

## CHAPTER XIX.

Revolution in the peaceful Arts.—Great captains of Industry raised up in Britain.—The duke of Bridgewater and Brindley.—Canals first constructed in England.—The Cotton manufacture.—The fly-shuttle of Kay.—Cotton-spinning machines.—The spinning-jenny of Hargreaves.—Cotton spinning ceasing to be a domestic employment.—Richard Arkwright.—His water-frame spinning machine.—The first water spinning mill.—Samuel Crompton.—His Hall-in-the-Wood wheel, known as the mule.—General rush to engage in spinning cotton.—Rapid increase of Lancashire towns.—Dr. Cartwright.—His power-loom.—Dr. Roebuck.—First furnace at Carron, for smelting iron by pit-coal.—Wedgwood.—Potteries of Staffordshire.—Commercial treaty with France.—Watt.—Progress of his improved steam-engine.—Its final success.

IN the last year of the reign of George the Second, and in a few years after the accession of George the Third, there was begun in this country an enormous revolution in the Arts, for accomplishing which Providence raised up very special instruments. The great designs of Superior Beneficence may be as readily traced in the formation of minds which are destined to effect mighty changes in social organization by what may seem humble labours, as in the permission given to lawgivers and warriors to operate upon the destinies of nations by more direct exercises of power. The revolution in the peaceful Arts in the middle of the eighteenth century in Britain, which was commenced and carried forward in various directions by a knot of men not greater in number than the mythical Seven Champions of Christendom, exhibited an unequalled series of bloodless triumphs over physical and moral obstacles, and produced immediate and still developing results, which have raised this little band to the unquestioned honour of being the great Captains and Champions of Modern Industry. During less than half a century, the labours of these men had increased the resources of their country to an extent which chiefly enabled it to sustain the pressure of the most tremendous war in which it ever was engaged; had bestowed upon a population increasing beyond all previous example abundant opportunities of profitable labour; and had opened new and unlimited fields of production, for the multiplication and diffusion of the necessaries of life and of the comforts and refinements of civilization. Whilst tracing the individual course of these remarkable contemporaries, we cannot fail to perceive what an intimate con-

nection of apparently diverging purposes existed between each and all,—how, whilst Brindley, Arkwright, Crompton, Cartwright, Roebuck, Wedgwood, and, greatest of all, Watt, each pursued his one absorbing object, there was a natural harmony in their labours,—how no one attempt could have been carried to perfection without the aid of another effort, differing in degree but the same in kind.

In the old timbered manor-house of Worsley, about six or seven miles from Manchester, there were three men, in 1758, daily occupied in discussing one of the boldest schemes of public improvement that had ever been devised by associated or private enterprise. One of these men was Francis Egerton, third duke of Bridgewater. He was in his twenty-second year. Of weak health as a boy, his education had been neglected; but he had travelled, and had seen much of the unsatisfactory pleasures of the life of London, at a period somewhat notorious for the dissolute manners of the great. He had endured a matrimonial disappointment, and had retired to this one of his family estates, to pursue a course of the strictest economy, and to devise plans for the improvement of his fortune, by making his encumbered property more productive. The estate of Worsley contained a rich bed of coal, but it was comparatively valueless. Within an easy distance was the great town of Manchester, and its suburbs, with a population of about 40,000, ready to welcome an additional supply of fuel for domestic and manufacturing uses. But Worsley and its neighbourhood could not supply coal so cheaply by land carriage as the pits on the other side of the town. Liverpool, also, offered a vast market, if coal could be cheaply conveyed thither from Manchester; but the water carriage was twelve shillings per ton, and the land carriage was two pounds per ton. Could these difficulties be surmounted? Could a canal be constructed from Worsley to Manchester? Might the line not be extended to the Mersey? Such were the ideas that pressed upon the inquiring mind of the young nobleman in his self-enforced solitude. There was a neighbouring canal in course of construction, which arose out of an Act passed in 1755 for making the Sankey-Brook navigable, and finally a canal was opened in 1760, following the course of the stream. It was a work in which the country through which it passed presented few difficulties. But the duke of Bridgewater had grander views. He would adopt a line which should render locks unnecessary,—which should cross rivers and cut through hills, like the railway-works of our own time. The duke had made two energetic men the confidential participators in his schemes. One was John



