlastings, and coatings in America on a commercial scale, was probably the aforesaid enterprising Samuel Wetherill, Jr. His goods were sold at his dwelling-house and factory, on what was then South Alley, between Market and Arch Streets and between Fifth and Sixth Streets, Philadelphia. This was prior to April 3, 1782, when his advertisement appeared in the *Pennsylvania Gazette.*

John Hewson, the first calico printer, came to this country from England at the invitation of Benjamin Franklin, and worked at his trade in Philadelphia. He was taken prisoner at the battle of Monmouth, and escaped. Thereupon the British, because of his skill in a branch of manufacture in which England wished to suppress colonial competition, offered a reward of fifty guineas for his head. After the Revolution he continued in business, and in 1789 received from the State treasury a loan of two hundred pounds, to enable him to carry on the business of calico printing and bleaching.

CONDITION OF THE MARKET IMMEDIATELY AFTER THE REVOLUTION

The close of the Revolution gave the English manufacturers of fabrics an opportunity to flood the American market with the one production which their activity during the Revolution had created in England, and English goods from 1783–87 were sold in America at prices less than their cost in Europe and for much less than they could be manufactured on this side. Some of the States imposed high duties upon fabrics manufactured by other States. This duty between the States, together with the low cost of English-made fabrics, was a serious detriment to American manufacturing, and numbers of persons in different parts of the United States undertook movements to promote American industries.

Some knowledge of the new labor-saving machines reached America from England, but nothing very definite about them was known because of the precautions England had taken to prevent the knowledge spreading abroad. So stringent were these acts that it was not until after 1770 that it was possible to secure from England designs and models of the new machinery, and then only with the utmost difficulty, owing to the prohibitory legislation. Some Hargreaves jennies and carding machines had been smuggled in, but none of Arkwright's machines, so that until Samuel Slater constructed these machines in 1790 at Pawtucket every attempt to make yarn by water power had failed.

AMERICAN EFFORT TO SECURE ENGLISH MACHINES

All kinds of expedients were tried by Americans to obtain either designs or copies of the English machines. Tench Coxe, a public-spirited Philadelphian, at his own expense had sent an English mechanic, who was living in Philadelphia, to construct brass models of the Arkwright machines.

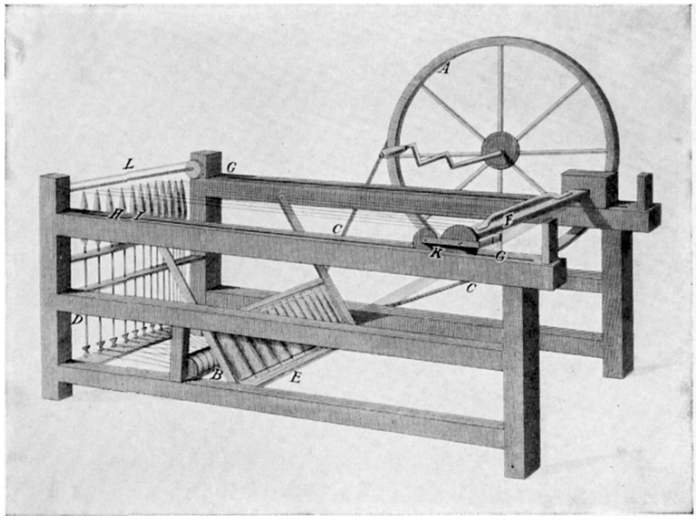
The models were to be shipped to Paris, and through the agency of the American minister reshipped to America. The designs of the mechanic were discovered, the models were seized, and the mechanic himself was bonded not to leave England for three years.

At another time, models were packed and shipped to France, to be repacked and reshipped by the American minister to France, but they were seized in transit. Again, when an English artisan had succeeded in smuggling himself aboard a ship bound for America, the ship was stopped, searched, and the artisan seized and brought back to England and put under bonds not to leave. In some instances, machines were bought in England, taken apart, boxed separately, labelled agricultural implements, and reshipped to America. For instance, card clothing was mounted on handles and called "cards for cattle"; while the spindles were called "teeth for horse-rakes." In other instances the machines were cut up in small pieces, shipped as glassware to France, and reshipped to America. It was not long after 1800 that the makers of textiles on this side of the water were almost as well equipped with English machines as were the English themselves.

ENGLAND AND COTTON

According to Bain's "History of Cotton," the importation of cotton in 1730, before the invention of the fly shuttle, was but 1,545,472 pounds, and the value of the cotton goods exported was 13,524 pounds; while in 1800, thirteen years after the invention of Cartwright's loom and Watt's steam-engine, the cotton imported was 56,010,732 pounds, and the exports were 5,406,501 pounds. The value of the product in 1787 was 3,304,371 pounds sterling, or five and one-half times that of 1766.

Cotton was being used in 1787 in the one hundred and forty-three mills in England, Scotland, Wales, and the Isle



IMPROVED JENNY

(*According to Guest*)

The wheel *A* turns the cylinder *B* by a band *CC*. The spindles are turned by strings from the cylinder *B*. The rovings are placed on the frame *E* and pass through the clove *F* to the spindles. The clove moves in the groove *GG*. When the clove is close to the spindles at *H*, it is opened and drawn from them eight or ten inches to *I*, the rovings sliding through it. It is then shut fast, and the spindles are set in motion by turning the wheel *A*. As the spindles revolve, the clove is drawn back from *I* to *K* by the left hand of the spinner: this stretches out the rovings into weft. When stretched out, the spinner holds the clove at *K* with the left hand, and gives the proper degree of twist by turning the wheel *A* with the right hand. The weft is then copped by turning the clove to *H*. *L*, the drop rod. The spindles in the first improved jennies were turned by strings from a drum on a perpendicular axis.

of Man as follows: calico and muslins, 11,600,000 pounds; fustians, 6,000,000 pounds; mixtures with silk and linen, 2,000,000 pounds; hosiery, 1,500,000 pounds; candlewicks, 1,500,000 pounds,—making a total of 22,600,000 pounds. 162,000 hands were employed in the industry.

Before Arkwright, printed calicoes were made of linen warp and cotton weft, because the cotton spun by hand was not strong enough to use for the warp. After Arkwright had strengthened the warp, manufacturers could not be persuaded to use it, and when Mr. Jedediah Strutt, Mr. Arkwright's partner, successfully wove cotton warp into calico, he was under the law subjected to a double duty and had to petition Parliament before he secured relief.

In 1780 there were twenty water-frame factories using Arkwright's patent in England. After 1785, when the court declared his patents void, the factories sprang up so rapidly that by 1790 there were one hundred and fifty in England and Wales. Before 1787 not only had the United States not exported any quantity of domestic cotton, but no planter had adopted its cultivation as a staple crop. Cotton was then secured from the East and West Indies and Brazil, for it was not until 1784 that England commenced to import cotton from the United States.

STARTING OF COTTON CULTIVATION IN THE SOUTH

One of the first things to which Tench Coxe, who subsequently became Assistant Secretary of the Treasury under Alexander Hamilton, turned his enterprising mind, was to the problem of the production of cotton in the colonies. He was early convinced of its feasibility, despite that prior to 1736 cotton, save as a garden flower, was uncultivated in the South. It was in 1736 being raised as a garden flower as far north as Talbot County, Maryland, and elsewhere on the eastern shore of Maryland, the lower coun-

ties of Delaware, and other places in the Middle States, but its useful qualities soon were recognized, and its regular cultivation for fabrics was begun in those sections. Coxe, having learned of the labor-saving machines in Great Britain and having secured more or less accurate knowledge of great importance to the cotton industry, turned his mind to increasing the production of cotton by its cultivation in the South, that "the Cotton Spinning Mill might be brought into very beneficial use in the United States." He took effective measures to interest the whole community, particularly the planters of the five original Southern States.

But Coxe found it a slow task to interest the planters of these five States. At the convention held in 1786 at Annapolis to consider what means could be used to improve the industrial condition of the country, James Madison, later President, who was a member of the convention, said in a conversation with Coxe, "There was no reason to doubt that the United States would one day become a great cotton-producing country."

And in the same year Thomas Jefferson wrote to M. de Warville, under date of August 15: "The four southernmost states make a great deal of cotton. Their poor are almost entirely clothed in it winter and summer. In winter they wear shirts of it, and outer clothing of cotton and wool mixed. In summer their shirts are linen, but the outer clothing cotton. The dress of the women is almost entirely of cotton manufactured by themselves, except the richer class, and even many of these wear a good deal of homespun cotton. It is as well manufactured as the calicoes of Europe. Those four states furnish a great deal of cotton to the states north of them, who cannot make, as being too cold."

