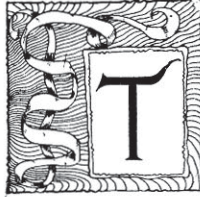


THE COTTON INDUSTRY IN NEW ENGLAND.

By George Rich.



THE rise of cotton manufacturing in this country, like that of the other great industries, was effected only after a long series of experiments. For this reason no one town can claim the distinction of having been its birthplace. The new industrial spirit was beginning to make itself felt everywhere at the close of the last century. But the fields were new and untried, and much of the work, so far as concerned the immediate effort itself, was fruitless. Beverly, Massachusetts, however, may be said to have been the seat of the the first cotton factory in America. There it was that cotton spinning, further than the hand-card and one-thread wheel, was carried through its first struggles. Taking that, then, as the starting-point, the rise of the industry in New England may be roughly divided into three periods. The first embraces the dozen years prior to 1790, and might be called the experimental period; the second covers the time from 1790 to 1814, during which the perpetual spinning system was established and perfected; and the third the years immediately following 1814, which marked the introduction of the power-loom and the development of the modern factory.

To Massachusetts belongs the credit of having been the first to give aid and encouragement to the cotton industry. Philadelphia, however, was the original centre of the manufacturing movement in this country. Tench Coxe, a prominent resident of that city, was the pioneer, and so untiring was he in his labors that he earned for himself the title of "Father of American Manufactures." It was he who first urged the cultivation of cotton in the South, at a time when the plant was scarcely seen outside of a flower garden, and who was most

active in the organization of a company for its manufacture. Through him, also, it was that the first spinning-jenny seen in America was exhibited at Philadelphia, in 1775. The jenny was constructed by one Christopher Tully, after the English plan of Hargreaves, and spun twenty-four threads. The "United Company of Philadelphia for Promoting American Manufactures" secured the machine and prepared to operate it. This company, as its name implies, had been formed through the instrumentality of Mr. Coxe, for the purpose of encouraging home industries and giving employment to idle workmen. But it proved a business as well as philanthropic success. Besides operating Tully's jenny, some four



Tench Coxe.

hundred women were employed by it in hand spinning and weaving. The stock, which had been originally fixed at £10, rose in two years to £17 6s 6d. Later the business passed into the hands of

Samuel Wetherell, one of the directors, and he during the Revolution turned from the spinning of cotton to the more profitable making of woollen fabrics.

Tully's machine was a rude and unsatis-



Moses Brown.

FROM A SILHOUETTE LOANED BY MR. MOSES GODDARD OF PROVIDENCE.

factory affair. Those who sought to improve it, however, had to contend against the greatest obstacles. Arkwright's patent was giving a decided impetus to the industry in England. But that country guarded the invention jealously and forbade every exportation of models; and the law was strictly enforced. A German in 1784 was fined £500 for trying to form a colony of English workmen for the Low Countries; and in

1786 some brass models prepared for Mr. Coxe were seized by the English customs officials. But relief came from another quarter. Hugh Orr, Esquire, of Bridgewater, Massachusetts, had in his employ two Scotchmen, Robert and Alexander Barr, who were familiar with the English spinning system. Orr himself was something of an inventor. He manufactured the first muskets in this country and the first machine-made nails. The Barrs suggested their ability to reproduce these machines, and Orr had them build three, for carding, roving, and spinning. But Orr was public-spirited as well as progressive, and when the machines were completed he had a committee from the state legislature out to Bridgewater to examine them. The result was that the legislature, on November 16, 1786, made a grant of £200 to the machinists, and afterwards supplemented it by six tickets in a state land lottery, in which there were no blanks. This bounty was given, so the grant declared, "as a reward for their ingenuity in forming those machines and their public spirit in making them known to the commonwealth." This was probably the first stock-card in the country. A year later, Thomas Somers, an English midshipman, drifted to Bridgewater, and at Orr's direction constructed an imperfect form of Arkwright's water-frame. The general court made him a grant of £20. These machines were then placed in charge of Mr. Orr and were exhibited by him as the state's model.

Many visited Bridgewater and examined these models. The immediate results were experiments in spinning at Providence, Rhode Island, and Beverly and Worcester, Massachusetts. Daniel Anthony was the one who secured the plans for Providence. He, with Andrew Dexter and Lewis Peck, had started a company in that city for the making of "homespun cloth," a stuff of linen warp and

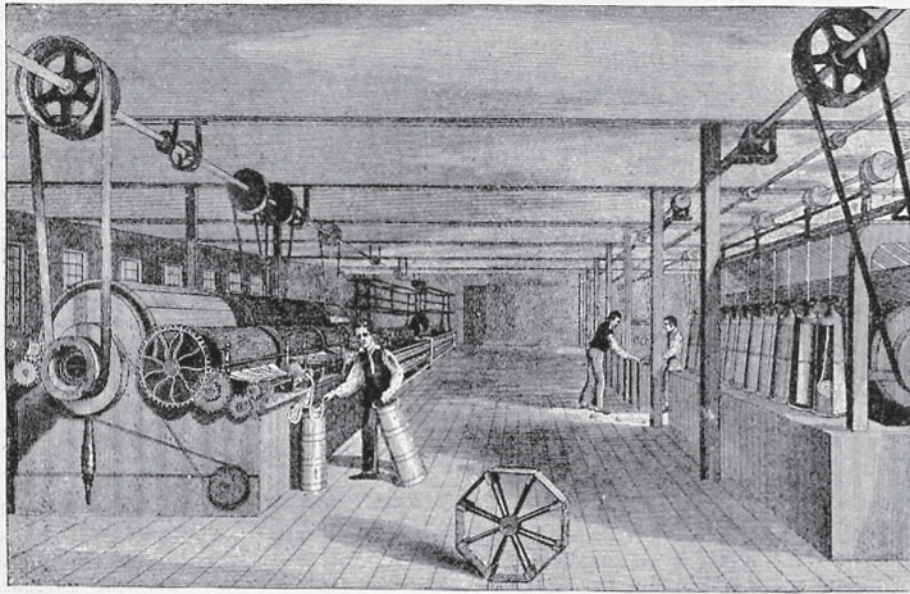
cotton filling. But the new venture proved unsuccessful and the machines passed into the hands of Almy & Brown, to be pronounced utterly worthless a few years later by Samuel Slater.

It was at Beverly that the first real advance was made. The Beverly Company was formed in 1787, and built a small brick factory on Bass River. The machinery consisted of one or more spinning-jennies and a carding machine. John Cabot and Joshua Fisher were the managers of the enterprise. General Washington, in the diary of his trip through New England in 1789, thus writes of a visit to it:—

In this manufactory, they have the new invented spinning and carding machines. One of the first supplies the warp, and four of the latter, one of which spins eighty-four threads at a time by one person. The cotton is prepared for these machines by being first (lightly) drawn to a thread on the common wheel. There

But the enterprise was not a financial success. The expenditures were large as compared with the receipts, the machinery rude, and as a result, the fabrics were of a coarse quality. The managers made an appeal to the legislature of the state in 1787, and secured an appropriation of £500. Again, in 1790, they petitioned for assistance, and the statement they then made is of much interest. It is too long to quote in full, but the introductory portion is as follows:—

The proprietors of the Beverly Cotton Manufactory beg leave to represent, that the establishment of a manufacture of cotton, in imitation of the most useful and improved stuffs which are formed of that material in Europe, and thence continually imported into this country at a very great expense, has been attempted by the said proprietors. This attempt commenced in the year 1787, from a consideration of the extensive public advantages to be obtained by it; and on this occasion your petitioners may be permitted to declare that in that view of the subject, the hazard of their private property,



Carding, Drawing, Roving, and Spinning, as introduced by Samuel Slater in 1790.

FROM AN OLD PRINT.

is also another machine for doubling and twisting the threads 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 cotton.

and the many obstacles which have since deprived them of every hope of present emolument to themselves were overlooked. The design has been prosecuted, although it has proved much more arduous and expensive than was first conceived, so far as to demonstrate that it is practicable; and that the manufacture, having been once established, will be sufficiently lucrative to support and extend itself, and will afford not only a supply for domestic consumption, but a staple for exportation.

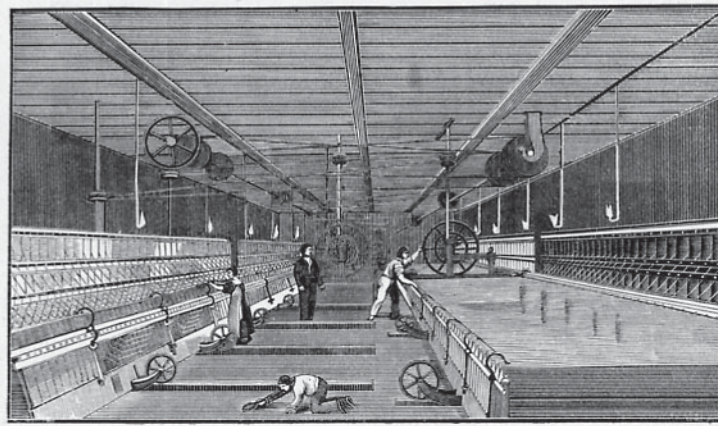
The petitioners then call attention to the general use of imported goods in the country, and the consequent drain on the public currency. Their description of some of the advantages to come from the establishment of the industry is amusing reading to us of to-day. "The raw material," they say, "is procured in exchange for fish, the most valuable export in the possession of this state, and, at this time, in great need of encouragement. It must be evident that the cod-fishery will be essentially encouraged by extending the demand for the imports to be obtained by it. This manufacture finds employment and support for a great number of persons, and, among others, for infirm women and children."