Gilbert, a land agent, who had been engaged in mining speculations; and who was especially useful in raising money to carry on the projected operations. The other was James Brindley, a millwright,—almost without the rudiments of education, and totally deficient in scientific training. This extraordinary man, the greatest civil engineer that had appeared in England before the present century—one whose constructive genius enabled him to overcome difficulties which appeared insuperable to other engineers of more technical pretensions—was twenty years older than his adventurous employer. He had effected some improvements in machinery, and had obtained a small provincial reputation. But when the professional men and the general public looked upon stupendous mounds of earth raised in deep valleys, and heard of an aqueduct to be carried over the Irwell, high enough for masted vessels to sail under it—when they inquired whence the supply of water was to be drawn to fill a canal of nine miles in length—they came to the conclusion that the duke and his engineer were equally mad, and that the project would end in total ruin. We have now become familiar with engineering difficulties far more vast; and can therefore scarcely forbear to smile at such forebodings. The aqueduct at Barton was opened in 1761. It has been said that when the moment arrived for admitting the water into this aqueduct, “Brindley’s nerve was unequal to the interest of the crisis, that he ran away and hid himself, while Gilbert remained cool and collected to superintend the operation which was to confirm or confute the clamour with which the project had been assailed.”\*

The subterranean canals in the coal-works at Worsley were as remarkable as the canal itself and its branches. The open works, all of one level, extended thirty-eight miles; the tunnels were originally about a mile and a half in length, although they now extend forty-two miles, of which two-thirds have gone out of use. When the works, above ground and under ground, were finished in 1762, they were described as “the greatest artificial curiosity in the world.”† The immediate effect of the duke of Bridgewater’s first great undertaking was sufficiently demonstrative of the public value of canals. The price of coals in Manchester was reduced one half after its completion. The duke and his brother-in-law, the first marquis of Stafford, were the chief promoters of the Grand Trunk Navigation, generally known as the Staffordshire Canal; and Brindley was the engineer. This work brought the iron and

\* “Quarterly Review,” vol. lxxiii, p. 311—a delightful paper by the late earl of Ellesmere.

† Kippis; “Biographia Britannica,” art. Brindley.

pottery districts into easy communication with the Mersey and the Trent. A letter dated from Burslem, in 1767, contains an interesting notice of the engineer: “Gentlemen come to view our eighth wonder of the world, the subterraneous navigation, which is cutting by the great Mr. Brindley, who handles rocks as easily as you would plum-pies, and makes the four elements subservient to his will. He is as plain a looking man as one of the boors of the Peak, or one of his own carters; but when he speaks, all ears listen, and every mind is filled with wonder at the things he pronounces to be practicable.”\* Brindley did not live to complete the Grand Trunk. But this, and concurrent undertakings which he designed or superintended, connected the Thames, the Humber, the Severn, and the Mersey, and united London, Liverpool, Bristol, and Hull, by water communication, passing through a district unsurpassed in natural resources and productive industry.

Fourteen years after the duke of Bridgewater had established his claim to be called “the father of British inland navigation,” the eventual success of these undertakings was regarded somewhat doubtfully: “Canals for carrying on inland navigation are new, and lately introduced, so as not to warrant great commendations; but the prospect is fair.” Again: “What the actual advantages that will be derived from these canals, when finished, may be, time and experience only can determine.”† In 1794, the extent of canal speculation produced the inevitable protest against “bold and precarious adventure.” There were the same rivalries of competing lines as we have seen in railways, and the same losses and disappointments. Yet the grandeur of these works excited the admiration even of those who doubted their eventual profit. “At the beginning of this century, it was thought a most arduous task to make a high road for carriages over the hills and moors which separate Yorkshire from Lancashire, and now they are pierced through by three navigable canals.”‡

The local historian of Manchester, who thus looks with a mixture of apprehension and of wonder at canal enterprise, says, “Nothing but highly flourishing manufactures can repay the vast expense of these designs.” He adds, as if to enforce his doubt, that when the plans under execution are finished, Manchester “will probably enjoy more various water communications than the most commercial town of the Low Countries has ever done.”§ The principal cause of this sudden increase to the power of cheap car-

\* Kippis; “Biographia Britannica,” art. Brindley, p. 601.

† Campbell’s “Political Survey,” vol. ii. p. 261 & p. 265.

‡ Aikin’s “Manchester,” 1795, p. 137.

