

## Edward Baines on the Mechanization of Spinning, 1835

(Edward Baines, a sympathetic nineteenth century historian of the rise of modern industry, tells the story of the mechanization of the spinning industry by such entrepreneurs and inventors as John Kay, James Hargreaves, and Richard Arkwright. Edward Baines. *History of the Cotton Manufacture in Great Britain*, 1835, 115-19, 121, 147-52, 153-6, 159-60, 163-4, 184, 197-9; in J. T. Ward, ed., *The Factory System, Vol. I, Birth and Growth* (New York: Barnes & Noble, 1970), pp. 84-96.)

Up to the year 1760, the machines used in the, cotton manufacture in England were nearly as simple as those of India; though the loom was more strongly and perfectly constructed, and cards for combing the cotton had been adopted from the woollen manufacture.

The cotton manufacture, though rapidly increasing, could never have received such an extension as to become of great national importance, without the discovery of some method for producing a greater quantity and better quality of yarn with the same labour. None but the strong cottons, such as fustians and dimities, were as yet made in England, and for these the demand must always have been limited. Yet at present the demand exceeded the supply, and the modes of manufacture were such as greatly to impede the increase of production. The weaver was continually pressing upon the spinner. The processes of spinning and weaving were generally performed in the same cottage, but the weaver's own family could not supply him with a sufficient quantity of weft, and he had with much pains to collect it from neighbouring spinsters. Thus his time was wasted, and he was often subjected to high demands for an article, on which, as the demand exceeded the supply, the seller could put her own price. (1) A high and sustained price of yarn would indeed have attracted new hands to the employment, but such high price would itself have tended to keep down the rising manufacture, by making the goods too costly in comparison with other manufactures.

This difficulty was likely to be further aggravated by an invention which facilitated the process of weaving. In the year 1738, Mr. John Kay, a native of Bury, in Lancashire, then residing at Colchester, where the woollen manufacture was at that time carried on, suggested a mode of throwing the shuttle, which enabled the weaver to make nearly twice as much cloth as he could make before. The old mode was, to throw the shuttle with the hand, which required a constant extension of the hands to each side of the warp (2). By the new plan, the lathe (in which the shuttle runs) was lengthened a foot at either end; and, by means of two strings attached to the opposite ends of the lathe, and both held by a peg in the weaver's hand, lie, with a slight and sudden pluck, was able to give the proper impulse to the shuttle. The shuttle thus impelled was called the *Fly-shuttle*, and the peg was called the *picking-peg*, (i.e. the *throwing* peg). This simple contrivance was a great saving, of time and exertion to the weaver, and enabled one man to weave the widest cloth, which had before required two persons. "Mr. Kay brought this ingenious invention to his native town, and introduced it among the woollen weavers, in the same year, but it was not much used among the cotton weavers until 1760. In that year Mr.

Robert Kay, of Bury, son of Mr. John Kay, invented the *drop-box*, by means of which the weaver can at pleasure use any one of three shuttles, each containing a different coloured weft, without the trouble of taking them from and replacing them in the lathe". (3)

These inventions, like every other invention which has contributed to the extraordinary advance of the cotton manufacture, were opposed by the workmen, who feared that they would lose their employment; and such was the persecution and danger to which John Kay was exposed, that he left his native country, and went to reside in Paris.

It has been seen, that the great impediment to the further progress of the manufacture was the impossibility of obtaining an adequate supply of yarn. The one-thread wheel, though turning from morning till night in thousands of cottages, could not keep pace either with the weaver's shuttle, or with the demand of the merchant.

The one-thread wheel, though much improved from the rude teak-wood wheel used in India. . . . was an extremely slow mode of spinning....