The best evidence proves that the first culture of cotton in the South was made on the peninsula between the Delaware and Chesapeake Bays, and that the growth of cotton spread across to Western Maryland and Virginia, and so on extended until it had become the great Southern crop.

ORIGIN OF SEA ISLAND COTTON AND BEGINNING OF ITS CULTIVATION IN THE SOUTH

The story of Sea Island cotton is much more precise. In 1785 Patrick Walsh, of Kingston, Jamaica, persuaded his friend, Frank Levett, who with his family and negroes was in a distressed condition, to settle on Sapelo, one of the islands off the coast of Georgia, and plant provisions. Walsh sent him in 1786 a large quantity of various seeds of Jamaica, and also three large sacks of the Pernambuco cotton seed. Levett wrote Walsh in 1789:—

"Being in want of the sacks for gathering in my provisions I shook their contents on the dung hill, and it happening to be a very wet season in the Spring, multitudes of plants covered the place. Those I drew out and transplanted them into two acres of ground and was highly gratified to find an abundant crop. This encouraged me to plant more. I used all my strength in clearing and planting, and have succeeded beyond my most sanguine expectations." Thus it was that Sea Island cotton originated, the most valuable of all cotton staples.

About the same time that Levett planted his cotton, James Spaulding, Colonel Robert Kelsal, and Governor Tatnall, all of Georgia, received parcels of the seed from friends who were exiled Royalists and who were living in the Bahamas, and planted them with excellent results. Levett's cotton was sent to London, and sold to Glasgow manufacturers for four shillings, sixpence, per pound. The purchasers said that they had never seen cotton so good and promised to take all that would be procured. The London agents, Simpson and Davidson, were told to inform their friends that the market could not be overstocked, so superior was the long-stapled, silky Sea Island cotton to that which England was getting from the East and West Indies.

Twenty persons in 1789 were growing Sea Island cotton

in Georgia, but it was not extensively raised in South Carolina until 1799.

The influence of Tench Coxe induced Congress in 1789 to protect the Southern growers by placing a duty of three cents a pound on foreign cotton. At this time the production of cotton, according to an estimate of the Treasury Department, was about one million pounds. In 1790 it was a million and a half, and in 1791 two million pounds, three-fourths of which came from South Carolina and the rest from Georgia.

The invention of Whitney's gin enormously increased, as we have seen, the production of cotton by making it easy to separate the fibre from the seed, and cotton soon became the great staple crop of the South.

According to a letter written by Richard Teake, of Savannah, Ga., to Thomas Proctor, of Philadelphia, dated Dec. 11, 1788, the year 1788 marked the introduction of cotton growing on a large scale in the Carolinas and Georgia:—

"I have been this year an adventurer and the first that has attempted on a large scale in the articles of cotton. Several here, as well as in Carolina, have followed me and tried the experiment. I will raise about 5,000 pounds in the seed from about eight acres of land and next year I expect to plant fifty to one hundred acres. The lands in the southern part of this state are admirably adapted to the raising of this commodity. The climate is so mild so far to the South, scarce any winter is felt and another advantage—whites can be employed. The labor is not severe attending it; not more than raising Indian corn."

Cotton was undoubtedly shipped from the colonies to England in 1747, 1753, 1757, 1764, and 1770. In fact, a reproduction of a bill of lading for eighteen bales of cotton shipped July 20, 1751, from New York to London on the vessel of Captain Barnaby Badgers, is reproduced in Chew's "History of the Kingdom of Cotton and Cotton Statistics

of the World." It has been claimed that this was a reshipment of cotton grown in the West Indies. Whether or not this is true, the fact remains that some of the cotton grown either for floral purposes or home industry in the colonies did find its way to Europe. Another authority says that Samuel Auspourgouer, a Swiss living in Georgia, took to London in 1739, at the time of the controversy over the introduction of slaves, a sample of the cotton raised by him in Georgia.

Jefferson mentions cotton as an article of export from Virginia previous to the Revolution. The real beginning of the cotton trade between the United States and Great Britain was in 1784, when Mr. Rathbone, an American merchant in Liverpool, received a consignment of eight bales of cotton, which were seized by the custom-house on the ground that they could not have been raised in the United States and were liable to seizure under the Shipping Act "as not being imported in vessels belonging to the country of growth." When its place of growth was proven to be the United States, so undesirable was the quality of the cotton that it lay in the warehouse some months after its release by the government before it could be sold. In 1785 fourteen bags were sent over, in 1786 six bags, and in 1787 one hundred and nine bags, of about one hundred and fifty pounds each, reached Liverpool.

In 1788 58,350 pounds were exported, and Sea Island cotton formed the bulk of the exports until 1793, and from this time on the exports of cotton rapidly increased, and cotton cultivation spread over the South until cotton had become the great staple crop, supplying the European industry as well as the American.

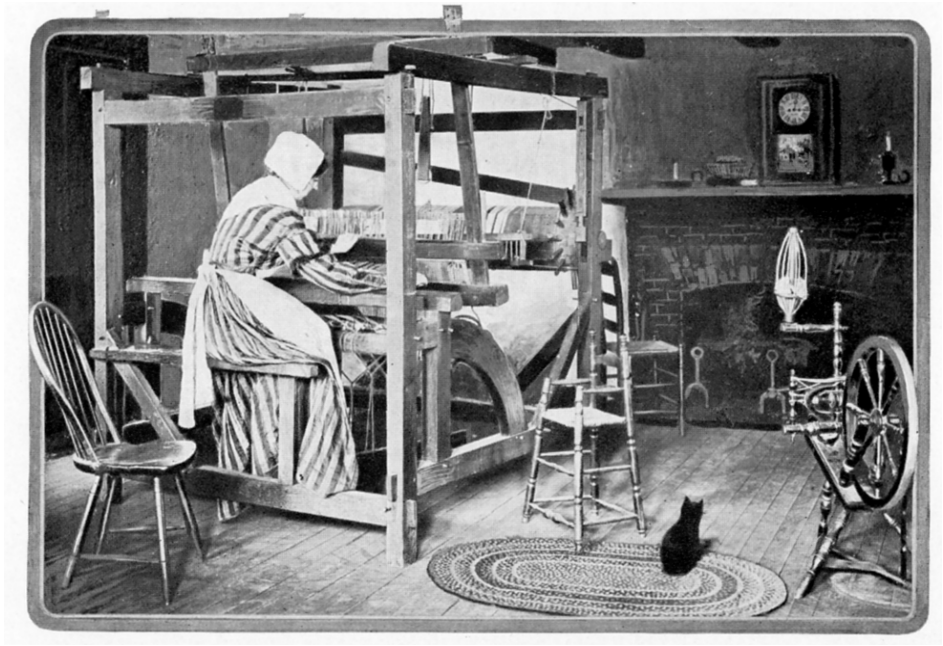
CHAPTER VI

AMERICAN INDUSTRY AFTER THE REVOLUTION AND BEFORE SLATER

FIRST MANUFACTURING IN PENNSYLVANIA—FIRST COTTON MILL IN NEW ENGLAND—FIRST TEXTILE TRADE-MARK—FIRST TEXTILE ADVERTISING—BOSTON SAIL CLOTH FACTORY—COMMENCEMENT OF THE COTTON INDUSTRY IN RHODE ISLAND—FIRST WOOLEN MILL—WASHINGTON INAUGURATED IN SUIT OF DOMESTIC WOOLEN —FIRST WOOLEN MILL OPERATED WITH POWER MACHINERY

The most influential of the early movements to promote textile manufacturing originated in Philadelphia, where cotton manufacturing with power machinery began in 1764, and according to the *Complete Magazine*, published in London that year, "Some beautiful samples of the cotton manufactures now carried on in Philadelphia have been lately imported and greatly admired." Through the efforts of Tench Coxe, Samuel Wetherill, Jr., and others, a society called "The Pennsylvania Society for the Encouragement of Manufactures and the Useful Arts," which was an outgrowth of the United Company of Philadelphia, was organized on the 9th of August, 1787, at a meeting held at the University of Pennsylvania. The necessity of promoting and establishing manufactures was pointed out in an address by Tench Coxe. Every member on admission paid to the treasurer the sum of ten shillings and the same sum annually for the purpose of defraying the necessary expenses of the society, and a subscription of not less than ten pounds was opened, and called the "manufacturing fund," for the purpose of establishing factories in such places as might be thought suitable.