§ *Ibid.*, p. 137.



riage possessed by Manchester,—a power greater than that which made the prosperity of Ghent and Bruges,—was, that within a quarter of a century it had become the Metropolis of Cotton,—the centre of that manufacture which, from very small beginnings, had grown into proportions then deemed gigantic, however dwarf-like they may appear in comparison with its present development. The population, busy in the middle of the eighteenth century with “small things called Manchester ware,” had passed away.\* Waggon had driven out pack-horses for the conveyance of goods. Canals had come, in great part, to supersede waggons. But the Manchester merchant still sent out his “riders” with patterns in their saddle-bags; and the manufacturer did not disdain to mix with the humbler tradesman in a common public-house, to take his glass of punch, and hear the news of the town. There was such a house of great resort in the market-place, which had been kept by the same landlord for half a century: “It is not unworthy of remark, and to a stranger is very extraordinary, that merchants of the first fortunes quit the elegant drawing-room, to sit in a small dark dungeon, for this house cannot with propriety be called by a better name; but such is the force of long-established custom.”†

It is asserted in a pamphlet published in 1788, that “not above twenty years before that time, the whole cotton trade of Great Britain did not return £200,000 to the country for the raw materials, combined with the labour of the people.”‡ This calculation takes us back to the period at which was invented the hand-machine for spinning cotton, termed “a jenny.” A previous invention in the process of weaving stimulated the mechanical attempts for increasing the quantity of yarn to be woven. About 1760, the cotton weavers began to use a simple but efficacious plan of throwing the shuttle, introduced by John Kay, of Bury, “which enabled the weaver to make twice as much cloth as he made before.” This was called “the fly-shuttle.” The greater speed attained in the weaving process, “destroyed the arrangement which up to that time existed between the quantity of yarn spun and the weavers’ demand for it.”§ John Kay was subsequently “mobbed out of the country, and died in obscurity in a foreign land.” This was probably in consequence of some further invention to supply the place of hand-labour in spinning wool, to which the fly-shuttle was originally applied. Dyer, in his poem of “The Fleece,” published in 1757, having noticed the spinning-wheel, the distaff, and wheels, “double spoled, which yield to either hand a several line,” says that “patient art,

\* *Ante*, vol. iv. p. 410.

† Aikin, p. 189.

‡ *Ibid.*, p. 178.

§ “*Life of Samuel Crompton*,” 2d edition, 1860, p. 20.

“Sagacious, has a spiral engine formed,  
Which, on an hundred spoles, an hundred threads,  
With one huge wheel, by lapse of water, twines.”\*

The writer of a very able article on “Cotton-spinning machines” implies that this was supposed to be a spinning machine, introduced into Yorkshire by John Kay.† Robert Anderson, the editor of the valuable edition of “British Poets” published in 1795, appends this note to the passage in “The Fleece:”—“Paul’s engine for cotton and fine wool.” Lewis Paul, in 1738, took out a patent for a machine “for the spinning of wool and cotton in a manner entirely new.” Several attempts were made to work this machine, persons of some note being concerned in the speculation, amongst others, Edward Cave, the proprietor of “The Gentleman’s Magazine.” But Paul’s machine, however ingenious, brought losses upon all concerned in it, and was finally abandoned. The demand for fine yarn still went on unsupplied; and it was increased by a growing market for fabrics in which it was endeavoured to compete with Indian muslins. An extensive manufacture of fabrics composed wholly of cotton does not appear to have been contemplated a few years before this period. “Bombaya’s wharfs,” writes Dyer, “pile up

“Wool-resembling cotton, shorn from trees,  
Not to the fleece unfriendly; whether mixed  
In warp or woof, or with the line of flax,  
Or softer silk’s material.”‡

The demand increased more and more, and it pressed on invention to find modes of supply. In 1764 the Society of Arts voted fifty pounds to Mr. Harrison “for a masterly improvement in the spinning-wheel, by which a child may do double the business that even a grown person can with the common wheel.”§ At length a great practical change was achieved.

In 1767, James Hargreaves completed his “Spinning-jenny.” He was a weaver near Blackburn, and his wife and children were employed in spinning weft for him to work upon at his loom, the warp being supplied by the wholesale manufacturers who gave him employment. The spinster’s machine in Hargreaves’ cottage being accidentally overturned, it was observed that the wheel and the spindle continued to revolve. In the position of the wheel on its side, the spindle became perpendicular. The ingenious man caught the idea, and forthwith constructed a multiplying wheel, with eight rovings and eight upright spindles. He knew what would be the fate of a labour-

\* Book iii.