The managers state that they have necessarily incurred a variety of expenses and losses, to which succeeding manufacturers will not be liable. Among the items is the extraordinary price of machines unknown to American mechanics, and only to be constructed after long and repeated ex-

to prevent rival manufacturers from securing them. Furthermore, the goods turned out lacked that finish and beauty which the English factories could show because of superior workmen and improved machinery. Messrs. Cabot and Fisher conclude:—

Your petitioners have ever conceived that the government of this commonwealth would at least indemnify them for these extraordinary expenses and losses, which cannot be reimbursed by any future success of their design, since the models of machines and the essential information obtained at their expense is open to every succeeding adventurer. The expenditure of the said proprietors has already amounted to nearly the sum of £4000, the value of their remaining stock is not equal to £2000, and a further, very considerable advancement is absolutely necessary to obtain that degree of perfection in this manufacture which alone can insure its success. This necessary addition to their stock will enable the proprietors to rival in beauty, perfection, and cheapness, the European manufactures, and in that case, they shall willingly trust in the prudence and patriotism of their countrymen for a preference. But the proprietors having already hazarded, some their whole fortunes, and others very large sums, are obliged to declare, without aid from this honorable court, no further advancement can be made, and, mortifying as it is, they feel themselves in the necessity of relinquishing a design highly beneficial to the public and undertaken by them from the purest motives. The intended aid by a grant of land made by a former legislature to the said petitioners has not in any degree answered the purpose of it.

The petition went to the House Committee for Encour-



Mule Spinning early in the Century.
FROM AN OLD PRINT.

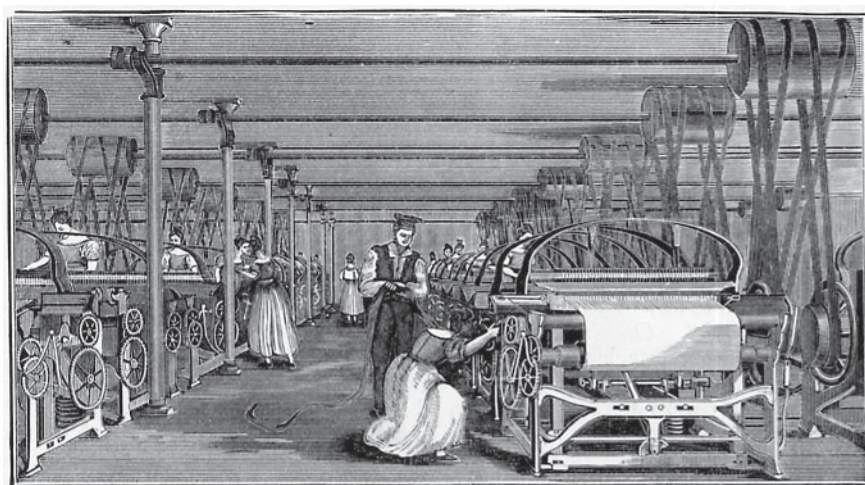
periments. An instance in point was the carding machine. The Beverly Company, when it was started in 1787, had to import a carder at a cost of \$1100, but within three years they could be bought for only \$200. Then, too, there was a great loss of material in the instruction of green workmen, and still more serious annoyance through the desertion of those who had become skilled in the use of the machines, and the necessity of paying higher wages

agement of Arts, Agriculture, and Manufactures, and Nathaniel Gorham, as its chairman, made a non-committal report, in which he recommended in conclusion, that the "petitioners have a grant of £1000 to be raised by lottery, on condition that they give bonds that the money be actually appropriated in such a way as will most effectually promote the manufacturing of cotton in this commonwealth." Messrs. Cabot and Fisher thus got their appropri-

tion, but the Beverly Company failed to improve even after it. The machinery was too imperfect to compete with that across the water.

Such was the situation when Samuel Slater arrived in this country at the close of the year 1789. Slater was fresh from the centre of the industry in England. Born in Derbyshire in 1768, he was early apprenticed to Jedediah Strutt, a Milford cotton manufacturer and a partner with Sir Richard Arkwright in the spinning

fortified by his long experience, gave him an equipment that no customs officials could seize. He landed in New York in November, 1789, and after some delay in that city, pushed on to Providence, Rhode Island. There Almy & Brown were trying to operate the card and jennies which they had bought from the old "home-spun cloth company." Slater looked them over and pronounced the whole lot utterly worthless. Moses Brown, the head of the firm, a worthy Friend, was rather astounded

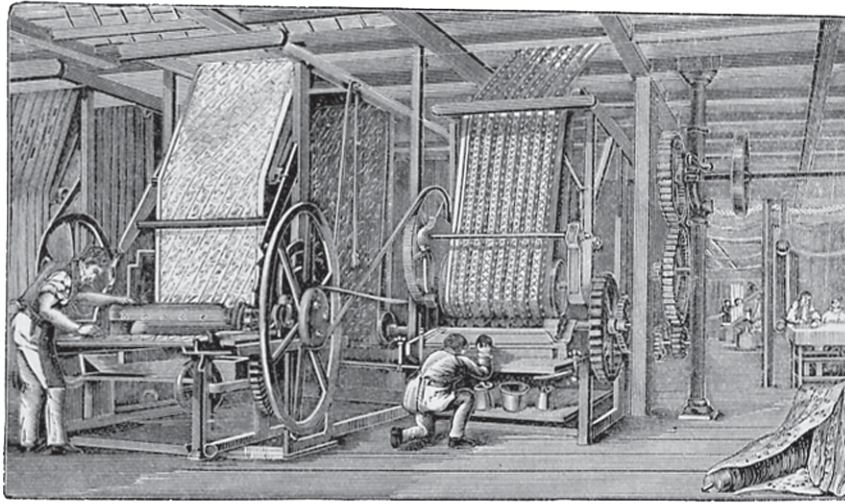


Power Loom Weaving early in the Century.

FROM AN OLD PRINT.

business. This latter circumstance was a most important one. It gave young Slater every opportunity to master the details of the construction of the best cotton machinery then in use. During the last years of his apprenticeship he was a general overseer, not only in making machinery, but in the manufacturing department of Strutt's factory. But Slater was a pushing, energetic young fellow, and was not content with the position of even an overseer. He chanced upon a copy of an American newspaper, and there learned of the general interest that was being taken by this country in cotton manufacturing and the generous bounties promised those who should build satisfactory machinery. This determined him to emigrate hither. But he knew that he could carry with him neither models nor drawings. He was blessed, however, with a mathematical mind and a retentive memory. These,

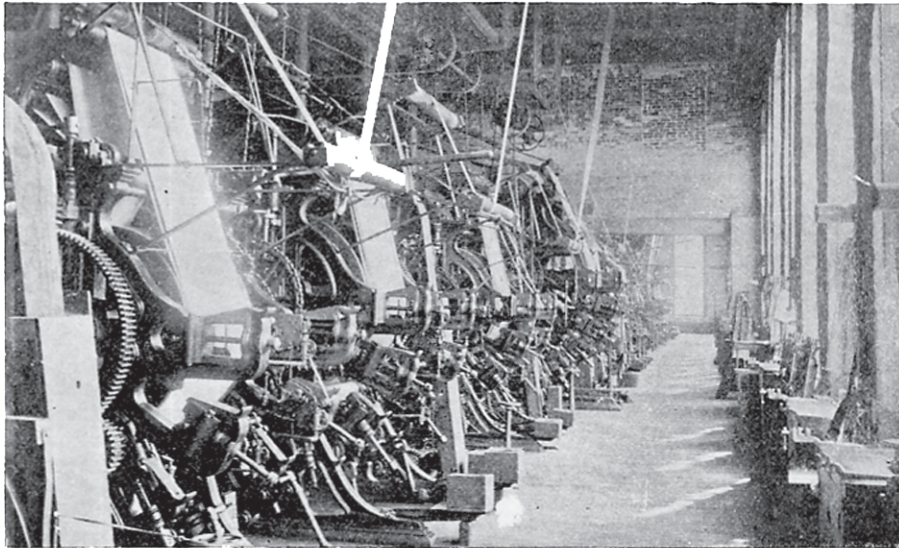
at the wholesale condemnation of his plant. He recovered, however, sufficiently to reply, "But thee hast said thee canst make the Arkwright machines; why not do it?" The result was that the young mechanic there contracted with Almy & Brown to produce a "perpetual card and spinning system" for them. On January 18, 1790, Mr. Brown drove Slater out to Pawtucket and there let him begin his work. They secured a shop by the Blackstone River, on what was then known as Quaker Lane. One can scarcely appreciate the difficulty of the task. All the plans had to be made from memory. Skilled machinists and modern tools for working wood and iron were wanting. Secrecy, furthermore, was necessary, lest some rival should get hold of and anticipate the plans. Sylvanus Brown was hired to do the wood-work, and David Wilkinson the metallic. These, with Slater and an old colored man, constituted



Calico Printing early in the Century. From an Old Print.

the force. Behind closed doors and barred windows this quartette worked for nearly a year before any of the machinery was ready for trial. On December 20, however, three cards, drawing and roving, together with seventy-two spindles, were complete. These were then taken to an old fulling mill and a test of them made. One does not have to use much imagination to revive the scene of that crisp December morning. The splendid curve

of the river as it sweeps through the town, the small, dimly lighted mill, the novel combination of wheels and pulleys and rollers, and the little knot of anxious workers about them, complete the picture. Slater, confident yet nervous, throws the belt over the wheel and then adds a few final touches; Wilkinson, with the keen interest of a clever machinist, inspects every detail and adjustment; while Brown and the colored man are by, ready to lend



Calico Printing in 1890. A View in the Merrimack Mills.

an assisting hand. A little apart stands the venerable Quaker, Moses Brown, hoping, yet doubtful of the success of the venture. None others know the nature of the operations within that closed door, or the importance that attaches to their result. The commendatory words of the Friend, "Samuel, thee hast done well," tell t

The machinery at the fulling mill was run twenty months, and such a quantity of yarn was turned out that the proprietors thought they were going to be ruined. Indeed, Moses Brown wrote Slater when only five hundred pounds had accumulated, that he must shut down the gates, or he would spin all his farms into cotton yarn. But the weather Friend must have been



John Slater.