The society on Aug. 23, 1788, had received thirteen



A HANDICRAFT WEAVER AT HER LOOM

(Courtesy of the Draper Company)

Showing the primitive construction of the loom used before the power loom.

hundred and twenty-seven pounds, ten shillings, and sixpence, had spent four hundred and fifty-three pounds, ten shillings, and twopence for machines, utensils, and equipping the house of the old United Company of Philadelphia for the manufactory, and had a capital left of eight hundred and seventy-four pounds, no shillings, and fourpence. As one of the objects of the society was the employment of the poor, a quantity of flax was bought, and between two and three hundred women were employed during the winter and spring in spinning linen yarn. Workmen were engaged to make a carding machine and four jennies of forty, forty-four, sixty, and eighty spindles for spinning cotton. As soon as possible the house was fitted up and the machines set to work. Various obstacles, such as finding proper workmen, making machines from imperfect models, various obstructions thrown in the way by agents of foreign manufacturers, combined to delay the work, so that it was the 12th of April, 1788, before the first loom was set to work. This was twelve days before the Beverly Cotton Manufactory turned out goods from its new mill, and, if the Beverly proprietors did not make any goods until moving into the Beverly mill, to Philadelphia belongs the distinction of establishing in America the first cotton mill with power machinery.

If when the Hon. George Cabot wrote to Alexander Hamilton that the Beverly gentlemen were engaged in the cotton manufacturing in October, 1787, he meant that they were then turning out cotton fabrics by machinery, the honor of being the first to engage in cotton manufacturing with machinery belongs not to Philadelphia, but to Massachusetts. If he simply referred to the fact that these men were engaged in promoting a cotton manufactory, then any distinction which springs from the establishment of the first cotton mill in America belongs without question to Pennsylvania.

The number of looms in Philadelphia was speedily in-

creased to twenty-six, and the following goods had been made up to Aug. 23, 1788: jeans, 2,959½ yards; corduroy, 197½ yards; federal rib, 67 yards; beaver fustian, 57 yards; plain cotton, 1,567½ yards; linen, 725 yards; tow linen, 1,337½ yards; total, 7,111 yards. In the looms at that time there were 200 yards of jeans, corduroys, cottons, and linens. The manufactory had sold manufactured goods, of jean, and cotton, and linen yarn, fine and tow linen, to the value of four hundred and forty-eight pounds, five shillings, eleven pence, one-half penny. By the first of November the manufactory had made in addition: jeans, 759½ yards; corduroy, 383½ yards; flowered cotton, 39 yards; cottons, 2,095 yards; flax linen, 123 yards; tow linen, 494 yards; bird's-eye, 123 yards,—making a total of 4,016 yards. The cotton yarn sold in Philadelphia for one dollar a pound.

There were also about two hundred and forty yards of different goods in the looms, amounting in all to 11,367 yards, and 185 pounds of plain and colored knitting thread had been made by the twisting mill. 190 yards of cotton had been printed, showing that by November, 1788, the output was considerable. None of these early efforts amounted to much because of the better goods turned out by the more perfect machines of English manufacturers. Then, too, from 1782 to 1789 the poverty and business depression in the United States were wide-spread, and proved a serious obstacle to the successful starting of new enterprises. The manufactory was finally burned March 24, 1790, and the mill in which horse-power ran some of the machines was not rebuilt.

FIRST COTTON MILL IN NEW ENGLAND

The first cotton mill in New England, if not in America, was that established by the proprietors of the Beverly Cotton Manufactory at Beverly, Mass. The production of cotton goods at their mill preceded by at least a year

the first products of Samuel Slater's mill at Pawtucket, but seems to have been a little later than the establishment of cotton manufacturing by the Pennsylvania Society for Promoting Manufactures and Useful Arts in Philadelphia. Unsuccessful attempts at spinning and weaving cotton had been made in 1780 at Worcester.

The interest in cotton manufacturing had been greatly stimulated by the action of the legislature of Massachusetts in 1786, and therefore before the thirteen States had become the United States of America. This legislature had on the 25th of October, 1786, appointed a committee of three—Mr. Richard Cranch of the Senate and Mr. Clarke and Mr. Bowdoin of the House—"to view any new invented machines that are making within this Commonwealth for the purpose of manufacturing sheep's and cotton wool, and report what measures are proper for the Legislature to take to encourage the same."

The committee examined at the works of Colonel Hugh Orr, the machines for carding and spinning that had been made at Bridgewater, by Robert and Alexander Barr, and at the suggestion of the committee the legislature granted the Barrs two hundred pounds to enable them to complete three machines, a roving machine, and to construct several other machines as might be necessary for carding, roping, and spinning cotton and wool.

Colonel Orr was a Scotchman who had settled in Bridgewater in 1740 and had been engaged in the manufacture of firearms. At the commencement of the Revolution he had made the first cannon produced in the country by boring a solid casting. Having become interested in the carding and spinning machines which he learned were being made in England, he had successfully urged Robert and Alexander Barr, two brothers, who were skilful Scotch mechanics, to come to America and construct textile machinery at Orr's works.

The Massachusetts legislature continued to watch with

much interest the progress of the Barrs, and on March 8, 1787, Richard Cranch was appointed by the Senate "with such as the House should join to examine the machines which are now nearly completed and to inspect and allow the account of Robert and Alexander Barr and also to report to the next General Court, what gratuity in their opinion the said Robert and Alexander justly deserve, as a reward for their ingenuity in forming these machines, and as an encouragement for their public spirit in making them known to this Commonwealth." The committee passed their account for one hundred and eighty-nine pounds and twelve shillings, which included the expense of transporting the machines to and from Boston, that the legislature could see them.

Thomas Somers, a Scotchman who had been a midshipman in the English navy, petitioned the legislature of Massachusetts, Feb. 15, 1787, on the subject of textile machinery, and represented that in the fall of 1785, while he was residing in Baltimore, tradesmen and manufacturers of that city had been influenced by a circular letter sent by a committee of the tradesmen and manufacturers of Boston to form themselves into an association for applying to the legislature in behalf of American manufacture. Somers said he had been brought up in cotton manufacturing, and, being willing to do what lay in his power to introduce the manufacture in America, at his own risk and expense had gone to England to prepare machines for carding and spinning cotton. He found after much difficulty that he could only secure descriptions and models of the textile machines. With these he had returned to Baltimore. Finding that the merchants of Baltimore were very dilatory about encouraging the matter, he resolved to take the advice of friends and try his success in Boston.

To encourage the textile manufacture and to give Somers an opportunity to prove his ability to perfect the manufacture, the legislature, March 8, 1787, granted him twenty

pounds, which were deposited with Colonel Orr, who was made a committee to supervise the expenditure. Somers, under the direction of Orr, constructed other textile machinery in addition to that already made by the Barrs, and about the same time Mr. Orr employed a Scotchman by the name of McClure to weave jeans and corduroy by hand with the fly shuttle. This was probably the first use in America of the fly shuttle.

The legislature on May 2, 1787, discharged the Barrs from any obligations under the grant of two hundred pounds, and granted them six tickets in the land lottery which had no blanks. It was further provided that the machines they and Somers had made should be left in charge of Colonel Orr, with the proviso that he should "explain to such citizens as may apply for the same the principles on which said machines are constructed and the advantages arising from their use, and also to allow them to see the machines at work." These machines were subsequently known as "The State Models," and the ones made in 1786 by the Barrs were the first jennies and stock cards made in the United States. They served as the models from which many who were interested in the construction of textile mills got their ideas for the machinery which was first used. But these models were very imperfect and of little use.

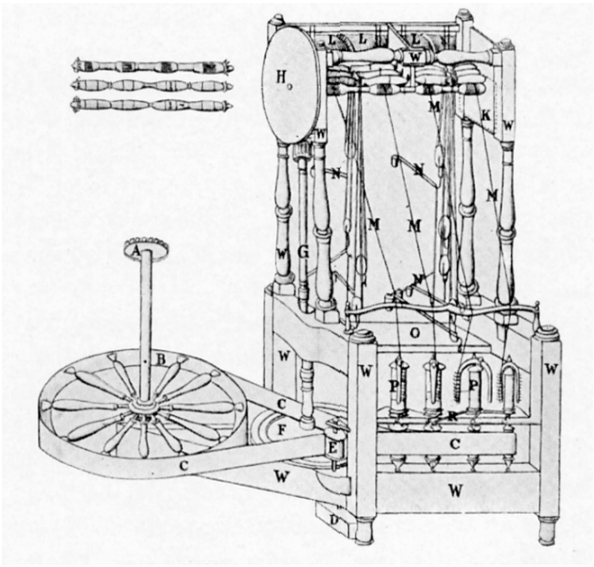
The legislature had also provided that public notice of the machines be given by advertising three weeks consecutively in Adams and Nourse's newspaper that the models could be seen and examined at Colonel Orr's in Bridgewater. They also included crude reproductions of Arkwright's roller spinning and other textile improvements, but they all had vital defects which made them impractical, so that Samuel Slater constructed the first practical Arkwright machines in America.