The yarn was spun by two processes, called *roving* and *spinning*. In the first, the spinner took the short fleecy rolls in which the cotton was stripped off the hand-cards, applied them successively to the spindle, and, whilst with one hand she turned the wheel, and thus made the spindle revolve, with the other she drew out the cardings, which, receiving a slight twist from the spindle, were made into thick threads called rovings, and wound upon the spindle so as to form cops. In the second process, the roving was spun into yarn: the operation was similar, but the thread was drawn out finer, and received much more twist. It will be seen that this instrument only admitted of one thread being spun at a time by one pair of hands: and the slowness of the operation, and consequent expensiveness of the yarn formed a great obstacle to the establishment of a new manufacture.

Genius stepped in to remove the difficulty, and gave wings to a manufacture which had been creeping on the earth. A mechanical contrivance was invented, by which twenty, fifty, a hundred, or even a thousand threads could be spun at once by a single pair of hands!

The authorship of this splendid invention, like that of the art of printing, has been the subject of much doubt and controversy; and by far the greater number of writers have subscribed the honour to an individual, who, though possessed of extraordinary talent and merit, was certainly not the original inventor. Sir Richard Arkwright is generally believed, even to the present day, to have invented the mode of *spinning by rollers*. . . .

The inventor of the mode of *spinning by rollers* was JOHN WYATT, of Birmingham....

... This is the invention ascribed to Sir Richard Arkwright, and on which his renown for mechanical genius mainly rests. It will be found, however, that the process had previously been described, with the utmost distinctness, in the specification of the machine invented by John Wyatt, and that cotton had for some years been spun by those machines. The patent for the invention was taken out, in the year 1738, in the name of Lewis Paul, a foreigner, with whom Mr. Wyatt had connected himself in partnership, and the name of John Wyatt only appears as a witness; but there is other evidence to show that the latter was really the inventor. The reason

why Paul was allowed to take out the patent can only be conjectured; it may have been, that Wyatt was then in embarrassed circumstances.

In pursuing the history of spinning by rollers, we come now to the successful introduction of that invention by Sir Richard Arkwright, who, though not entitled to all the merit which has been claimed for him possessed very high inventive talent, as well as an unrivalled sagacity in estimating at their true value the mechanical contrivances of others, in combining them together, perfecting them, arranging a complete series of machinery, and constructing the factory system-itself a vast and admirable machine, which has been the source of great wealth, both to individuals and to the nation.

Richard Arkwright rose by the force of his natural talents from a very humble condition in society. He was born at Preston on the 23rd of December, 1732, of poor parents: being the youngest of thirteen children, his parents could only afford to give him an education of the humblest kind, and he was scarcely able to write. He was brought up to the trade of a barber at Kirkham and Preston, and established himself in that business at Bolton in the year 1760. Having become possessed of a chemical process for dyeing human hair, (4) which in that day (when wigs were universal) was of considerable value, he travelled about collecting hair, and again disposing of it when dyed. In 1761, he married a wife from Leigh, and the connexions he thus formed in that town are supposed to have afterwards brought him acquainted with Highs's experiments in making spinning machines. He himself manifested a strong bent for experiments in mechanics, which he is stated to have followed with so much devotedness as to have neglected his business and injured his circumstances. His natural disposition was ardent, enterprising, and stubbornly persevering: his mind was as coarse as it was bold and active, and his manners were rough and unpleasing.

In 1767, Arkwright fell in with Kay, the clockmaker, at Warrington, whom he employed to bend him some wires, and turn him some pieces of brass. From this it would seem that Arkwright was then experimenting in mechanics; and it has been said, that he was endeavouring to produce perpetual motion. (5) He entered into conversation with the clockmaker, and called upon him repeatedly; and at length Kay, according to his own account, told him of Highs's scheme of spinning by rollers. Kay adds, in his evidence, that Arkwright induced him to make a model of Highs's machine, and took it away. It is certain that from this period Arkwright abandoned his former business, and devoted himself to the construction of the spinning machine; and also, that he persuaded Kay to go with him first to Preston and afterwards to Nottingham, binding him in a bond to serve him at a certain rate of wages for a stipulated term. The particulars of what passed between Arkwright and Kay rest wholly on the evidence of the latter; but there is no doubt that Kay was thus engaged to accompany Arkwright, and that he worked for him some time at Nottingham. Those who believe in the invention of Highs find in this fact, combined with Highs's own evidence, a very strong presumption in its favour: but those who disbelieve it may adopt the conjecture, that Arkwright, not being a practical mechanic, engaged the clockmaker to construct the apparatus he had himself contrived. The statement of Arkwright, in the "Case" drawn up to be submitted to parliament, was, that "after many years' intense and