† Book iv.

‡ “*Quarterly Review*,” vol. cvii. p. 53.

§ “*Annual Register*,” vol. vii. p. 66.



saving inventor if he made his discovery public. He long worked in secret at his "jenny;" but such mysteries cannot be preserved. His jealous neighbours broke into his house, destroyed his invention, and compelled him to fly for his life to Nottingham. He there received assistance to enable him to take out a patent; but he had sold several of his machines before the date of his patent; the invention became common property; and the instrument, surreptitiously imitated, was soon found in every weaver's cottage in Lancashire. Thomas Highs, about the same period, invented a somewhat similar hand-machine. Samuel Crompton, the inventor of the "mule," which changed the whole course of cotton spinning, when sixteen years of age, in 1769, was spinning upon one of Hargreaves' machines of eight spindles.\*

The time was fast approaching when the spinning of cotton would cease to be a domestic manufacture. The weaving would long continue under humble roofs; but machines, driven at first by water-power, would gradually banish the wheel and the jenny. The double occupation of weaver and small farmer was very common in Lancashire. This united business was conducted with small profit to the yeoman, who occupied a few acres, and worked at intervals at one loom. It was far from advantageous to the general interests of the country. Arthur Young described the North of Ireland as "a whole province peopled by weavers: it is they who cultivate, or rather beggar, the soil, as well as work the looms; agriculture is there in ruins. . . . The lands are infinitely subdivided; no weaver thinks of supporting himself by his loom; he has always a piece of potatoes, a piece of oats, a patch of flax, and grass or weeds for a cow." Young held the two occupations to be incompatible. "A weaver who works at a fine cloth can never take the plough or the spade in hand without injury to the web."† The Lancashire weavers had not driven out the farmers proper, as in the North of Ireland, but the same system was in partial operation in the whole cotton-working district. The father of Samuel Crompton was the occupier of a farm near Bolton; he and his family, "as was the custom at that time, employing their leisure hours in carding, spinning, and weaving." In 1758 he became the tenant of a portion of an old mansion, also near Bolton, called Hall-in-the-Wood. The father died soon after this removal. The widow continued the labours of the little farm, and devoted all her leisure, as before, to the spindle and the loom.‡

\* Ure's "Cotton Manufacture," vol. i. book iii. chap. i.

† "Tour in Ireland," vol. ii. p. 305.

‡ French; "Life of Crompton," chap. ii.

Bolton was then a place of very inconsiderable population. Their wants were so small that not more than one cow used to be killed in the town for a week's supply. To the weekly market London and Manchester traders resorted, to purchase the heavy fabrics for which Bolton was the chief mart. "The fustians, herring-bones, cross-overs, quiltings, dimities, and other goods, were carried to market by the small manufacturers (who were for the most part equally small farmers) in wallets balanced over one shoulder, while on the other arm there was often hung a basket of fresh butter.\* There was one bustling man in Bolton who must have been among the most active on the market-day—Richard Arkwright, the barber, who had come from Preston, his native place, and hung out his attractive invitation to the townsman and the visitor, of "a clean shave for a penny." But he had higher aspirations. He was a peruke maker, and travelled about the country as a merchant in a peculiar line. An adroit man he must have been, and a pleasant; for at the statute fair he marked down the lass with the most attractive locks; and although he might not have played "with the tangles of Neæra's hair," he contrived to possess himself of the treasure for a pecuniary consideration, and bear it off to his wig-making shop in whatever new locality he chose to plant himself for a year or two. He saw many men, and acquired many valuable notions. He had a mechanical genius, and thoughts of "perpetual motion" sometimes engrossed his mind. At Warrington he became acquainted with John Kay, a clock-maker, the son of the fly-shuttle inventor; and the two set their ingenuity to work upon something likely to be more practicable and more profitable than "perpetual motion." Kay had been thinking of schemes for superseding the spinning-wheel, incited probably by having been employed by Thomas Highs in making the wheels and springs of his "jenny." Out of this communication of the ideas of Highs, who is alleged to have conceived the notion of spinning by rollers, was matured, by the ingenuity and perseverance of Arkwright, the invention which was very speedily to convert the region which Gray called "the deserts of Lancashire" into the busiest district of the world. Arkwright went to Preston, and having expended his last shilling in completing, however imperfectly, a machine of a new construction, it was exhibited, in 1768, in that town. In a lucky hour for Arkwright, murmurs and threats reached his ear. He hastily packed up his apparatus in the dread of mob-law; went to Nottingham; obtained two moneyed partners, of whom Jedediah Strutt was one; and took out his first patent in 1769.