These Bridgewater experiments centred attention on the possibilities of the textile industry, and undoubtedly

influenced the proprietors of the Beverly factory to take up cotton spinning. The cotton used in these Bridgewater experiments, as well as that used later at the Beverly factory, came from Barbadoes, Surinam, Pernambuco, Cayenne, and other places in the West Indies and South America, and was imported in exchange for fish which New England exported. The cotton was often mixed with linen or sheep's wool, and was originally sold in the shops by the pound for domestic use.

One of the prime movers in the organization of the Beverly cotton manufacture was the Hon. George Cabot, who wrote to Alexander Hamilton, the first Secretary of the Treasury, and to Benjamin Goodhue, Massachusetts' first member of Congress, that the Beverly manufacturers were engaged in the cotton industry as early as October, 1787. The Salem *Mercury* on April 22, 1788, stated that "several public-spirited gentlemen in Beverly have procured a complete set of machines for carding and spinning cotton, with which an experiment was made a few days ago, answering the warmest wishes of the proprietors. The jenny spun sixty threads at a time, and with carding machine forty pounds of cotton can be well carded in a day,—the warping machines, and the other tools and machinery, part of which go by water, are all complete,—perform their various operations to great advantage, and promise much benefit to the public and emolument to the patriotic adventurers."

A few weeks later the same newspaper said that a "Mr. Leonard and Mr. Somers," who understood the making and finishing of velvets, corduroys, jeans, fustians, denims, marseilles quiltings, dimity, muslins, etc., had introduced into Beverly the machines for carding and spinning. They had the patronage of the Hon. George Cabot, who had secured the influence of a number of gentlemen in Beverly to organize for the purpose of establishing the industries.



ARKWRIGHT'S ORIGINAL WATER FRAME WITH THE SPECIFICATIONS ON THE ORIGINAL PATENT PAPERS TAKEN OUT BY HIM ON JULY 15, 1769.

"Now know ye that I, the said Richard Arkwright, do hereby describe and ascertain the nature of my said invention, and declare that the plan thereof drawn in the margin of these presents is composed of the following particulars, (that is to say) *A*, the Cogg Wheel and Shaft, which receive their motion from a horse. *B*, the Drum or Wheel which turns *C*, a belt of leather, and gives motion to the whole machine. *D*, a lead weight, which keeps *F*, the small drum, steady to *E*, the forcing Wheel. *G*, the shaft of wood which gives motion to the Wheel *H*, and continues it to *I*, four pair of Rollers, (the form of which are drawn in the margin,) which act by tooth and pinion made of brass and steel nuts fixt in two iron plates *K*. That part of the roller which the cotton runs through is covered with wood, the top Roller with leather, and the bottom one fluted, which lets the Cotton, &c. through it; by one pair of Rollers moving quicker than the other, draws it finer for twisting, which is performed by the spindles *T*. *K*, the two iron plates described above. *L*, four large Bobbins with cotton rovings on, conducted between Rollers at the back. *M*, the four threads carried to the Bobbins and Spindles by four small wires fixt across the frame in the slip of wood *V*. *N*, iron leavers with small lead weights hanging to the Rollers by Pulleys, which keep the Rollers close to each other. *O*, a cross piece of wood to which the leavers are fixed. *P*, the Bobbins and Spindles. *Q*, Flyers made of wood, with small wires on the side, which lead the thread to the bobbins. *R*, small worsted bands put about the whirl of the bobbins, the screwing of which tight or easy causes the bobbins to wind up the thread faster or slower. *S*, the four whirls of the spindles. *T*, the four Spindles, which run in iron plates. *V*, explained in letter *M*. *W*, a wooden frame of the whole machine."

FIRST TEXTILE TRADE-MARK

These men, who on June 6, 1788, petitioned the legislature for incorporation, which was granted on Feb. 3, 1789, were John Cabot, George Cabot, Deborah and Andrew Cabot, Moses Brown, Joshua Fisher, Israel Thorndike, James Leonard, Thomas Somers and Isaac Chapman, of Beverly, and Henry Higginson, of Boston. They were given permission to hold real estate to the amount of ten thousand pounds and personal estate to the amount of eighty thousand pounds for the purpose of manufacturing textiles; "and be it further enacted by the state aforesaid," read the charter, "that all goods which may be manufactured by the said corporation, shall have a label of lead affixed to one end thereof, which shall have the same impression with the seal of the said corporation, and that if any person shall knowingly use a like seal or label with that used by said corporation, by annexing same to any cotton or cotton and linen goods, not manufactured by said corporation with a view of vending or distributing thereof, as the proper manufacture of the said corporation, every person so offending shall forfeit and pay treble the value of such goods, to be sued for and recovered for the use of said corporation, by action of debt, in any court of record proper to try the same."

This shows conclusively the first cotton mill in New England was wise enough to trade-mark its goods, and it also advertised them for sale in Salem and Beverly under the trade-mark.

The five or six acres on which the factory stood adjoined the Beverly Tavern on "the road from Mr. Oliver's meeting-house to Beverly Ferry," and was purchased Aug. 18, 1788, for eighty pounds and five shillings, by John Cabot, merchant, and Joshua Fisher, physician. Work was at once commenced on the mill, and before Jan. 6, 1789, it was completed. The Salem *Mercury* speaks of the

"promising cotton manufactory at Beverly," and it is described as "a plain three story building of brick, measuring about sixty by twenty-five feet with a pitching shingled roof, and a deep basement, in one end of which moved a heavy pair of horses to furnish rotary power." The horses were driven by a boy, Joshua Herrick, of Maine, who afterwards became a member of Congress. When the horses went too fast, Mr. Somers would call out the window, "Hold on there! not so fast! Slower!" and Herrick would slow up, but soon he would forget and speed up again, when again Somers would cry out, "Hold up!" and this continued most of the day. In a corner of the lot stood a small wooden dye-house. The mill stood about seventy feet behind the tavern yard.

In a letter written to Alexander Hamilton by George Cabot, Sept. 6, 1791, the number of employees is given as forty, thirty-nine of whom were native. The machines were enumerated as follows: "one carding machine with the labor of one man carded fifteen pounds per day, and with the labor of two men was capable of carding thirty pounds per day; nine spinning jennies, of sixty to eighty-four spindles each; one doubling and twisting machine, constructed on the principle of the jenny; one stubbing machine, or coarse jenny, to prepare the ropings for the finest jennies, whereon they are fitted for doubling and twisting; one warping mill, sufficient to perform this part of the work for a very extensive manufactory; sixteen looms with flying shuttle, ten of which are sufficient to weave all the yarn our present spinners can finish; two cutting frames, with knives, guides, etc.; one burner and furnace, with apparatus to singe the goods; apparatus for coloring, drying, etc."

According also to Mr. Cabot, actual expenditures on the enterprise had been about $14,000; of which the building had cost $3,000, machinery and apparatus $2,000, goods and unwrought material $4,000, sunk in waste of

materials, extraordinary cost of first machines, in maintaining learners and compensating teachers, etc., $5,000. He wrote that the net loss to the manufacturers had been about $10,000 and the interest on their money, and that the legislature of Massachusetts had granted aids in lands and lottery tickets to about $4,000. The mill was then turning out 8,000 to 10,000 yards per year.

The incorporators found from the outset of their enterprise the construction of the proper machinery not only difficult, but expensive, and they applied to the legislature for aid, and on Feb. 17, 1789, were granted five hundred pounds, to be paid from the proceeds of eastern lands of the Commonwealth, with the condition that the petitioners should manufacture, within seven years from the date of the grant, cotton and cotton and linen goods of a quality usually imported to the amount of fifty thousand yards. As the grantees found the eastern lands not available for raising the money they required, in June they again petitioned the legislature, representing they had expended about four thousand pounds, and that the present value of this stock was not equal to two thousand pounds, and that, owing to the cost of machines (a carding machine is cited as costing eleven hundred pounds) and the difficulty and expense of carrying on the business, they must have some "very considerable advancement."