Slater's machines were all constructed on the Arkwright principle, a fact of peculiar significance. Edward Atkinson thus emphasizes it:—

In the whole treatment of cotton, as it is now practised in the finest factories of modern kind, there is but one original invention; all else is but a change or modification of prehistoric methods. That invention was one which Sir Richard Arkwright borrowed from a previous inventor and put in use about a century ago; namely, the extension of the strand prior to the twisting of the spindle. This was accomplished by the use of several pairs of rollers, one placed in front of the other, and those in front working at a higher speed than those behind.

somehow reassured, for the spinning went on until twenty thousand pounds of yarn had collected. Nothing but spinning was done at that time. The yarn was then sent out among the farmers to be woven into cloth. The current prices paid for this were from six to twelve cents per yard. In 1793 the firm, which had now become Almy, Brown & Slater, built a small mill at Pawtucket, which still remains, and is known as the "old factory." This ran seventy-two spindles at first, but the number was gradually increased. Slater, in 1798, formed a partnership with Oziel and William Wilkinson and Timothy Green, as

Samuel Slater & Co., and built another factory. His brother John joined him from England in 1806, bringing with him all the recent English improvements. The two brothers then started the factories at Smithfield, which have since grown into the modern Slatersville.

ping or the fisheries had then to turn to the various manufacturing industries. Factories and mills sprung up throughout all New England. The whirl of the spinning-jenny became a common sound. The men who had received their training under Slater took this chance to branch out for



Webster in 1830.

The spinning system once established, its extension was rapid. At the close of the Revolution there sprang up all over the country societies for the promotion of various objects, such as agriculture, the arts, and the trades. It was the fashion for gentlemen of leisure to take an active part in some such movement. The result was that a knowledge of the new inventions and improvements was quickly and widely spread. American cotton was then of a very poor quality. The picker was a thing of the future, and the staple had to be sent into the country to be whipped and cleaned. The work was of necessity imperfectly done. Slater declined to use the home cotton when he began his operations, insisting on that imported from the West Indies. Finally, the war of 1812 shut off the stream of importations from Great Britain and forced the people of this country to depend upon themselves. Commerce was unnaturally checked. Thousands who had been employed in ship-

ping themselves. Slater himself was a rare business man, and untiring in the extension of his factories. He was a ceaseless worker. He used to say that "sixteen hours' labor a day, Sundays excepted, for twenty years, had been no more than fair exercise." But in that time, as Mr. John L. Hayes says in an article on the textile arts, he founded not only the art of cotton spinning, but also the manufacture of American textile machinery, and thus placed the modern worsted and woollen factory under great obligation to him. The great New York Mills at Utica originated in a small factory built in 1807-8 by B. S. Waldron, Jr., who had worked in Pawtucket. Another Pawtucket man named Robbins started the first factory in New Hampshire in 1804. Factories were started at Fitchburg and Watertown in 1807, and at Amoskeag Falls, New Hampshire, in 1810. In that year, also, the first Maine (then a province of Massachusetts) factory was started at Brunswick. Secretary Gallatin,

in his treasury report of April 17, 1810, thus writes of the growth of the manufacture : —

During the three succeeding years ten mills were erected or commenced in Rhode Island, and one in Connecticut, making altogether fifteen mills erected before the year 1808, working at the time 8000 spindles. Returns have been received from 87, which were erected at the end of the year 1809, 62 of which were in operation and worked 31,000 spindles, and the other 25 will be in operation in the course of the year 1810.

These factories were very generally distributed through the northeast. There were 109 factories in New England according to the census returns of 1810. Massachusetts had 54, New Hampshire 12, Vermont 1, Rhode Island 28, and Connecticut 14. There were then in New York 26 factories, in New Jersey 4, in Delaware 3, in Maryland 11, Kentucky 15, Tennessee 4, Ohio 2, and Pennsylvania 64. Under the impetus given the manufacture by the war, the capital invested in it in 1815 was estimated at \$40,000,000, and the operatives numbered 34,000 men and 66,000 women.

But there came now a second revolution in the industry. This was wrought by the introduction of the power-loom. Francis C. Lowell, of Boston, was the principal agent in this change. He was ably assisted, however, by Patrick T. Jackson, Nathan Appleton, and Paul C. Moody. The power-loom was invented by Rev. Edmund Cartwright in 1785. But the looms did not come into general use on account of the necessity of stopping the machine every few minutes to dress the warp as it unrolled from the beam. This required the labor of an extra man for each loom and prevented the saving of any expense. But in 1802 Messrs. Johnson and Radcliffe, of Stockport, obviated this difficulty by the construction of a machine by which the dressing of the warp was completed before it went into the loom. Later, Messrs. Horrocks and Marsland, also of Stockport, adapted the loom so that it could be driven by steam, and Mr. Roberts, of Manchester, brought its working parts to nearly their present perfection. But all this was in England. In 1811, however, Mr. Lowell made a visit to

that country for the purpose of inspecting its factories. There he met Nathan Appleton. The two held a consultation as to the advisability of attempting the introduction of the looms into their own country. The upshot was that Mr. Lowell made a careful study of the English machinery and then returned home to reproduce and improve it. The experiments were begun at a store on Broad Street, Boston. He was aided in this work by Paul Moody, a skilled machinist from Amesbury. Moody proved a valuable man. Edward Everett said of him : —



Francis C. Lowell.

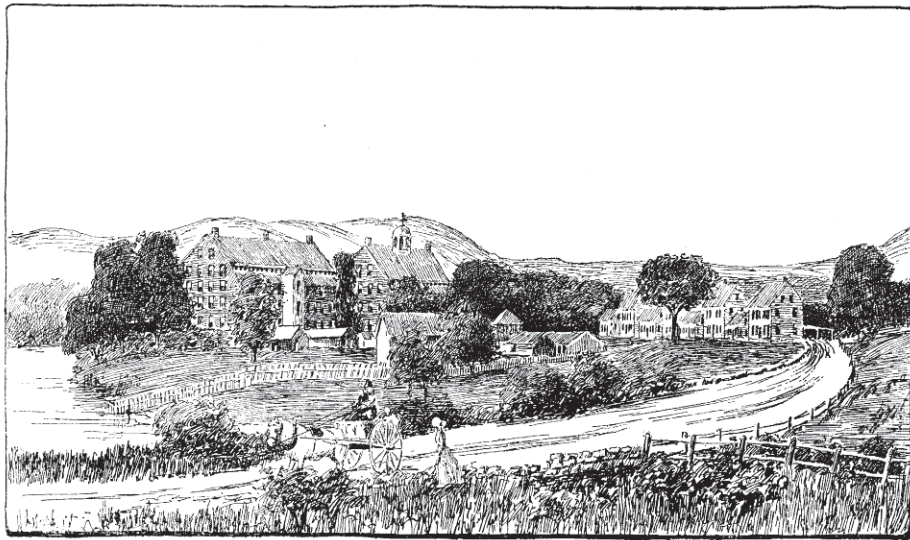
FROM A SILHOUETTE LOANED BY FRANCIS C. LOWELL, ESQ., OF BOSTON.

To the efforts of his self-taught mind, the early prosperity of the great manufacturing establishments at Waltham and Lowell is in no small degree due.

The Boston Manufacturing Company was now organized, with Messrs. Appleton, Jackson, and Lowell as the principal own-

ers in it. The capital stock was placed at \$400,000, and in 1813 they began to build a factory at the upper fall in Waltham, the site of the old Boies paper mill. The factory was four stories high, and ninety by forty feet in dimensions. Thither Lowell's machines, which differed essentially from the English ones, were taken, and their operation begun. Finding that it would be more profitable to combine the operation of spinning with the weaving, some seventeen hundred spindles were introduced, thus comprising within one establishment all the processes necessary for converting raw cotton into finished cloth. This was, without doubt, the first complete cotton factory in the world. But the Waltham people were a little slow in completing the manufacturing system. Rhode Island preceded them by ten years in the adoption of the crank-loom, and nearly a score of years in mule spinning. Judge Lyman, of Providence,

The factories of that day were smaller than the modern ones, and not so well lighted or ventilated; but the processes of manufacture were practically the same. The interior of a cotton factory, with its intricate and almost sentient machinery, must be a source of perpetual delight to a skilled mathematician. Indeed, some enthusiast has said that cotton machinery constitutes the poetry of mechanical action. But to the chance visitor the impression is one of confusion and wonder, and it requires some careful inspection before the medley of wheels and rollers and spindles begins to assume any definite relations to the finished cloth. The cotton in the course of this change from the raw state undergoes four general processes of treatment. These are cleaning, carding, spinning, and weaving. Really, however, it is advanced to the first stage of manufacture when it is ginned, and the cotton separated



The Old Mill at Waltham in 1820.

From an old picture

secured twelve of these Scotch looms through William Gilmore, and successfully operated them in 1817. This leads Samuel Batchelder to point out, in his notes on the early manufacture of cotton, that—

Mule spinning having been introduced in Rhode Island, the building of the power-loom by Gilmore completed the manufacturing system of that state within about three years from the time when the power-loom was put in operation at Waltham.