\* Life of Crompton, chap. ii.



Those who look upon the operations of a cotton-factory of the present day may feel surprise that such complete machinery as now exists, with its wonderful results, should have grown out of so apparently simple and rude a machine as that claimed by Arkwright as his design. But the principle existed in that machine, out of which all the more elaborate contrivances of ninety years have proceeded. "The principle remains the same, namely, to enable rollers to do the work of human fingers, with much greater precision, and incomparably cheaper."\* The machines of the small factory at Nottingham, which Arkwright was enabled to establish with his partners, were worked by horse-power. In 1771 a site was selected by them where water-power might be applied. In the beautiful valley of the Derwent, at Cromford, was erected the first water-spinning mill. Henceforward the machine was called the water-frame, and the yarn which it produced was called water-twist. But the great merit of Arkwright, however disputable his claim as an inventor, was as an organizer of the labour required in a cotton-factory. The mechanics who made his machines had to be formed; the workmen had to be trained to accommodate their irregular habits to automatic precision. All the difficulties that interpose between the completion of an invention and its commercial value had to be overcome; and but for the wondrous energy of Arkwright, his career might have been as unsuccessful as that of Lewis Paul. "We find that so late as the year 1779, ten years after the date of his first patent, his enterprise was regarded by many as a doubtful novelty."† It was five years before any profit was realised at Cromford. But in the meantime Arkwright had, in 1775, taken out a second patent. His right to the inventions therein claimed was contested. His monopoly was invaded on every side. Actions at law were decided at one time in his favour; at another time the decisions of the courts were adverse. In October, 1779, a mill which he had erected in the neighbourhood of Chorley was burned by a mob; who in a similar manner destroyed the cotton-spinning machines at Manchester, Wigan, Blackburn, Bolton, and Preston. The Lancashire weavers had been reasoned out of their opposition to the jenny, and it was generally adopted. They abstained from destroying the water-frame only through the terror of the sword and the halter. The combinations of rivals and the violence of mobs had no power to turn the courageous Arkwright from pursuing the career which had opened to his sanguine view. To the fullest measure of success

\* "Knowledge is Power," by Charles Knight, p. 219.

Ure, vol. i. p. 237.

which could be reached by indomitable industry and perseverance, he devoted himself without relaxation, even when enormous wealth was accumulating around him. As he rose into rank and importance, he felt the necessity of correcting the defects of his early education; and after his fiftieth year, he applied two hours of each day, snatched from sleep, to improve himself in grammar, orthography and writing.

The career of Samuel Crompton presents as striking a contrast to that of Richard Arkwright, as the difference in the characters of the two men. The orphan boy of Hall-in-the-Wood was shy, sensitive, studious, a mathematician, a musician, an inventive artisan. Arkwright was pushing, callous, ignorant, unrefined, without originality in his ideas, but a most skilful appropriator. The bold man died worth half a million sterling, for he had self-confidence, tact, and knowledge of human character. The timid man was easily disheartened, shrinking from speculation, and easily deceived. He would have lived a poor weaver to the end of his days, unable, as he said of himself, "to contend with the men of the world," had not Parliament, in 1812, granted him a paltry compensation of 5000*l.* for the great invention which he "gave up to the country," as he said, but which he was really cheated into giving up by a host of selfish manufacturers, who made fortunes out of his simple trust. Crompton was spinning with Hargreaves' jenny four or five years after Arkwright had produced harder and finer yarn by his water-frame than the jenny could produce, whatever amount it had added to the quantity spun. Crompton saw what was wanting. With a few common tools, and a claspknife, he worked for five years before he perfected what was originally called the Hall-in-the-Wood wheel. "The great and important invention of Crompton was his spindle-carriage, and the principle of the thread having no strain upon it until it was completed. The carriage with the spindles could, by the 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 stress of winding on the spindle."\* This was "the cornerstone of the merits of his invention," which Crompton connected with the system of rollers, and thus added the second great and permanent principle of the machinery for cotton-spinning.