The House granted them thirteen hundred pounds to be obtained from a lottery, but the Senate refused the grant, and allowed seven hundred pounds on March 4, 1791, to be raised by lottery.

Washington made a tour of New England in 1789, and on October 30 took breakfast with George Cabot, and afterward visited the cotton mill on his way to Portsmouth. Senator Henry Cabot Lodge, in his "Some Early Memories," says that his grandfather, Henry Cabot, the son of George Cabot, used to tell how he hid under the sideboard and watched the "Father of his Country" at breakfast

with his father, when Washington stopped at Senator Lodge's great-grandfather's house on this occasion. According to the Salem *Mercury* of Nov. 3, 1789, Washington "was shown in the lower story a jenny of eighty-four spindles, upon which some of the manufacturers were spinning warp; and three or four other jennies upon which they were spinning weft, and about a dozen looms upon which they were weaving cotton denim, thicksett, corduroys, velveret, etc. In the middle story was seen a roping jenny of forty-two spindles and a machine on which a person usually doubles and twists in a day a cotton warp of fifty yards. In the upper story were exhibited the business of carding, working, and cutting; and in a contiguous building that of dressing on the stove." The goods there made were mostly a coarse fabric, and amounted to about ten thousand yards.

Washington, under date of Friday, October 30, wrote in his diary: "After passing Beverly two miles we came to a cotton manufactory, which seems to be carried on with spirit by the Cabots principally. In this manufactory they have the new invented carding and spinning machines; one of the first supplies the work, and four of the latter; one of which spins eighty-four threads at one time by one person. The cotton is prepared for this machine by being first lightly drawn to a thread on the common wheel.

"There is another machine for doubling and twisting the thread for particular cloths. This also does many at a time. For winding the cotton from the spindles and preparing it for the warp there is a reel which expedites the work greatly. A number of looms, fifteen or sixteen, were at work with spring-shuttles, which do more than double work. In short, the whole seemed perfect, and the cotton stuffs which they turn out excellent of their kind, warp and filling both are now of cotton."

FIRST TEXTILE ADVERTISING

The Beverly goods were advertised for sale from December, 1789. Baker & Allen, of Beverly, were selling the corduroys as the equal in price and quality with imported fabrics, and Francis Cabot at Salem also sold corduroys, royal ribs, thicksett, stockinette, and rib delures, wholesale and retail, and all made in Beverly and at lower prices than English goods of the same quality. In fact, by 1790 the wear of Beverly corduroys is said to have been common. Despite every effort, it was impossible to make the early mills pay, and we soon find Moses Brown, the patron of Slater, writing to Moses Brown, of Beverly, his namesake, asking the co-operation of the Beverly proprietors in petitioning Congress for an additional duty on cotton goods. It was also with difficulty that the employees of the Beverly mill could be kept, because as fast as they mastered the business they were enticed away by other manufacturers.

In fact, the Beverly enterprise met with more difficulties than usually confront a new industry, and finally, shortly before the Embargo Act of 1807, which paralyzed the industry, passed out of existence. A deed of land in 1813 describes it as follows: "A certain piece of land with brick buildings now thereon standing, with all the machinery and utensils formerly used for the manufacture of cotton which remain unsold," and until this date the machines and land were unsold. The old brick factory was finally burned in 1828.

BOSTON SAIL CLOTH FACTORY

As the result of a bounty offered by the Massachusetts legislature in 1788 for home-manufactured sail cloth, etc., a number of Boston merchants formed a company called the Boston Sail Cloth Factory. Land which was probably

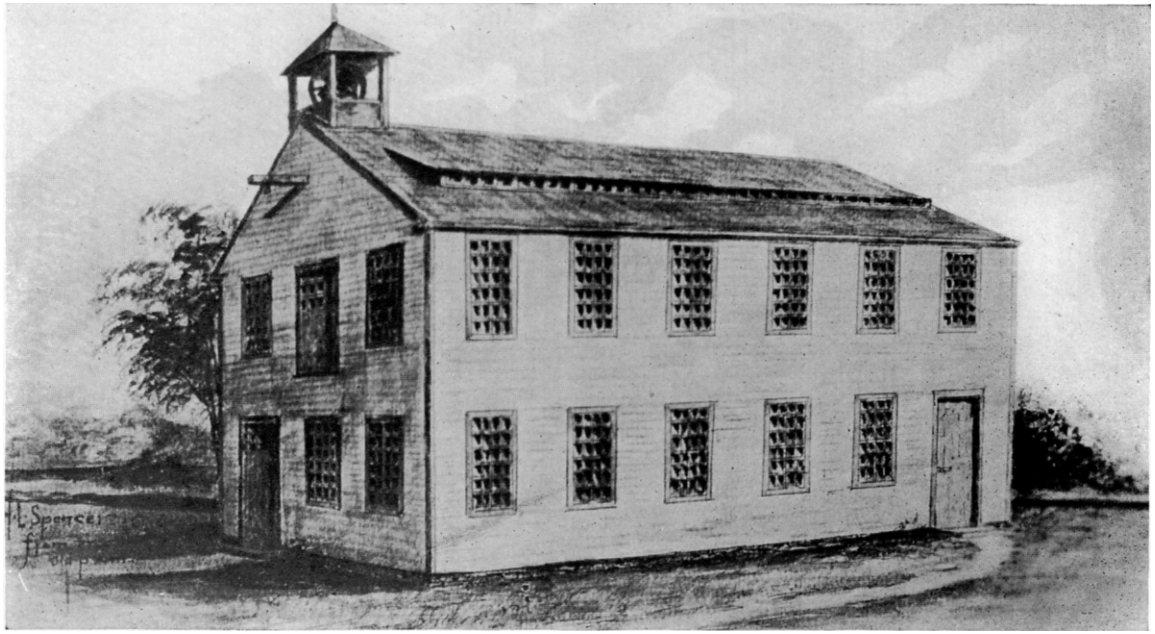
an open pasture was rented for nine pounds a year at the corner of Frog Lane, now Boylston Street, and Holyoke, now Tremont Street, and by 1789 sixteen women and as many girls were working twenty-eight looms and were turning out forty yards per week.

Washington, who described it on his New England visit in 1789, wrote, "They have twenty-eight looms and fourteen girls, spinning with both hands, the flax being fastened to the waist. Children, (girls) turn the wheels for them; and with this assistance each spinner can turn out fourteen pounds of thread a day when they stick to it; but as they are paid by the piece or the work they do, there is no other restraint upon them but to come at eight o'clock in the morning and return at six in the evening. They are the daughters of decayed families; none others are admitted."

In 1792 about four hundred employees were turning out about fifty pieces of linen duck a week. As described in 1789 in the *Gazette* of the United States, "The manufacturing house for duck in Boston is pleasantly situated in the south west part of the town. The building is 180 feet long, two stories high. The upper part is improved by the spinners of chains or warp of the duck. Sixteen young women and as many girls under the direction of a steady matron are here employed. In the lower part there are twenty-eight looms which can turn out two pieces of duck of forty yards each per week."

A high degree of perfection was attained, and the business was very prosperous until about 1795, when the bounty was withdrawn and the business gradually died. In the mean time, however, duck had begun to be manufactured in Haverhill, Springfield, and in New Hampshire and Connecticut.

About the same time various other attempts at duck manufacturing were made elsewhere, one of them being in Worcester, where a factory was erected in 1789, and on April 30, 1789, the first piece of corduroy was turned out.



THE OLD SLATER MILL, PAWTUCKET, R.I.

(Courtesy of Job L. Spencer)

Built by Samuel Slater in 1793, in which was first introduced into America the spinning of cotton by Arkwright machines.

Sketch made by H. L. Spencer, whose grandfather, Gideon L. Spencer, worked in the mill.

Fustians, ribs, and corduroys were subsequently offered for sale. The enterprise, however, was not a success, and within a few years after it started passed out of existence. Other attempts were made at Colchester, Conn., at Exeter, N.H., at Haverhill, Mass., and also at Springfield, Salem, and Stratford.