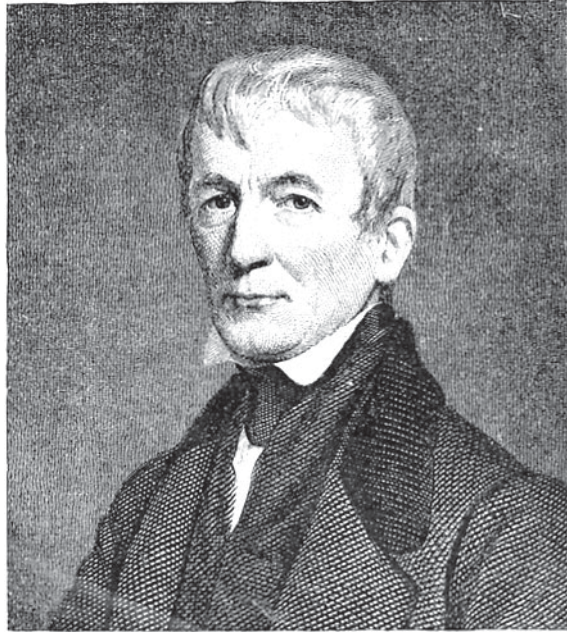
from the seeds. This has to be done near the place of its growth, and Whitney's saw-gin is the effective agent in it.¹ The bales, then, as they come from the South, are taken first to the mixing room. There the cotton is spread uniformly over a perfectly clean space upon the floor prepared for it.

¹ See article on *The Story of the Cotton-Gin*, by Edward Craig Bates, in the NEW ENGLAND MAGAZINE for May, 1890, with picture of the original model of the cotton-gin.

Upon the layer thus made, the contents of another bale are emptied and spread, and the operation is continued until the pile is complete. This mountain of filmy fibre is termed the "bing," and the object of thus mixing is to secure uniformity in the character of the yarn. The quality of the cotton in each bale must necessarily vary despite all care used in sorting it. The yarn spun from it then would be uneven in strength and quality, and no little skill is required to produce the necessary uniformity. But the cotton in the bing is too impure for spinning until it has been cleaned and the fibres opened and loosened by whipping. The finest, which is intended for the most delicate yarns and laces, is beaten by hand with twigs over a wire screen, through which the impurities fall. The most of it, however, is passed through a sheet-iron tube into a revolving cylinder. This cylinder has an inner bottom wall of fine screen work and an internal mechanism of moving arms. There the cotton receives a violent beating, and the dust and sand and other foreign materials are pretty thoroughly shaken out, the cotton being afterwards projected by an air-blast upon an extended apron in great fluffy masses. But the work of cleansing even now is not complete. Leaves and nubs remain behind despite the snowy texture of the mass, and it is the office of the pickers to remove them. These pickers consist of a series of fluted rollers, revolving rapidly, and armed with blunted knife blades. These tear the cotton masses into minute fragments, and disintegrate every remaining impurity, while a powerful air draught seizes the lighter fibres and lodges them on the face of a revolving screen. Carried on this screen, the cotton is introduced to another set of beaters, from which it finally emerges in the shape of a delicate, filmy sheet of uniform thickness. These sheets are wound on rollers, and are then ready for the carding machine.

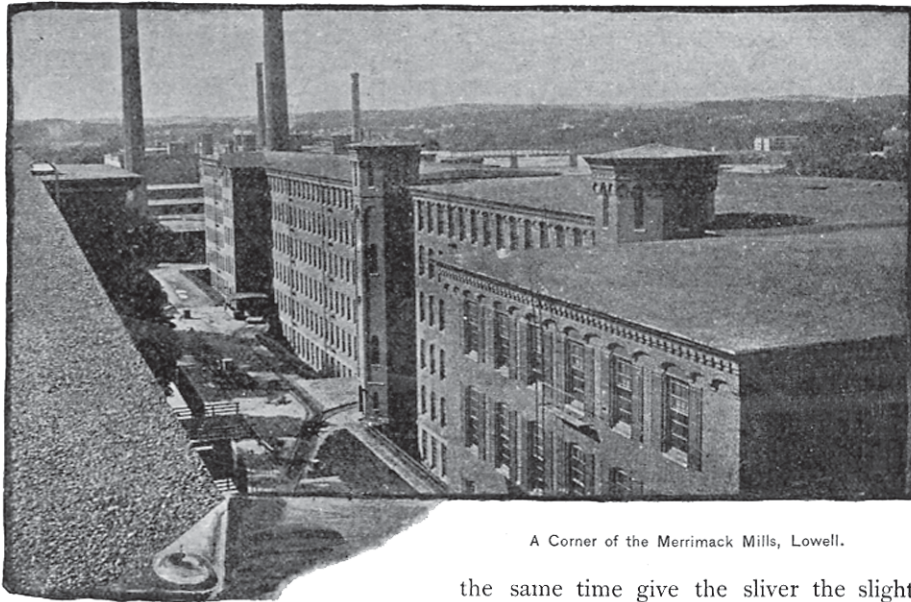
The carding machines are simply the hand-cards of our grandmothers, trans-

lating their rubbing motion into rotary motion. They extend the work of the picker; but instead of turning out the cotton in a sheet, they form it into a continuous strand. The machine consists of a large drum studded with minute wire teeth, and revolving within a box. This box is also lined with these card teeth, and occasionally four small cylinders are placed in



Patrick Tracy Jackson.

it besides, arranged so as to revolve in an opposite direction from the large one. The cotton apron is fed to the cards by a couple of slowly moving rollers, and by the former the fibres are straightened and arranged in parallel lines. On the opposite side of the carding machine from that on which the cotton enters, but revolving in a contrary direction, is another cylinder called the "doffer." The office of this is to receive the straightened and carded filaments and roll them into a single fleecy sheet. But when this latter cylinder has made half of a revolution, the cotton is stripped from it by a rapidly vibrating comb which runs the whole length of the doffer. These card-ends are termed the "sliver," and the result of the process is indicated by the fact that the apron has only about one one-hundredth of the thickness it possessed



A Corner of the Merrimack Mills, Lowell.

when it entered the cards. The card-ends are then passed through a funnel and rollers, so as to be further consolidated and elongated, and then delivered into tin cylinders. These cards, as a matter of fact, are usually worked in gangs of a dozen or more, and the transfer is made from them to the series of extension rollers by means of an endless belt.

This gives the first form of the thread, but it is much too coarse for use, and the spinning processes are necessary. The spinning-room presents a marked contrast to the carding-room with its cumbrous machines. Its machinery is a development of the old-fashioned spinning-wheel, whose object was to draw out and twist the thread. The drawing frames perform the first of these functions, the roving machines further extend that and add a slight twist, while the mules complete the work. The drawing machine consists of a series of rollers and funnels. Three separate strands of the cotton ribbon are drawn together by the action of the fluted rollers and united into a single thread through a metallic tube. The second and third processes are but extensions of this, the product of one serving as the raw material for the other. The rovers or speeders are known respectively as the "slubber," the "intermediate," and "jack." These continue the work of the drawing frames and at

the same time give the sliver the slight twist alluded to. This necessitates the introduction of a spindle. The sliver is first subjected to a train of rolls and by them passed along until it is seized by the "flyer" attached to the revolving spindle. The flyer is a double-armed arrangement, one arm of which is swung round and round by the revolution of the spindle, thus imparting a twist to the thread, the other winding the thread thus twisted about the bobbin or spool at the head of the spindle. The spinning-mule has its essential train of rollers with the large frame in the background. The bobbins are placed in a creel upon this frame and their strand ends introduced between the rollers. In the foreground of the machine are the spindles arranged on small carriages in lines parallel with the rollers. In this way the rank of spindles can move forward and backward over the space which separates it from the roller-beam. The spindles, in the operation of the machine, are first run up to the roller-beam and the strand-ends attached. The carriage then moves out, the rollers delivering the thread, at first with a speed considerably greater than the surface motion of the front rollers, and the spindles at the same time revolve with moderate velocity, giving the strand some twist. When the carriage has covered about half of its path, the rollers cease to deliver the thread and the carriages move along slowly, extending the

roving, while the spindles begin to revolve with great rapidity, thus decidedly increasing the twist. This completed, the spindles are stopped and reversed for a few turns, the carriages move back again to the frame, the spun thread being automatically wound upon the bobbins, and the process recommences. The amount of twist given the thread depends upon the use to which it is to be put, warp requiring more than weft. The thread is then taken to the weaving room. That designed for warp is dressed and wound on the yarn-beam, while the weft thread is taken cop by cop and placed in the shuttle. The shuttle is to the loom what the needle is to the sewing-woman. The hand of the woman, however, can direct her needle so that its thread shall pass over one strand and under another. The shuttle lacks this intelligent guide, and the warp strands have to be so arranged that it can do it automatically. To do that is the function of the harness or heddles. This consists simply of a web of varnished hempen twines enclosed in a wooden or iron frame. Each couple of twines by a system of knotting is furnished with a small loop, so that the harness has a row of eyelets across its whole length. The warp at the back of the loom is passed through the two harnesses by means of a web-drawer, half through the eyes of one and half through those of the other. The ends of each pair of threads are then inserted in some dents in the "reed," a light wooden framework, and secured to the cloth beam. There are thus two banks of warp web playing upward and downward through the harnesses, with the opening space between them constantly changing. Through this space, which is called the "shed," the shuttle plays back and forth, the reed vibrating backward at every play of the shuttle cross-wise, thus forcing the weft threads closer together. The cloth as it comes from the loom is treated in various ways, such as bleaching, sizing, fulling, printing, according to the style and design of the goods.