In 1779, when this machine was completed by the young weaver, the riots broke out by which Arkwright's mill at Chorley was destroyed. From the solitary room where Crompton had been so long working in secret, he heard the shouts of a mob who were breaking

\* "Memoir of Crompton," by John Kennedy; quoted in Mr. French's "Life."



to pieces a carding-engine in the adjoining hamlet of Folds. He was prepared for such an emergency. He had cut an opening in the ceiling of his room to the loft above, which aperture he had fitted with a trap-door. He hastily took his machine to pieces, and hoisted the parts into the dark hole where they were concealed for many week. The riots were put down, and tranquillity was restored; but not till after the jennies had been destroyed for miles round Bolton. Whilst working upon his invention Crompton had married. He took to wife a young woman of good family and education, but who, being left an orphan in reduced circumstances, maintained herself by spinning. The home of the young people was in a cottage attached to the Hall-in-the-Wood; and in a room of the old mansion they secretly worked on the now-perfected mule. No yarn comparable for fineness and firmness had ever been produced as that which Crompton carried to the Bolton market, obtaining a proportional price. People began to think that there was some mystery. Fingers could not produce such yarn; nor could the jenny. Manufacturers gathered round, some to buy, others to endeavour to penetrate the secret. They in vain tried to obtain admission to the old house. They climbed up to the windows to look in. The bewildered man soon saw that it would be impossible to keep his secret. In a manuscript which he left behind him, he says, of this anxious period, "during this time I married, and commenced spinner altogether. But a few months reduced me to the cruel necessity either of destroying my machine altogether, or giving it up to the public. To destroy it I could not think of; to give up that for which I had laboured so long was cruel. I had no patent, nor the means of purchasing one. In preference to destroying it, I gave it to the public." Manufacturers had come about him with tempting promises, and had persuaded him to give up his secret, upon the condition, recited in a formal document, of subscribing sums to be affixed to the name of each "as a reward for his improvement in spinning." The whole sum they subscribed was 67*l.* 6*s.* 6*d.* The subscription paper is in existence. "The list is curiously interesting as containing among the half-guinea subscribers the names of many Bolton firms now of great wealth and eminence as mule spinners, whose colossal fortunes may be said to have been based upon this singularly small investment."\* In five years Crompton's "mule" was the machine chiefly employed for fine spinning, not only round Bolton, but in the manufacturing districts of England, Scotland, and Ireland.

\* French. "Life of Samuel Crompton," p. 72, from which interesting volume we derive the facts thus briefly related by us.

The common piracies of Arkwright's water-frame, its more extensive use when the patent expired in 1784, and the general appropriation of Crompton's mule, very soon changed the neighbourhood of which Manchester was the centre, from a country of small farmers into a country of small manufacturers. Houses on the banks of streams whose currents would drive a wheel and shaft were greedily seized upon. Sheds were run up in similar situations. The clank of wheels and the buzz of spindles were heard in once solitary places upon the branches of the Irwell. The smaller streams that flowed from the barren hills into secluded valleys, might be apostrophized in the lines of Ebenezer Elliott:

"Beautiful rivers of the desert! ye  
Bring food for labour from the foodless waste."

Crompton's mules, worked by hand, "were erected in garrets or lofts; and many a dilapidated barn or cow-house was patched up in the walls, repaired in the roof, and provided with windows, to serve as lodging room for the new muslin wheels."\* Amidst this hurried system of expedients to obtain the gains of cotton-spinning, these small factories were supplied with the labour of children by a mode which excited the indignation of all right-thinking persons. Children of very tender age, collected from the London workhouses, and other abodes of the friendless, were transported to Manchester and the neighbourhood as apprentices. These were often worked through the whole night; had no regard paid to their cleanliness; and received no instruction. Aikin, who records these grievances, adds that in many factories, remedies had been adopted. It was forty years before the Legislature effectually interfered to protect factory children.

A greater change than that produced by the water-frame and the mule was impending. The period was quickly approaching when the tall stalk would start up in the bye-streets of quiet towns, and gather around its clouds of smoke a new population. Of Bolton, whose inhabitants had more than doubled from 1783 to 1789, it is recorded that "the want of water in this district is made up by the ingenious invention of the machines called mules."† The want of water would in a few years be made up by a far more manageable power. Bury had its "cotton manufacture, originally brought from Bolton," with "factories erected upon the rivers and many brooks within the parish."‡ Its population had increased in a larger proportion than that of Bolton; but the increase would be far more rapid when the rivers and brooks were no longer es-

\* French, p. 76.

† Aikin, p. 262.