COMMENCEMENT OF THE COTTON INDUSTRY IN RHODE ISLAND

Cotton manufacturing began in Rhode Island in 1788, and was due to the efforts of Daniel Anthony, Andrew Dexter, and Lewis Peck, of Providence, who formed a partnership to manufacture "Home Spun Cloth." It was the original purpose to spin by hand and make linen jeans with linen warp and cotton filling, but, learning of the Bridgewater experiments, Anthony and John Reynolds, of East Greenwich, who had begun the making of woolens, visited Bridgewater and made a sketch of the machine. Nothing was done with this sketch, for soon after they proceeded to build a jenny from a model of the machine that Somers had at Beverly. The construction of the woodwork was done by Richard Anthony, while the spindles and brasswork were made by Daniel Jackson, a coppersmith, of Providence. The jenny was set up in a private house, but was subsequently removed to a chamber in the market house, Providence.

A machine for carding cotton spun upon the lines of the sketch of a similar machine seen at Beverly was made by Joshua Lindly, of Providence, and a spinning machine, somewhat like the Arkwright frame, but very imperfect, was also built. It had eight heads of four spindles each, and was worked by a crank turned by hand. John Bailey, an ingenious clock maker, of Pembroke, Mass., made the first head, while the other seven, together with the brasswork and spindles, were the work of Daniel Jackson, the woodwork being by Joshua Lindly. In 1787 Joseph Alex-

ander and James McKerries, expert fly-shuttle weavers, had arrived in Providence, and were engaged to make corduroy. Alexander went to work in Providence, while McKerries took up the work in East Greenwich. The first fly shuttle in Rhode Island was built according to the directions of Alexander, and was operated in the market-house chamber. A piece of corduroy was woven, of a linen warp and filling of cotton, but, as there was no one who knew how to cut the corduroy or to finish it so as to raise the pile, the manufacture was abandoned, and Alexander went to Philadelphia. McKerries worked in East Greenwich for some years.

The spinning frame which had been made from the State model, after being tried in Providence, was taken to Pawtucket and attached to a wheel propelled by water, but the machine was so imperfect that it was set too hard to work by hand. Eventually, the machine was sold to Moses Brown, of Providence, who had become much interested in the textile industry. Brown, together with Smith Brown, a kinsman, also purchased the stocking loom of John Fullem, an Irishman, who had some time in 1788 commenced stocking weaving in East Greenwich, but, not prospering, went to Providence.

After selling his loom, Fullem operated it under the superintendence of Smith Brown, but the business, not proving successful, was given up. In the mean time, calico printing had been introduced by Herman Vandausen, a German calico printer, who settled in East Greenwich. He cut his design on wood, and printed for those who home-spun calico. This calico was little inferior to that imported from India, but Mr. Moses Brown, who was then trading with India and to whom the domestic cloth was shown, decided it was cheaper to import the Indian fabrics.

FIRST WOOLEN MILL

The first woolen factory in which water power was used, other than in the fulling process in which water power was early employed, and in fact the first large woolen mill in America, was that of the Hartford Woolen Manufactory, which was organized April 15, 1788, and started at Hartford, Conn., by a number of shareholders, of whom Jeremiah Wadsworth was the largest. Other stockholders were Oliver Wolcott, signer of the Declaration of Independence, and Peter Colt, uncle of the man who originated Colt's revolver. On the books of the company appears under date of Dec. 27, 1788, a charge for one piece of smoke cloth, $23\frac{3}{4}$ yards, and also for one piece of Hartford gray, showing that about then manufacturing began.

In order to encourage the industry, the Connecticut General Assembly passed a resolution exempting the buildings and employees from taxation, and offered a bounty of one cent per pound upon all woolen yarns woven into cloth before a certain date, and considerable perfection was soon attained in the production of the best cloths.

WASHINGTON INAUGURATED IN SUIT OF DOMESTIC WOOLEN

At the inauguration of Washington, April 3, 1789, the President, Vice-President, and the Connecticut senators were all clothed in fabrics made by this mill. Washington appeared dressed in a coat, waistcoat, breeches of fine dark brown cloth, and white silk stockings. Plain silver buckles were on his shoes, his head uncovered, and his hair dressed after the prevailing fashion of the time. In a letter to General Henry Knox, who sent him the suit, Washington wrote as follows:—

MT. VERNON, March 2, 1789.

My dear Sir,—I beg of you to accept my acknowledgment of and thanks for your obliging favors of the 12th, 16th, and 19th

of last month, and particularly for the trouble you have had in procuring and forwarding for use, a suit of the Hartford Manufacture. It is come safe and exceeds my expectation. I will take an early opportunity of paying the cost of it. I am ever yours, GEORGE WASHINGTON.

"The cloth is of as fine a fabric," said one of the newspapers, describing the President's suit, "and so handsomely finished, that it is universally mistaken for a foreign manufactured superfine cloth."

The proprietors of this mill, like the proprietors of the Beverly manufactory, believed in calling the public's attention to their goods by advertising, and therefore they inserted in the Connecticut *Courant*, Sept. 14, 1789, and also in 1790, this advertisement:—

"American manufactured woolens for sale at the Hartford Woolen Manufactory. A great variety of cloths, sergings and coatings. The colors may be relied upon, being principally dyed in grain. They have lately established a blue dye where all the different shades from a pearl color to navy blue are dyed." On Nov. 2, 1789, an advertisement read, "A great variety of fine, middling and coarse, broad and narrow cloths, serges, coatings, and baises, etc., by wholesale."

In the year from September, 1788, to September, 1789, about five thousand yards of cloth were made, the spinning only being done outside by the country people. Broadcloths of a good, but not first quality were produced, some of which sold as high as five dollars per yard. Their Hartford gray became a celebrated cloth. About 1789 one cloth presser finished in seven months, at one press, 8,133 yards, of which 5,282 yards were fulled coatings. Cassimeres, serges, and everlastings were also turned out. Early in colonial days and even after the starting of the Hartford Mill, worsteds that were woven into serges and everlastings were spun in the households.

It was difficult for the manufactory to get ahead, so it secured in 1790 from the General Assembly a grant of a lottery to further its interests, the proceeds being used for machinery, implements, and increase of stock. The Connecticut *Courant*, Oct. 3, 1791, could report that the manufacture after struggling with every obstacle began to flourish. "The quality of the cloths, more especially the coarser, is acknowledged on all hands to be superior to English of the same fineness. It is an undeniable fact that the coatings made here are more durable than the English. The great objection formerly made to the coloring and finishing of the cloths is now removed, it being agreed by the best judges that the difference between the best finish English cloths and those of this manufacture is hardly perceivable." The first and only dividend passed by the company was one of 50 per cent., which was declared Dec. 10, 1794.

The sale of goods was not rapid, and, as the demand seemed to be for imported fabrics, the stock accumulated so fast in the factory that it finally had to be sold at auction. The business, which had never been a commercial success, was eventually sold in 1795 at auction, and the greater part of the machinery was bought by Jeremiah Wadsworth, who for a while carried on the business. It was finally given up, and for some time previous to April 3, 1854, when the building (which stood on the bank of Little River at the foot of Mulberry Street) was burned, it was occupied by a manufacturer of soap and candles.

FIRST WOOLEN MILL OPERATED WITH POWER MACHINERY

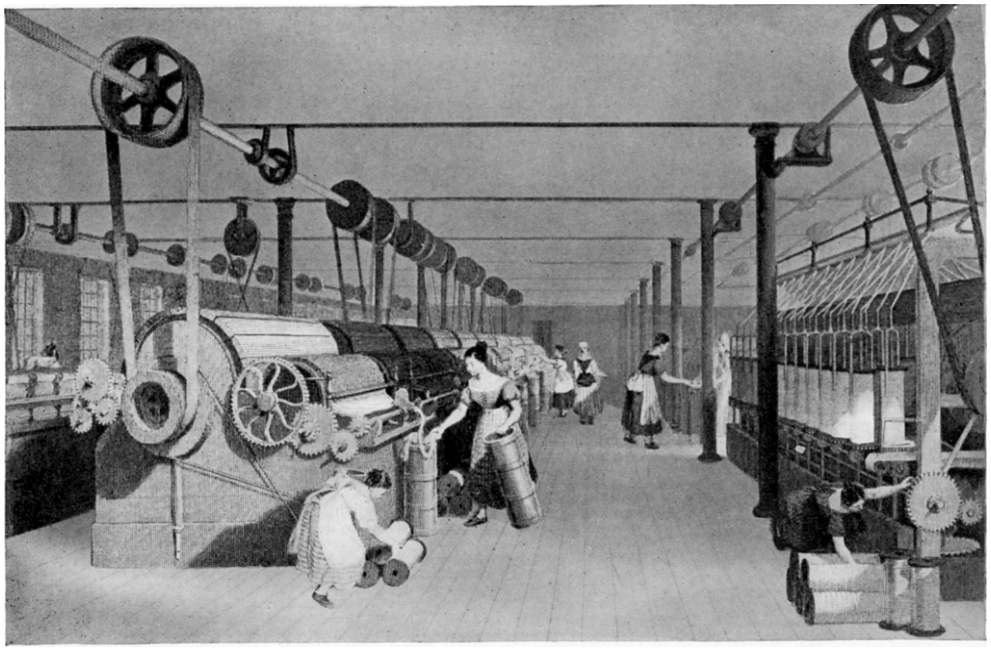
According to Royal C. Taft, who investigated the matter, the first woolen mill that was successfully operated in the United States with power machinery was built in 1794 at the falls of the Parker River in Byfield Parish of Newburyport, under the direction of John and Arthur Scholfield, who arrived in Boston from Saddleworth, Yorkshire,

England, in May, 1793, and went to live in Charlestown, not far from Bunker Hill. Meeting Jedediah Morse, author of "Morse's Geography and Gazetteer," and telling him of their knowledge of the textile industry and the best methods of manufacturing, he became interested, and introduced them to people of wealth in Newburyport, who were desirous of starting the industry there, and by whom they were engaged to erect the mill.