painful application, he invented, about the year 1768, his present method of spinning cotton, but upon very different principles from any invention that had -one before it". It is true that Arkwright had been experimenting in mechanics, but there is no evidence to shew that he had even thought of making a spinning machine before his interview with Kay at Warrington. Kay appears not to have been able to make the whole machine, and therefore "he and Arkwright applied to Mr. Peter Atherton, afterwards of Liverpool", (then probably all instrument maker at Warrington), "to make the spinning engine; but from the poverty of Arkwright's appearance, Mr. Atherton refused to undertake it, though afterwards, on the evening of the same day, he agreed to lend Kay a Smith and watch-tool maker, to make the heavier part of the engine, and Kay undertook to make the clockmaker's part of it, and to instruct the workman. In this way Mr. Arkwright's first engine, for which he afterwards took out a patent, was made".(6)

Being altogether destitute of pecuniary means for prosecuting his invention, Arkwright repaired to his native place, Preston, and applied to a friend, Mr. John Smalley, a liquor-merchant and painter, for assistance. The famous contested election, at which General Burgoyne was returned, occurring during his visit, Arkwright voted; but the wardrobe of the future knight was in so tattered a condition, that a number of persons subscribed to put him into decent plight to appear at the poll- room. His spinning machine was fitted up in the parlour of the house belonging to the Free Grammar School, which was lent by the head-master to Mr. Smalley for the purpose. (7) The latter was so well convinced of the utility of the machine, that he joined Arkwright with heart and purse.

In consequence of the riots which had taken place in the neighbourhood of Blackburn, on the invention of Hargreaves's spinning jenny in 1767, by which many of the machines were destroyed, and the inventor was driven from his native county to Nottingham, Arkwright and Smalley, fearing similar Outrages directed against their machine, went also to Nottingham, accompanied by Kay. This town, therefore, became the cradle of two of the greatest inventions in cotton spinning. Here the adventurers applied for pecuniary aid to Messrs. Wright, bankers, who made advances on condition of sharing in the profits of the invention. But as the machine was not perfected so soon as they had anticipated, the bankers requested Arkwright to obtain other assistance, and recommended him to Mr. Samuel Need, of Nottingham. This gentleman was the partner of Mr. Jedediah Strutt, of Derby, (8) the ingenious improver and patentee of the stocking-frame; and Mr. Strutt having seen Arkwright's machine, and declared it to be an admirable invention, only wanting an adaptation of some of the wheels to each other, both Mr. Need and Mr. Strutt entered into partnership with Arkwright. Thus the pecuniary difficulties of this enterprising and persevering man were terminated. He soon made his machine practicable, and in 1769 he took out a patent. In the specification, which was enrolled on the 15th of July in that year, he stated that he "had by great study and long application invented a new piece of machinery, never before found out, practised, or used, for the making of weft or yarn from cotton, flax, and wool; which would be of great utility to a great many manufacturers, as well as to his Majesty's subjects in general, by employing a great number of poor people in working the

said machinery, and by making the said weft or yarn much superior in quality to any ever heretofore manufactured or made" . . .

Such is the original of the present water-frame and throstle. It was afterwards greatly improved by Arkwright himself; and, when horse-power was exchanged for waterpower, the number of spindles in the frame was multiplied. The original machine was adapted only to perform the last operation in spinning, namely, reducing the rovings into yarn; but it was easily applicable to the process of roving itself, as will subsequently appear. It is remarkable that the inventor, in his application for a patent, described himself as "Richard Arkwright, of Nottingham, *clockmaker*"(9). He and his partners erected a mill at Nottingham, which was driven by horses; but this mode of turning the machinery being found too expensive, they built another mill on a much larger scale at Cromford, in Derbyshire, which was turned by a water wheel, and from this circumstance the spinning machine was called the *water-frame*.