‡ *Ibid.*, p. 267.



essential for the movement of rollers and spindles. In 1794 some small steam-engines, made by Mr. Sherrard, a very ingenious and able engineer, had begun in Manchester to be "used in cotton-mills, and for every purpose of the water-wheel, where a stream is not to be got." This local manufacture of steam-engines was beginning to encounter a formidable rivalry: "Some few were also erected in this neighborhood by Messrs. Bolton and Watts, of Birmingham, who have far excelled all others in their improvement of the steam-engine."\* In this stage of his career, the name of the Glasgow mechanic whose statue is in Westminster Abbey, appears not to have been sufficiently known to be spelt correctly by a writer of note. Dr. Aikin probably knew little of the achievements of the man who, "directing the force of an original genius, early exercised in philosophic research, to the improvement of the steam-engine, enlarged the resources of his country, increased the power of man, and rose to an eminent place amongst the illustrious followers of science and the real benefactors of the world."† The rotatory steam-engine of Watt was first applied to the textile manufactures of Lancashire in 1787, when one was erected at Warrington. It had been applied in Nottinghamshire in 1785.

In 1856, according to the Report of the Factory Commissioners, the steam-engines employed in 5000 factories represented 161,000 horse-power, giving motion to the astounding number of 33,000,000 spindles. It is calculated in the Statistical Account of the Population of 1851, that in Great Britain "more than a million young women are *spinsters*"—the still recognized name for unmarried women. To produce the same amount of yarn spun in the old domestic way, would probably require not only all the spinsters of our own country, and all the spinsters of our great Indian empire, where the Hindoo girl still produces the finest yarn from her primitive wheel, but all the spinsters of the habitable globe. The rate at which the spindles of a cotton-mill move so far exceeds the rate of the spinning-wheel, that no smaller number, we may presume, could convert a thousand million pounds of raw cotton into yarn in one year, as is now done in Great Britain. But if the rate of speed were equal, and the object could be effected by the daily movement for ten hours of thirty-three millions of spindles, it would be necessary that every British spinster should have the power of giving activity to thirty-three wheels with one spindle each; or that, having the advantage of the spinning-jenny with eight spindles, she should have the power of working four jennies at one and the same time. The contrast between the old spinning-

\* Aikin, p. 177.

† Lord Brougham's Epitaph on Watt.

wheel and the spinning-mill cannot be put in a stronger point of view.

Inventions connected with the more rapid processes of spinning were not long behind the jenny and the water-frame. Such was the cylindrical carding-engine. The natural progression of machinery in spinning, from the simplest domestic wheel to the complex mule, would, we may presume, have suggested that the same advance would be applicable to weaving; that as the flyshuttle had doubled the rate at which a hand-weaver could work, so some invention might double, or even supersede, the still tardy process of the hand-weaver. Such an invention did come, though in a very rude and imperfect state. Edmund Cartwright, a clergyman, bred at University College, Oxford—a poet and critic—was at Matlock in 1784, when, in a mixed company in which were some persons from Manchester, the talk was about cotton—how the want of hands to weave would operate against the spinning-mills. Cartwright knew nothing of machines or manufactures; he had never even seen a weaver at work; but he said that if it came to a want of hands, Arkwright must invent a weaving-mill. The Manchester men maintained that such a notion was impracticable. Cartwright went home, and, turning his thoughts from weaving articles for the "Monthly Review," laboured assiduously to produce a loom that would weave cloth without hands to throw the shuttle. His children remember him as walking about as if in deep meditation, occasionally throwing his arms from side to side and they were told that their father was thinking of the action of the shuttle.\* He completed his machine, which, he says, required the strength of two powerful men to work at a slow rate, and whose springs were strong enough to have thrown a Congreve rocket. He took out a patent. Cartwright's power-loom, improved by the inventor by incessant exercises of ingenuity, came very slowly into use. A mill, the first erected for their employment on a large scale, was wilfully set on fire, and five hundred of the power-looms were destroyed. The patent expired, having been to the inventor a constant source of loss and anxiety. The invention, great as its results have been, was scarcely recognized in the last century. The power-loom was first brought into profitable use at Glasgow, in 1801. But the ultimate advantage of the principle of automatic weaving was fully acknowledged; and in 1807, upon a memorial of the principal cotton-spinners, Parliament granted Dr. Cartwright 10,000*l.*, for "the good service he had rendered the

\* The late Mrs. Penrose, whose "History" is known as that of "Mrs. Markham," was a daughter of Dr. Cartwright.