Most of the machinery was built in Newburyport by Messrs. Standring, Armstrong, and Guppy. Benjamin Greenleaf, Theophilus Parsons, William Bartlett, Moses Brown, and others were incorporated as the proprietors of the Newburyport Woolen Manufactory, with a capital in real estate of ten thousand pounds and in personal estate of eighty thousand pounds, and here was constructed and operated the first carding machine for wool in America. Until the mill was ready to contain it, it was worked by hand. John Scholfield was employed as agent, and for years the business was successfully conducted, broadcloth and flannel being made. It is not known how long the mill continued in operation, but it was burned Oct. 29, 1859.

Previous to the Newburyport enterprise John Manning had in 1792 built a mill in Ipswich upon land granted by the town, in which broadcloths, blankets, and flannels were made, all the work of carding, spinning, and weaving being done by hand. The mill was a hundred and five feet long by thirty-two feet wide, two stories high, and built of wood. As it was not successful, cotton took the place of wool, but this, too, failed to pay, and finally in 1800 work stopped.

After being with the Newburyport Woolen Mill for about five years, John Scholfield in 1789 hired for fourteen years water power on the Oxoboro River in Montville, Conn., moved there, and built the first woolen mill in Connecticut, which he operated with his brother Arthur until 1806, when he sold out to John and Nathan Comstock. In this same



CARDING, DRAWING, AND ROVING AS IT WAS IN SAMUEL SLATER'S EARLY MILLS

(From an old engraving)

year he fitted up a factory he had bought at Stonington, Conn., and operated it.

In the mean time Arthur Scholfield, who had gone to Pittsfield in 1800, built a woolen mill there, and started operations in November, 1801; and on Nov. 2, 1801, his first advertisement appeared in the Pittsfield *Sun*, advising the people of Pittsfield that he would card their wool and sell them woolens. In 1804 John Bissell, a leading merchant of Pittsfield, who had gone to New York to buy goods, brought home two pieces of Scholfield's cloths, gray mixed broadcloth, which he had bought for imported fabrics. James Madison in 1808 was inaugurated President in a suit made from thirteen yards of black broadcloth made by John Scholfield. In 1809 Daniel Day built a mill at Uxbridge, Mass., twenty by forty feet, two stories, and put in a carding machine and picker, later adding to his mill a billy and jenny for weaving, and still later added five hand looms.

The situation in Massachusetts, Rhode Island, and Pennsylvania when Samuel Slater arrived from England in 1789 was that textile manufacturing of both cotton and wool goods in factories on a scale large enough to meet some of the domestic demand had been established, and, though not a commercial success, was making some progress. The little power machinery that was used was confined mainly to carding machines and spinning jennies,—imperfect machines which were either domestic attempts at copying the machines in use in England or crude productions of American inventors. No one had yet succeeded in water spinning, because Arkwright's machines could not be obtained from England, and, despite the inducements held out by various commercial bodies, no one had been able to make practical reproductions of the English machines. The arrival of Slater marked a new and more flourishing era in textile making.

CHAPTER VII

ERA OF SAMUEL SLATER

SLATER'S ARRIVAL IN AMERICA—GOES TO PROVIDENCE—STARTS FIRST COTTON MILL WITH ARKWRIGHT'S MACHINES IN AMERICA—PAYMENT AND DISCIPLINE OF EMPLOYEES—STARTS HIS SECOND MILL; THE FIRST WITH ARKWRIGHT MACHINERY IN MASSACHUSETTS—FIRST COMMISSION HOUSES—SHEPARD STARTS MILL AT WRENTHAM—OTHER MILLS START—WHITTENTON COTTON MILLS—START OF THE INDUSTRY IN CONNECTICUT—SPREAD OF INDUSTRY THROUGH INFLUENCE OF SLATER—GILMORE'S LOOM—BEGINNING OF POWER WOOLEN MILLS IN RHODE ISLAND—SOUTHERN DEVELOPMENT

Samuel Slater has been rightly called the father of the American cotton industry, for to him more than to any one else was due the construction and first successful operation in America of Arkwright's system of cotton machines. Before Slater came to America, all attempts to make Arkwright's machinery had been futile, despite the many inducements held out by various commercial bodies for practical Arkwright machines.

Slater was the son of a yeoman farmer in Belper, Derbyshire, where he was born June 9, 1768, and was early apprenticed to Jedediah Strutt, who was a partner of Arkwright, and had established one of the first cotton mills in Belper. He was with Strutt, who was a friend of his father, for over eight years, and later served as superintendent of Strutt's mill, so that he had a comprehensive knowledge of Arkwright's machines.

SLATER'S ARRIVAL IN AMERICA

A few months prior to November, 1789, when he arrived in New York, he read in a Philadelphia paper an account of a bounty of a hundred pounds granted by the legislature of Pennsylvania to a person who had imperfectly succeeded in constructing a carding machine to make rolls for jennies. The account also told of the offers of other State governments to encourage manufactures, and the great need in America of the proper textile machines. Pennsylvania, wishing to establish the cotton industry, had put a duty on fabrics of 10 per cent. Influenced by the pecuniary reward that America offered to one familiar with cotton spinning, Slater determined to emigrate secretly. Knowing the stringent regulations of the English government to prevent a knowledge of the textile machines spreading abroad, having fixed the designs of Arkwright's machines in his mind, he set out for America without telling even his parents of his intentions.

He had intended to go to Philadelphia, but upon his arrival he secured work with the New York Manufacturing Company. Becoming dissatisfied, however, with his prospects, and learning, from the captain of one of the Providence packets, of Mr. Moses Brown's interest in the textile business, Slater wrote to Mr. Brown, Dec. 2, 1789, that, as he had learned Mr. Brown "wanted a manager of cotton spinning, etc., in which business" he flattered himself he could give the greatest satisfaction, "in making machinery, making good yarn, either for stockings or twist, as any that is made in England," if Mr. Brown was "not provided for," he should be "glad to serve" him. He asked Mr. Brown to drop him a line "respecting the amount of encouragement" he "wished to give." Slater stated that he had "had an oversight of Sir Richard Arkwright's works," and was "in Mr. Strutt's mill upwards of eight years," and that the New York manufactory had

but one card, two machines, and two spinning jennies which were hardly worth using.

The New York manufactory was the outgrowth of "The New York Society for the Encouragement of American Manufactures," which was organized late in 1788, and made at first only linen yarns and cloth; for their advertisement read, "For sale at the factory on Vesey Street, a quantity of brown linen sheeting, linen yarn of the first quality, hatchelled flax, tow and backings."

In reply Moses Brown wrote him from Providence under date of Dec. 10, 1789, that "Almy and Brown who has the business in the cotton line," which Brown began, Almy being his son-in-law and Brown a kinsman, "did want the assistance of a person skilled in the frame or water spinning." An experiment had been made, but it had failed, as no one was acquainted with the business. "We hardly know what to say to thee, but if thou thought thou couldst perfect and conduct them to profit, if thou wilt come and do it, thou shalt have all the profit made of them over and above the interest of the money they cost, and the wear and tear of them. We will find stock and be repaid in yarn as we may agree, for six months. And this we do for the information thou can give, if fully acquainted with the business."