The difficulty, delay, and expense which attended the completing of the invention, prove, at the very least, that Arkwright did not receive it from any other person a *perfect* machine. If he had seen either Watt's machine, or the model of that of Higs, he had still to perfect the details; and the determined assiduity and confidence with which he devoted himself to this undertaking, before the machine had ever been made to answer, show that he had sufficient mechanical capacity to appreciate its value, and sufficient talent and energy, to make the invention practicable and profitable. . . .

The great demand for yarn, while the one-thread wheel was the only instrument for spinning, set other wits on contriving a substitute for it, besides those of Wyatt, Higs, and Arkwright.

We learn from the "Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce", that in 1783 the society had in its repositories models of the following spinning machines: "A Spinning Wheel, by Mr. John Webb, invented 1761. A Spinning Wheel, by Mr. Thomas Perrin, 1761. A Horizontal Spinning Wheel, by Mr. Wm. Harrison, 1764. A Spinning Wheel, by Mr. Perrin, 1765. A Spinning Wheel, by Mr. Garrat, 1766. A Spinning Wheel, by Mr. Garrat, 1767" (10). Between the establishment of the society in 1754 and the year 1783, it distributed £544. 12s. in premiums "for improving several machines used in manufactures, viz. the comb-pot, cards for wool and cotton, stocking frame, loom, machines for winding and doubling, and spinning wheels" (11). None of these inventions of spinning machines, however, succeeded. The compiler of the Transactions, writing in 1783, says, "From the best information hitherto obtained, it appears, that about the year 1764, a poor man, of the name of Hargreaves, employed in the cotton manufactory near Blackburn, in Lancashire, first made a machine in that county, which spun eleven threads; and that in the year 1770 he obtained a patent for the invention. The construction of this kind of machine, called a *Spinning jenny*, has since been much improved, and is now at so high a degree of perfection, that one woman is thereby enabled with ease to spin a hundred threads of cotton at a time" (12).

James Hargreaves, a weaver of Stand-hill, near Blackburn, was the author of the admirable invention noticed in this extract (13). It has been generally supposed that the date of

the invention was 1767, not 1764; and Arkwright, in his "Case", states the machine to have been made in 1767. It is, however, in the highest degree probable, that the jenny would not be at once perfected: its construction would probably occupy the author, who was a poor man, and had to work for his daily bread, some years: and as Hargreaves went to Nottingham in 1768, before which time his machine had not only been perfected, but its extraordinary powers so clearly proved, notwithstanding his efforts to keep it secret, as to expose him to persecution and the attacks of a mob, I am strongly disposed to think that the invention was conceived, and that the author began to embody it, as early as 1764.

Hargreaves, though illiterate and humble, must be regarded as one of the greatest inventors and improvers in the cotton manufacture. His principal invention, and one which shewed high mechanical genius, was the jenny. The date of this invention was some years before Arkwright obtained the patent for his water-frame; and it differs so completely from that machine, and from Wyatt's, that there can be no suspicion of its being other than a perfectly original invention....

Before quitting Lancashire, Hargreaves had made a few jennies for sale; (14) and the importance of the invention being, universally appreciated, the interests of the manufacturers and weavers brought it into general use, in spite of all opposition. A desperate effort was, however, made in 1779-probably in a period of temporary distress-to put down the machine. A mob rose, and scoured the country for several miles round Blackburn, demolishing the jennies, and with them all the carding engines, water-frames, and every machine turned by water or horses.... It may seem strange, that not merely the working classes, but even the middle and upper classes, entertained a great dread of machinery. Not perceiving the tendency of any invention which improved and cheapened the manufacture, to cause an extended demand for its products, and thereby to give employment to more hands than it superseded, those classes were alarmed lest the poor-rates should be burdened with workmen thrown idle....