We return to the Waltham manufacturers. They were greatly prospered. In

1816 they built a new factory, of double the capacity of the first, and in 1819 they purchased the property of the Waltham Cotton and Wool Factory, and added \$200,000 to their capital. But death had in the meantime stricken Mr. Lowell from their number, and Mr. Jackson became the controlling spirit in the enterprise. The success at Waltham led in 1822 to the incorporation of the Merrimack Manufacturing Company. Messrs. Jackson, Appleton, and Kirk Boott had previously visited the site of the Patucket Canal on the Merrimack River in Chelmsford. The location impressed them as being a most favorable one for their new venture. The canal and adjoining real estate were bought up at a cost of some \$49,000, and the foundation of the present city of Lowell



Nathan Appleton.

was then laid in the construction of their first factory. The name Lowell was given the place by Mr. Jackson, as a just tribute to his late associate.¹ Messrs. Jackson and Boott pushed their business with phenom-

¹ Concerning the exact circumstances of the naming of Lowell, see note in the *Editor's Table*.

enal energy and intelligence. Capital began to flow thither. New corporations were organized, and new factories built. How great and constant this growth has been during the sixty-eight years is indicated by the fact that the assessors' books for the last year place the city's valuation at more than \$62,000,000.

Fall River had about ten years the start of Lowell. Colonel Joseph Durfee made an unsuccessful attempt at cotton manufacturing there as early as 1811, but his plans were not realized until two years afterwards. Two companies were then organized,—the Fall River and the Troy.

which bear the names of the Bordens, Durfees, Davols, and others was begun early.

Lawrence belonged to a much later period than either, owing its rise to the organization of the Essex Manufacturing Company in 1844, and its name to Abbott and Samuel Lawrence, who were largely interested in it. Biddeford and Lewiston in Maine, Manchester in New Hampshire, Holyoke in Massachusetts, all have about the same industrial history.

Cotton manufacturing has had its ups and downs like other industries. The changes in tariff legislation, general depression in business, and

struggles at home and abroad, have all contributed to its advance or decline. Bishop, in his *History of American Manufactures*, estimates that in 1826 there were four hundred distinct factory buildings in New England, averaging seven hundred spindles and consuming 39,200,000 pounds of cotton. About one-third of these used the power-looms, while the others spun yarn and twist for the middle and western states. The factories in the other states at that time were placed at 275, and their consumption of cotton annually as about 20,000,000 pounds. The feature of the development from 1830 to 1840 was the increase in the capacity of the factories already built, rather than the building of new ones. In 1850 there were 1094



David Anthony.

David Anthony was the working spirit in the former, and Oliver Chace in the latter, and to the practical knowledge and energy of these two the early success of the industry in Fall River is due. As at Lowell, the excellent water-power drew manufactures thither, and the great net-work of mills

factories in the United States, employing 92,286 operatives, consuming 288,558,000 pounds of cotton, and realizing a product of \$65,500,000 upon an invested capital of \$74,500,000. The growth during the successive decades is shown by the following table:—

	1860	1870	1880
Factories . . .	1,091	956	1,005
Looms . . .	126,313	157,810	229,784
Spindles . . .	5,235,727	7,132,415	10,713,677
Operatives . . .	122,028	135,369	185,472
Capital . . .	\$98,586,260	\$140,706,291	\$219,505,794
Wages . . .	\$23,938,236	\$39,044,132	\$45,614,419
All materials . . .	\$57,285,534	\$111,736,936	\$113,765,537
Products . . .	\$115,681,774	\$177,489,739	\$210,950,383

and a weekly productive capacity of 714,000 yards; the Appleton Company, with 50,280 spindles and 1639 looms, and a weekly productive capacity of 350,000 yards; the Lawrence Manufacturing Company, with 120,000 spindles and 3432 looms, and a weekly productive capacity of 696,526 yards; the Boott Cotton Mill,

The amount of raw cotton used in 1880 was about 770,000,000 pounds, against some 398,000,000 in 1870, and 422,000,000 pounds in 1850. The apparent decline between 1860 and 1870 is accounted for by the natural tendency of industries to concentrate, and the fact that during the war many of the cotton factories were converted into woolen mills.

The detailed statistics for the decade from 1880 to 1890 are yet to be prepared. The number of spindles in operation, however, is estimated at about 14,500,000. A remarkable feature is the hold the industry is securing in the South. In 1888 there were 1,250,000 spindles there. There are now in those states 336 mills, with 40,819 looms and 1,819,291 spindles. The cotton crop this year is the largest the country has ever produced. The official figures place it at 7,311,322 bales; 265,489 bales greater than the highest figures of previous years, and 373,032 bales in excess of last year. The estimated value of this magnificent yield is \$500,000,000.

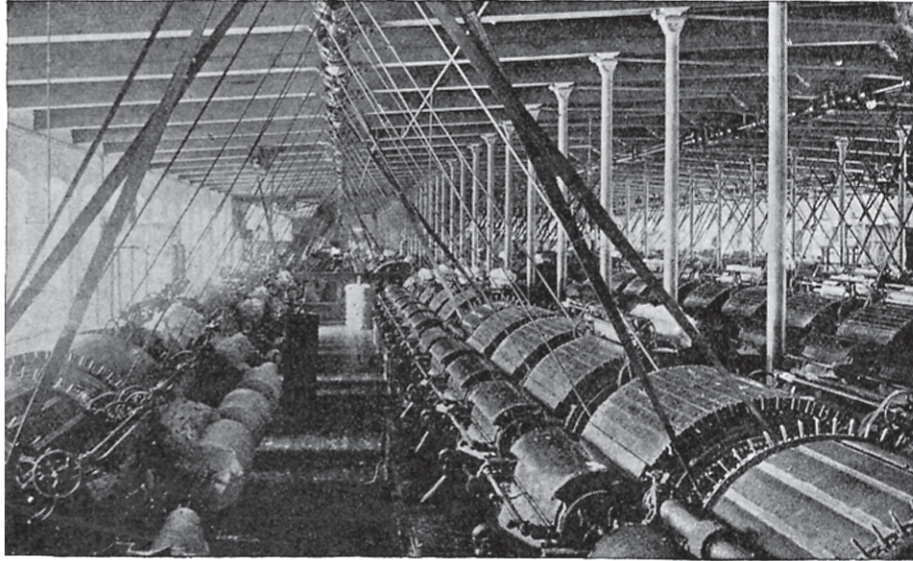
In Lowell are centred seven large corporations, with a capital stock of \$10,600,000. These are the Merrimac Manufacturing Company, with 156,480 spindles and 4607 looms, and producing 1,000,000 yards of dyed and printed cloth per week; the Hamilton Manufacturing Company, with 109,816 spindles and 3131 looms,



Oliver Chace.

with 148,412 spindles and 4000 looms, and producing weekly 775,000 yards; the Massachusetts Cotton Mill, with 126,648 spindles and 3728 looms, and producing weekly 90,000 yards; and the Tremont and Suffolk Mills, with 114,000 spindles and 3800 looms, producing weekly 560,230 yards. These seven mills consume weekly about 1,496,293 pounds of cotton. They employ 9901 women and girls and 4699 men and boys, and the wages paid each week aggregate more than \$83,000.

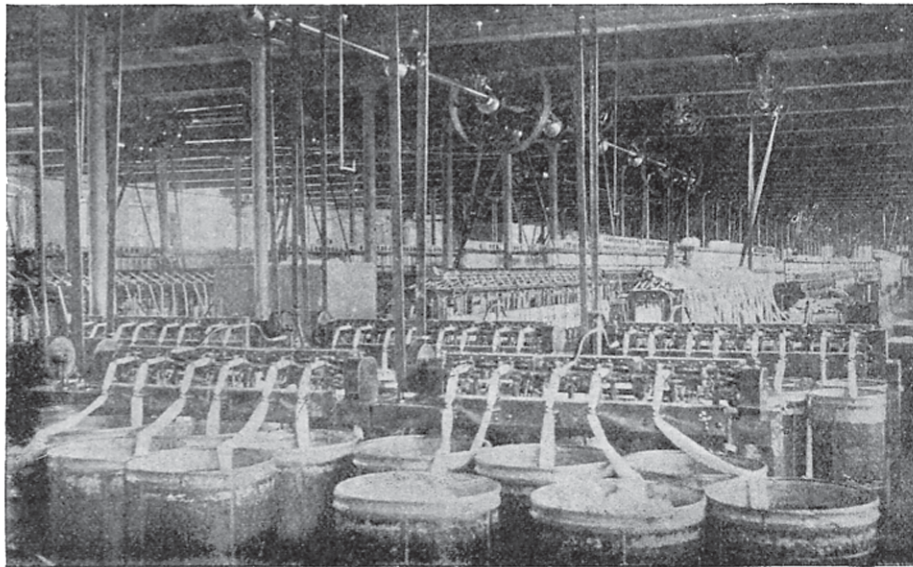
The Pacific Mills are the largest in Lawrence. These were started in 1852, and make largely prints and cotton. The mills



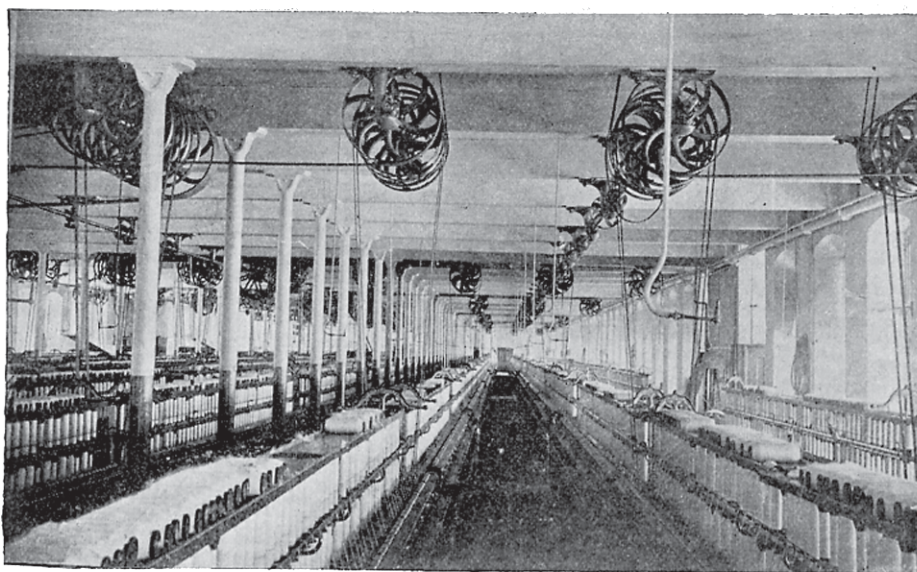
Carding — First Stage.

contain 180,000 cotton spindles, 4000 looms, and thirty printing machines. The Pacific mills carry a capital of \$2,500,000. The Atlantic mills, which were started in 1846, stand next, with a capital of \$1,000,000. Sheetings and shirtings are their specialty, and 101,344 spindles and 2001 looms are operated. The Everett and Pemberton

are two other large corporations. Factory life at Lawrence has been shadowed by one sad calamity in its early history. This was the fall of the Pemberton mill in January, 1860. There were 700 operatives in the five stories at the time of its collapse, and less than one-quarter of them escaped without injury. The death



Carding — Second Stage.