The letter concluded, "If thy present situation does not come up to what thou wishest, and, from thy knowledge of the business, can be ascertained of the advantages of the mills, so as to induce thee to come and work ours, and have the credit as well as advantages of perfecting the first water mill in America, we should be glad to engage thy care so long as thee can be made profitable to both and we can agree, I am for myself and Almy and Brown, thy friend, Moses Brown."

GOES TO PROVIDENCE

Moses Brown was a retired rich merchant of Providence who had long been identified with the East India trade, and had lately become interested in the cotton industry. He had purchased and installed at Pawtucket the imperfect machines of Daniel Anthony, Andrew Dexter, and Lewis Peck, and with his two relatives, William Almy and Smith Brown, was endeavoring to establish the cotton spinning.

Accordingly, Slater, Jan. 18, 1790, went to Providence and showed Mr. Brown his apprentice indenture with Mr. Strutt, and Mr. Brown took Slater to Pawtucket and showed him the machinery that had failed to work. When Slater saw the machines, he shook his head and said:—

"These will not do: they are good for nothing in their present condition, nor can they be made to answer." It was finally proposed that Slater should build wholly new machines after the Arkwright patents, but Slater would not consent until he was promised a man to work on wood who should be put under bonds not to steal the patterns or disclose the nature of the work.

"Under my proposals," said he, "if I do not make as good yarn as they do in England, I will have nothing for my services, but will throw the whole of what I have attempted over the border."

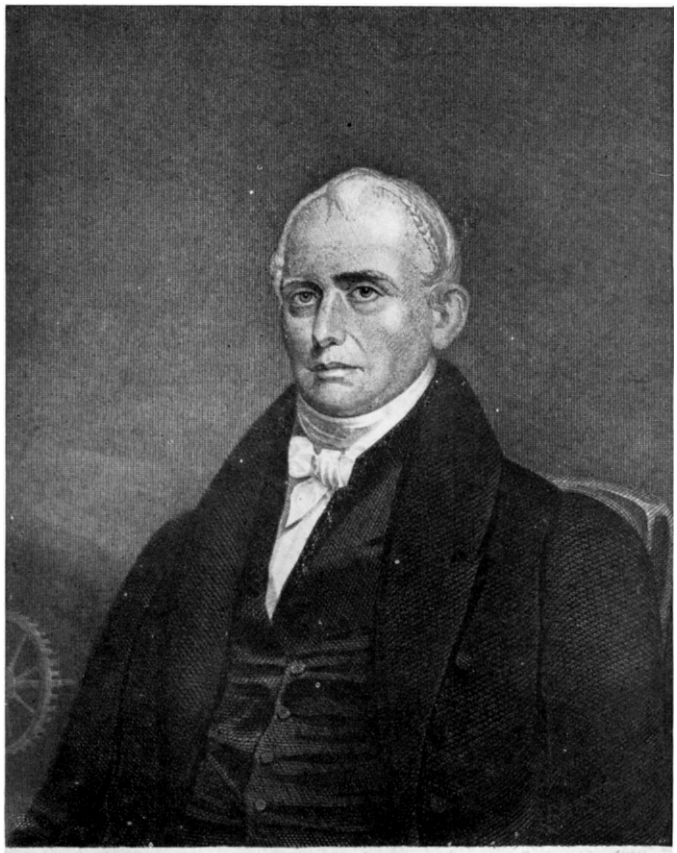
Articles of partnership were drawn up April 5, 1790, between William Almy, Smith Brown, and Slater, under which they furnished the capital and Slater in return for constructing the machinery and spinning the cotton was to have one-half of the profits and own one-half of the machinery. Almy and Brown were to have 2½ per cent. commission for the purchase of stock and 4 per cent. for selling yarn. Slater was charged one-half the expense of purchasing and constructing the machines and also for his living expenses while developing the business. The firm was to be Almy, Brown & Slater.

At the time that Slater went to Pawtucket, Almy and Brown were manufacturing billies and jennies, and had carding machines driven by men, and wove and finished jeans, fustians, thicksetts, velveret, the work being done mostly by Irish emigrants. The spinning frame shown Slater, and which he discarded, was the one that Brown had bought from Andrew Dexter and Lewis Peck. It made very poor yarn, the cotton being carded by hand and "roped on a wooden wheel by a female." Brown had also bought and installed at Pawtucket the loom with fly shuttle that Joseph Alexander and another Scotchman unsuccessfully attempted to operate in the market house at Providence.

The building in which Slater's new machines were set up was the fulling mill of Ezekiel Carpenter, and stood on the south-west abutment of the Pawtucket bridge. It was swept away by a freshet in 1807. Slater at once began to build a water frame of twenty-four spindles, two carding machines, and the drawing and roping frames necessary for the spinners, and soon after added a frame of forty-eight spindles. Great secrecy was maintained while the machinery was being made, shutters shielding the front windows and blinds covering the back windows. Sylvanus Brown cut out the parts of the spinning machines after Slater had chalked them out on the wood.

Oziel Wilkinson, the clever blacksmith of Pawtucket with whom Slater boarded and whose daughter Hannah Slater married, made with his sons, under Slater's direction, the iron-work of the machines, while Pliny Earl, of Leicester, made the cards. At first the cards would not work, and, when Slater pointed out the defect, Earl and he beat them to the proper curve with a piece of grindstone. The power was supplied at the start by a wheel propelled by an old negro, Samuel Brunius Jenks, but later water power was installed.

When Slater started his cards, the water wheel was so



Drawn by Mr Inman.

Engraved by A.W.Graham

CRESCIT SUB POMPERE VIRTUS

Samuel Slater

exposed that it was frozen every night, and, as he could get no one to bear the cold of the water in order to break the ice to start the wheel, he himself had to spend two or three hours before breakfast every morning doing the work.

STARTS FIRST COTTON MILL WITH ARKWRIGHT'S MACHINES IN AMERICA

It took Slater longer than he anticipated to finish his frames, so that it was not until Dec. 20, 1790, that he started three cards, drawing and roving, and seventy-two spindles in the clothier's shop of Carpenter at Pawtucket, where the machines were set up and driven by an old fulling water wheel.

The cotton in Slater's time was laid by hand, a handful of it being taken up and pulled apart with both hands. It was shifted to the right hand to get the staple straight and to fix the handful so as to hold it firm. Then it was applied to the surface of the breaker, the hand being moved horizontally to and fro until the cotton was prepared.

Soon they had several thousand pounds of yarn on hand. The infant industry quickly felt the need of government protection, and Moses Brown wrote, April 19, 1791, to one of the proprietors of the Beverly Cotton Manufactory upon the subject of applying to Congress for some encouragement to the cotton manufacturers, to take the shape of an additional duty that could be offered as a bounty partly for sowing and raising cotton in the Southern States and partly as a bounty on cotton goods that might be manufactured.

In a letter to John Dexter, Oct. 15, 1791, Moses Brown said that, previous to Slater's arrival, Almy and Brown had been making warps of linen, and that it was more than twelve months before Slater could complete enough machinery to spin perfectly single warps of cotton. During the time that Slater was working on his machinery, linen warps were woven, and the spinning jenny was operated

in the cellars of dwelling-houses. Finding the inconvenience of sending out the spinning, Slater and his partners erected in 1793 a new mill, called the "Old Slater Mill," and dye-shop, about forty feet long, twenty-six feet wide, two stories high, with an attic; and later, also, additions were built for singeing, calendering, and other machines. Alexander Hamilton, in his report as Secretary of the Treasury, made Dec. 5, 1791, said,—

"The manufactory at Providence has the merit of being the first in introducing into the United States the celebrated cotton mill, which not only furnishes materials for that manufactory itself but for the supply of private families, for household manufacture."

PAYMENT AND DISCIPLINE OF EMPLOYEES

According to Moses Brown the manufacturing of the mill yarn was done by children from eight to fourteen years old. Some of the first yarn spun by Slater was as fine as No. 40, and with some of the first cloth made from the warp was sent to the Secretary of the Treasury. Before Slater began manufacturing, a yard of cloth made by the wheel and loom cost fifty cents, and never less than forty cents. A few years later it could be bought for nine or ten cents.

As employees received but eighty cents to $1.30 and $1.40 per week, and indoor work was not alluring, it was difficult to secure the right kind of help. Slater introduced the English apprentice system, but it did not work, and was soon given up. One boy, who found the work too hard and discipline too strict, complained to a companion, who replied, "Very well, act like the devil, and Slater will lay you off."

Slater maintained a strict yet sort of paternal care over the welfare of his employees, starting in 1793 the first Sunday-school in America, and also day schools for the workmen's children. The first market for Slater's yarn