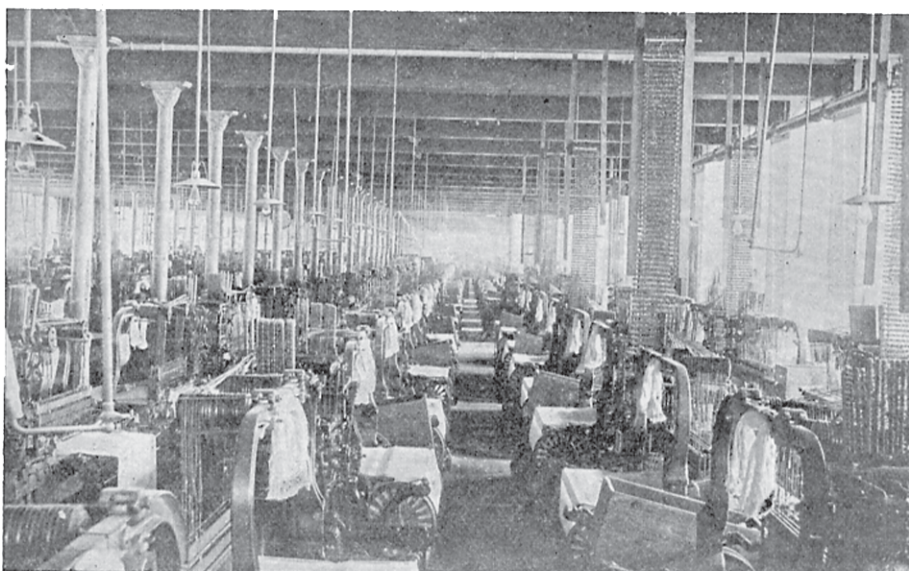


Ring Spinning.

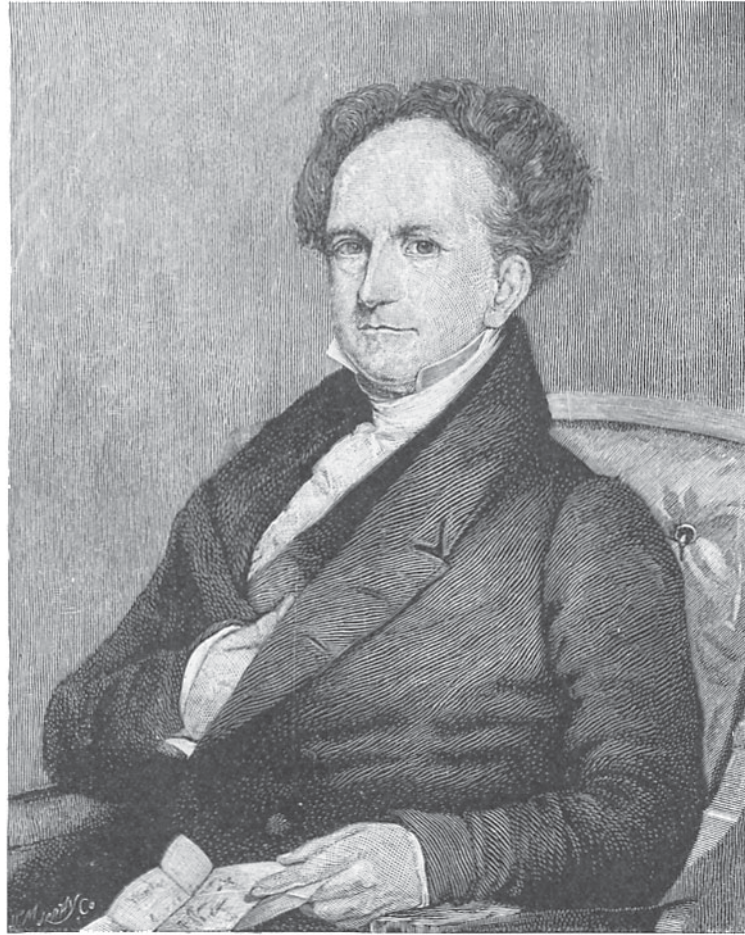
list aggregated 114, and the injured more than 400.

There are about forty cotton corporations at Fall River. The King Philip mills were started in 1871, and are capitalized at \$1,000,000. They contain 103,440 spindles and 2300 looms. The Border City Manufacturing Company, capitalized

at \$1,000,000, and operating 118,016 spindles and 2700 looms; the Davol mills, with 35,304 spindles and 924 looms; the Pocasset, with 68,084 spindles and 1575 looms; the Sagamore, with 89,904 spindles and 2176 looms; the Stafford, with 82,496 spindles and 2104 looms; the Durfee, the Merchants, and the Union, are all



Weaving.



Abbott Lawrence.

leading corporations among the large number of great Fall River corporations. The American Print Works here are of special interest and importance. The whole great city of Fall River is devoted almost exclusively to the cotton industry. William C. Davol, one of the organizers of the Davol corporation, played an important part in the development of the industry at Fall River. In 1838 he visited England, and there saw the Sharp and Roberts self-acting mule. He immediately entered upon the construction of these English machines, and after much delay and difficult work he succeeded in not only making them but improving them. His success subjected him to the trials which usually fall to the lot of an inventor.

Rival manufacturers tried to steal patterns of the machinery, and suits followed over the patents; but in the end Mr. Davol established his claim to the invention.

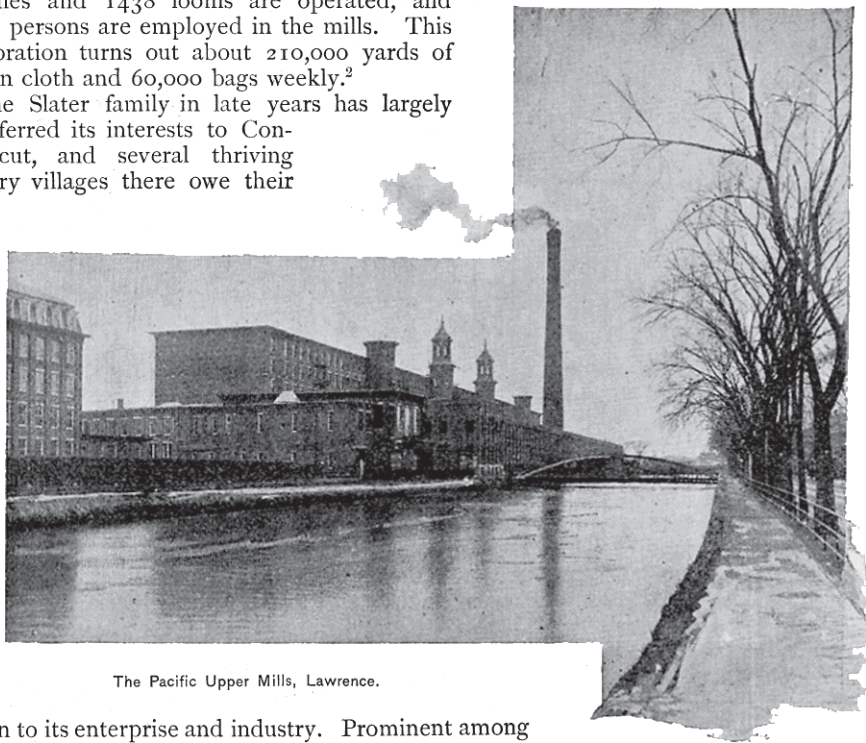
New Bedford is becoming a considerable cotton centre. Located here are the Wamsutta, the Potomska, the Grinnell Manufacturing Company, and the Howland Mill corporation. The Wamsutta mills were started in 1847, and make largely fine shirtings, sheetings, and muslins. They are capitalized for \$3,000,000, and contain 204,000 spindles and 4500 looms. The Potomska mills are more recent, having been started in 1871. They contain 108,120 spindles and 2713 looms, and carry a capital of \$1,200,000.

Messrs. B. B. and R. Knight have mills

at Hebronville and Dodgeville, Massachusetts, besides many along the various streams in Rhode Island. The Knights are perhaps the most extensive cotton manufacturers in America to-day. The Browns and Goddards of Providence are the owners of immense factories on the Blackstone river in the villages above Pawtucket.¹ There are large corporations also at Chicopee, such as the Dwight, with 120,000 spindles, and the Chicopee Manufacturing Company, with 67,000 spindles; and at Holyoke, the principal one of which is the Lyman mill, with a capital of \$1,470,000, and operating 82,000 spindles.

The Amoskeag, the Amory, the Manchester, and the Stark are the leading corporations at Manchester, New Hampshire. The Amoskeag was started in 1831, is capitalized for \$4,000,000, and operates 225,000 spindles and 7500 looms. It makes tickings, ginghams, and fine goods. The Androscoggin and the Bates are the two leading corporations at Lewiston, Maine. The former produces cotton goods of all kinds, while the latter makes a specialty of ginghams, damasks, and seersuckers. The Bates Manufacturing Company is the first in point of organization, it having been started in 1852. It occupies four large five-story factories, containing 69,000 spindles and 1664 looms. The company has a capital of \$1,000,000, and employs some 1800 operatives. The Androscoggin corporation is eight years younger. It has three large mills, besides storehouses, engine-house, and cotton-house. Its capital is \$1,000,000, the same as that of the Bates; some 62,000 spindles and 1438 looms are operated, and 1000 persons are employed in the mills. This corporation turns out about 210,000 yards of cotton cloth and 60,000 bags weekly.²

The Slater family in late years has largely transferred its interests to Connecticut, and several thriving factory villages there owe their



The Pacific Upper Mills, Lawrence.

origin to its enterprise and industry. Prominent among Connecticut mills are the Ponemah at Norwich. They are capitalized at \$1,500,000, and operate 117,000 spindles and 2766 looms. The Slaters have become identified with Norwich, and their philanthropy is marked. One of them has given \$1,000,000 for the education of the freedmen in the South, and a

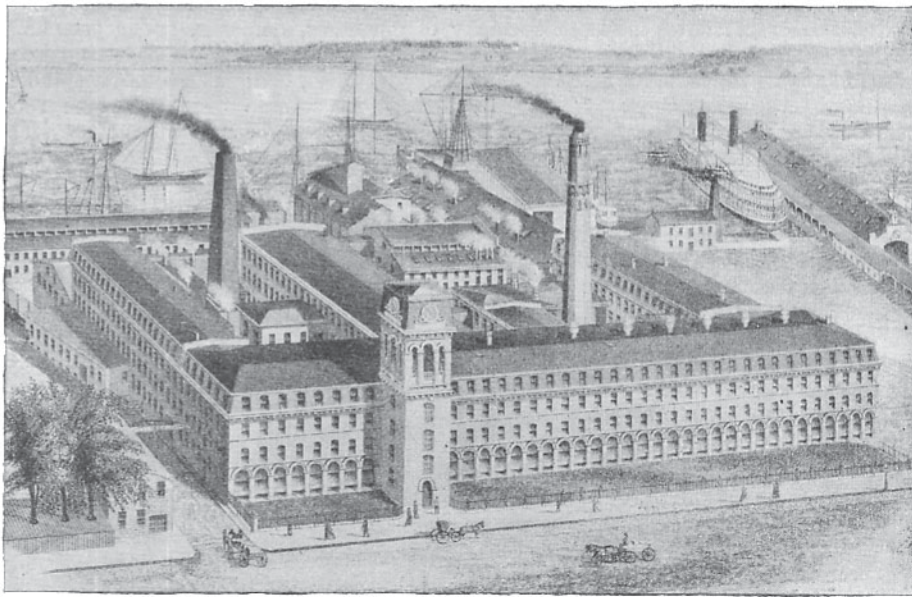
¹ A special illustrated article on "The Busy Blackstone River" is to appear in an early number of the NEW ENGLAND MAGAZINE, which will be in a measure supplementary to this article. — *Editors.*

² The above statistics for Lowell and Fall River are from local handbooks. Those for the other cities are based on Dockham's Textile Reports for 1890.

younger member of the family has presented his city with a magnificent art museum.

With the establishment of the great manufactures have come new and varied social conditions. To these changes, however, only a glance can here be given. The germ of the textile factory existed in the old carding and fulling mill; but it was not until Lowell and Jackson had made a success of their enterprise at Waltham that

of labor. Calculations have been made which show that under the modern system one person can perform as much work as could fifty under the old individual system. The disputed point is the moral effect of the system upon the character of the people involved in the changes produced by it. Colonel Carroll D. Wright made a careful investigation of this matter for the census of 1880. The points especially considered by him were whether the sys-



The American Print Works, Fall River.

that system of manufacture was completed. Originally both the spinning and weaving of the cotton had been done by the farmers' wives and daughters at their homes. Slater's spinning-frame and the power-loom wrested both these from the housewife. It was not without a struggle, however, that she relinquished her hand-loom and the money it had brought to the family purse. So eminent a man as Thomas Jefferson was for a long time the champion of these home industries. But the current of events was against them. This concentration of the processes of manufacture necessitated the concentration of operatives, and the manufacturing village or city was the result. No one doubts the economic advantages of the factory system, with its cheaper conveniences and minute division

tem necessitates the employing of women and children to an injurious extent; whether it leads to thriftlessness and poverty, swells the criminal list, or produces intellectual degeneracy. He thus summarizes the result of his inquiries: "It is obvious, from all the facts presented, that the factory system has not affected society so badly as has been generally believed; and if in its introduction it has brought evils to light, it has at the same time not only sought to remove them, but has done much to remove others. The unheard of powers it has given labor, the wealth that has sprung from it, are not the sole property of any class or body of men. They constitute a kind of common fund, which, though unequally divided, 'as are all the gifts of Nature to finite understanding,'

ought 'at least to satisfy the material and many of the moral wants of society.' The weal or the woe of the operative population depends largely upon the temper in which employers carry responsibilities entrusted to them."

The New England factory population has undergone several revolutions. Originally it was composed almost wholly of the sons and daughters of the New England farmers. Thirty years ago one could scarcely find a country village in Maine, New Hampshire, or Vermont, that had not furnished its quota to Lowell, Lawrence, and Manchester. But with the opening up of more congenial and remunerative employments, this class deserted the factories, and their places were taken by the Irish, English, and German immigrants. This class was a thrifty one, however, and soon saved up enough to enable them to buy the small farms which the more pushing New England yeomen had deserted for the boundless West. They

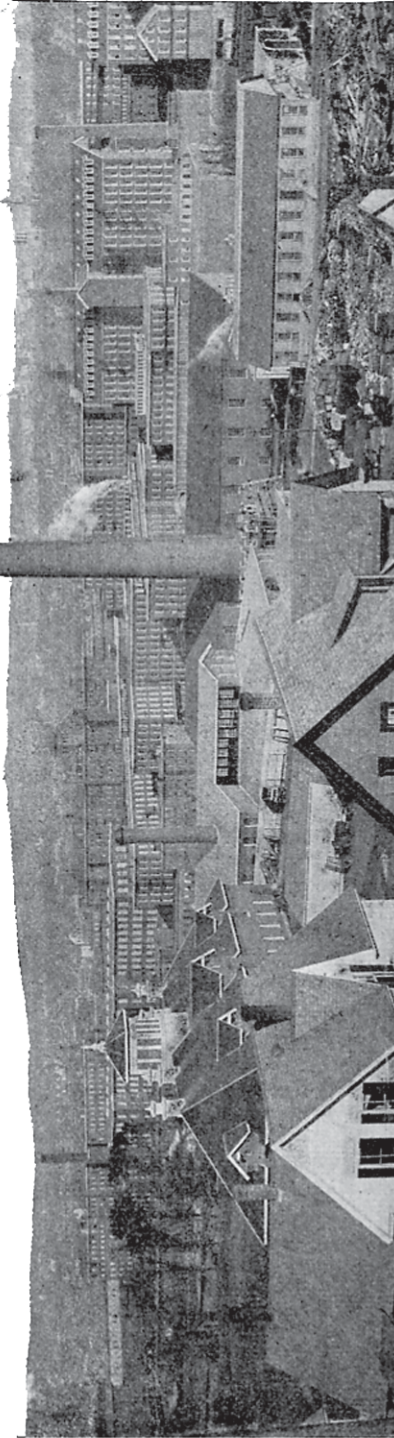
have been succeeded by French Canadians, and the predominating life. These, too, feel the spell of energy and ambition. prophecy. What will do for the cotton can be only a maturation. Certainly be done in the invention and machinery. They are continually ways to reduce production, and the

waking to life under the touch of a new hand. That the next century will show a record of such wonderful progress in this field as the past one has done may be doubtful. Yet "it is the unexpected that happens."

It is interesting to go back to the early days of cotton manufacturing in New England, and see how the new social and moral problems raised by the drawing age of machinery then affected people's minds. We quote a single passage from White's *Life of Slater* :—

"In the progress of manufactures among us, every department becomes interested in its prosperity; the operatives receive a greater emolument for their services than in any other part of the world, whilst capital receives but a small interest, compared with other branches of industry. With such a power established

in turn by the this race is now element in factories are beginning to American energy. This article is no the next century ton industry ter of speculation much can yet way of new improved manufacturers discovering the cost of production, and the great South is



The Amoskeag Mills, Manchester, New Hampshire.

merely by selfishness, morality is promoted so far and no further than interest; but the promotion of morals becomes their



William C. Davol.

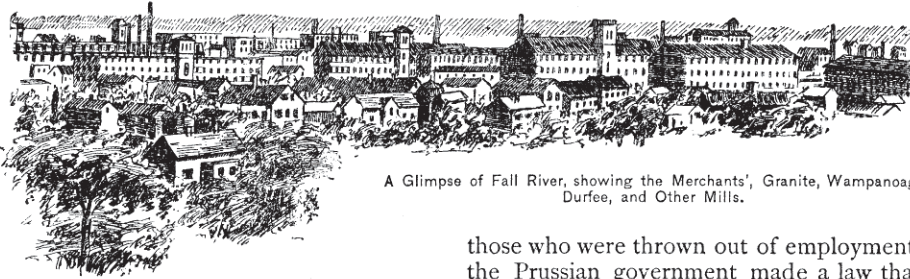
interest. And if religion appears sometimes in name or in sectarianism more than in reality, still its promotion is for the interest of the whole community. It is said, on the presumption that the capitalists are aiming solely at personal wealth, the facility for acquiring a fair compensation becomes less and less at every pressure. A rise of wages is then adapted to convenience or pleasure. But it must be remembered that the pressure bears as heavy on the employer as the employed, and renders him liable to lose all the earnings of many years of labor, and the savings of much self-denial, and render him poor and dependent. There are two sides to this question, and the operatives in good times ought to lay up for time of need. Then they would not be obliged to bring their labor into market the best way they can, to obtain their daily bread. To take advantage of such a position is one of the greatest immoralities. The liability of its consequences are as bad in creating discord and producing civil commotions. But the owners of factories are not known to stop their mills till obliged

by dire necessity: they generally run them till they become bankrupt. The real power belongs to the laboring class; no one ought to expect to employ this without paying for it, and no one does expect it. It is power when rightly used, and most often ceases to be so when abused. Those who are so thoughtless, negligent, or squandering, as to trust wholly to the present occasion for a bare subsistence, can hardly be thought powerful compared with what they would be did not necessity compel them to take what they can get for the present occasion. It is a mistaken notion to suppose the manufacturing interest promoted by creating poverty, or, in the end, by heavy reduction of wages. The articles manufactured very soon sink in like proportion, and the profits are swallowed up in the payment of the operative. Besides these consequences, the ability to purchase does not exist, a consideration which more or less affects the value of every article brought into market. Our day has witnessed the surprising effects of the ingenuity of man, in calling into existence and putting in operation labor-saving machinery. If it would be, in reality, promoting human existence and human happiness, in our



Stephen Davol.

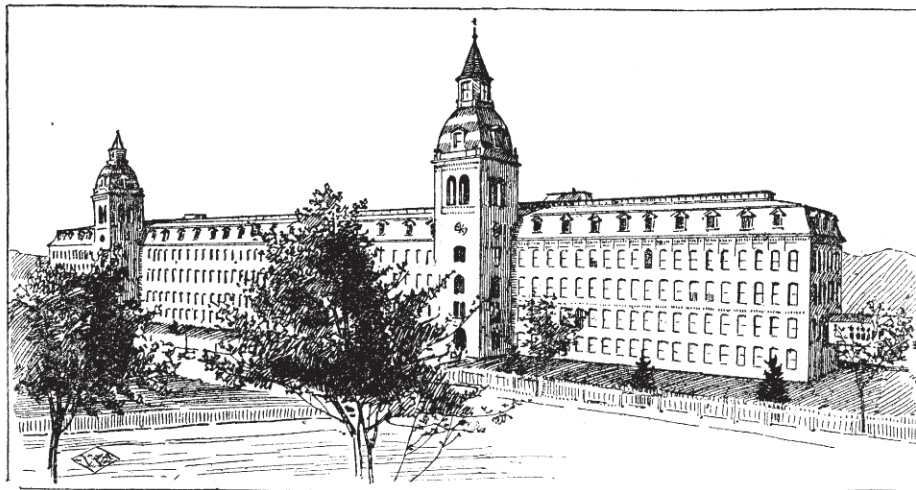
present character and condition, that our food should come to us ready made, our



A Glimpse of Fall River, showing the Merchants', Granite, Wampanoag, Durfee, and Other Mills.

habitations ready built, our conveyances already in motion, and our understandings already improved — the nearer we approach such a state of things the better. But if not — if the desire and pursuit of objects be no less blessings than their possession — if human nature be bettered, and the grand object of existence benefited by employment — there must be a point beyond which to obtain food and clothing and other things, without application, would be objectionable. To be moral and desirable, labor-saving machinery must bring along with it some particular benefit to the community, as well as to individuals. This may be such as more than compensates for the many losses which are sustained in some countries, in consequence of the improvement. When it was proposed to introduce printing into the Prussian dominions, the king objected by saying, it would throw forty thousand amanuenses out of employment. After printing went into operation, to ameliorate the condition of

those who were thrown out of employment, the Prussian government made a law that the initial letters should be omitted by the printers in order that they might be executed by the amanuenses at a high compensation. That they performed these letters with great ingenuity, and in a manner difficult to be imitated, may be seen from a copy of a Bible now in possession of the antiquarian society at Worcester, Mass. It must have been a calamity for so many to be thrown from their pursuits, and be deprived of the means of getting a livelihood. The benefit resulting from the introduction compensated for this loss, more than ten-fold. This is one among many instances of human invention, which wonderfully adds to the dignity and happiness of mankind. The first introduction of Hargreaves' and of Arkwright's machinery into England was not only met with objections, but with popular vengeance. It threatened a speedy destruction to every jenny and water-frame in England, and so in appearance carried in its motions frightful evils. The anticipated evils actually happened : hand spin-



The Ponemah Mills, near Norwich, Connecticut.

ning met with a speedy overthrow, and those who had earned a few pence per day in following it, were compelled to resort to other employments, and perhaps to be em-

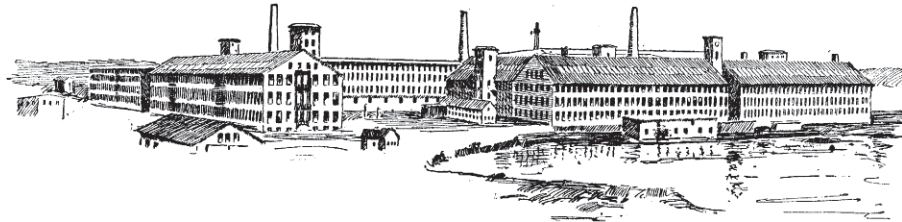
and abuses. It is evidently an abuse to collect a mass of vicious population, and keep them in a state of ignorance and irreligion. When this is done, the whole



The Border City Mills, Fall River.

ployed in manufacturing on the new plan which they had labored to oppose. Similar feelings and similar consequences have happened and are still happening in America. Manufacturing, instead of going on quietly and single-handed in private families, with immense labor, grows into large establishments, which employ and bring into association masses of population. This position is moral or immoral according as it furnishes proper stimulants for industry and for exertion, and for improving and directing the mental powers and principles. With little or no inducements or expectation of emerging from a state of ignorance, with no schools, no moral or religious instruction, the liability is great for an introduction of all the evils which the opposers of manufacturing establishments have often predicted. It is well known that vice grows worse by contact with its kind. If it can be proved that manufacturing establishments tend to accumulate, consolidate, and perpetuate vicious propensities, and their consequences, on the community, this will serve as no inconsiderable drawback upon the appar-

community have a right to complain. If it can be shown that such things are frequently done, it is contended that they are not necessary consequences of manufacturing establishments. The owners of such establishments have it in their power to change the current of vice from its filthy and offensive channel, and make peace, order, and comfort among those they employ. The dependence between the employed and employers should be mutual. But by employing vicious, improvident, and indigent characters, the dependence falls mostly on one side; yet it is a benefit to the community that such a class should find employment and support. Though in some countries oppression ensues, poverty and vice show their dismal and disorderly features, and then the honest, upright, and intelligent are driven from the establishment, and perhaps from the employment, better things can be spoken of this country, where the



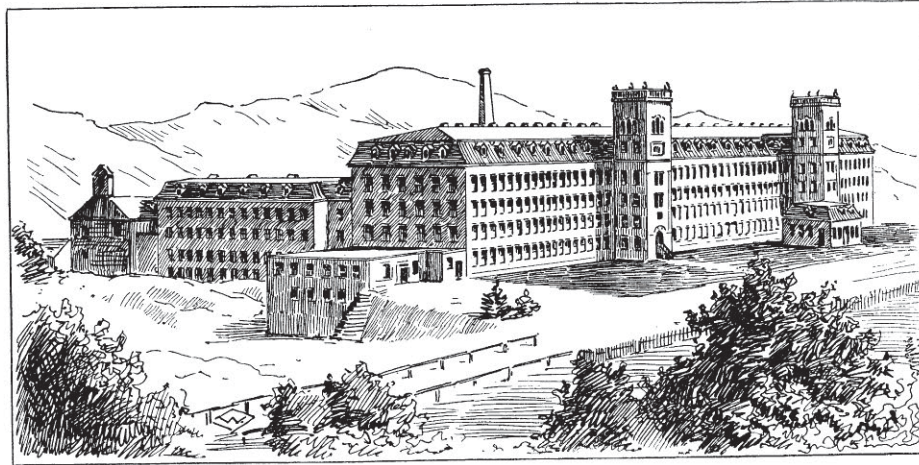
The Wamsutta Mills, New Bedford.

ent prosperity which is indicated in their immediate vicinity. If found so, the condition must be charged directly to the establishments or to their consequences

honest, upright, and intelligent have always a preference. Such are leaving the Old World; they are disappearing, and many of them are in the West, engaged in

other employments. Pursuing such a policy, by and by only the dregs are left, and then, without looking for the causes, it appears that factories have been the immediate cause of all the mischief. On a candid inquiry, it is seen to be the abuse,

by Arkwright & Strutt in England, taking the oversight of the instruction and morals of those he employed, and instituting and keeping up Sabbath-schools, he successfully combated the natural tendency of accumulating vice, ignorance, and poverty. Such



The Androskoggin Mills, Lewiston, Maine.

and therefore not chargeable to a proper use. Slater, the founder of the cotton manufacture in America, abundantly demonstrated that under right management they had no immoral tendency. On the contrary, he made it appear that they might be serviceable to the most moral purposes. Following the plan instituted

remedies not only prevented their occurrence, but had a tendency to remove them, when they actually existed. Industry, directed by honest and intelligent views, and honorably rewarded, holds a high rank among moral causes. To maintain good order and sound government, it is more efficient than the sword or bayonet."