The two important inventions for spinning, of which the history has been traced, broke down the barrier which had so long obstructed the advance of the cotton manufacture. The new machines not only turned off a much greater quantity of yarn than had before been produced, but the yarn was also of a superior quality. The water-frame spun a hard and firm thread, calculated for warps; and from this time the warps of linen yarn were abandoned, and goods were, for the first time in this country, woven wholly of cotton. Manufactures of a finer and more delicate fabric were also introduced, especially calicoes, imitated from the Indian fabrics of that name. The jenny was peculiarly adapted for spinning weft; so that the two machines, instead of coming in conflict, were brought into use together. . . .

The factory system in England takes its rise from this period. Hitherto the cotton manufacture had been carried on almost entirely in the houses of the workmen. . . . But the water-frame, the carding engine, and the other machines which Arkwright brought out in a finished state, required both more space than could be found in a cottage, and more power than could be applied by the human arm. Their weight also rendered it necessary to place them in

strongly-built mills, and they could not be advantageously turned by any power then known but that of water.

During the period that has now passed under review, Hargreaves and Arkwright had established the Cotton Manufacture by their spinning machines; but those machines were not adapted for the finer qualities of yarn. . . . This defect in the spinning machinery was remedied by the invention of another machine, called the *Mule*, or the *Mule Jenny*, from its combining the principles of Arkwright's water-frame and Hargreaves's jenny...

This excellent machine, which has superseded the jenny, and to a considerable extent the water-frame, and which has carried the cotton manufacture to a perfection it could not otherwise have attained, was invented by Samuel Crompton, a weaver, of respectable character and moderate circumstances, living at Hall-in-the-Wood, near Bolton. The date of the invention has been generally stated to be 1775, but ... his own account is decisive: he says in a letter to a friend: -"In regard to the mule, the date of its being first completed was in the year 1779...."

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(1) Dr. Aikin says, "The weavers, in a scarcity of spinning, have sometimes been paid less for the weft than they paid the spinner, but durst not complain, much less abate the spinner, lest their looms should be unemployed." *Hist. of Manchester*, p. 167. Mr. Guest, in his "*History of the Cotton Manufacture*", states that "it was no uncommon thing for a weaver to walk three or four miles in a morning, and call on five or six spinners, before he could collect weft to serve him for the remainder of the day; and when he wished to weave a piece in a shorter time than usual, a new ribbon, or a gown, was necessary, to quicken the exertions of the spinner". p. 12.

(2) In the first print of Hogarth's admirable series, "*Industry and Idleness*", where the two apprentices are seen at their looms, the old form of shuttle and lathe is represented: the industrious apprentice has the shuttle in his hand, ready to throw it; and the shuttle of the idle apprentice hangs dangling by the thread at the end of the lathe, affording a plaything for the cat, whilst the lad sleeps.

(3), p. 8. Mr. Guest derived his information on these points "from a manuscript lent to him by Mr. Samuel Kay, of Bury, son of Mr. Robert Kay, the inventor of the drop-box". p. 30.

(4) I have no means of knowing whether this secret was a discovery of his own, or was communicated to him. Mr. Guest says, he "possessed" the secret; Mr. Culloch, that he "discovered" it.

(5) Aikin and Enfield's *General Biography*, Vol. I. p. 391

(6) Aikin and Enfield's "*General Biography*", Vol. I. p. 391. The authors profess to have obtained some of these facts from private sources; and Dr. Aikin's opportunities were good, as he resided at Warrington.

(7) These facts are stated on the authority of Nicholas Grimshaw, Esq., several times mayor of Preston, who has personal knowledge of them.

(8) Mr. Strutt was brought up a farmer, but, having a passion for improvement and a mechanical genius, he succeeded in adapting the stocking-frame to the manufacture of ribbed stockings, for which improvement he obtained a patent. He established an extensive manufacture of ribbed stockings at Derby, and, after his connexion with Mr. Arkwright, he erected cotton works at Milford, near Belper: he raised his family to great wealth. Some of the circumstances connected with Arkwright's settling at Nottingham, were communicated by the late Mr. William Strutt, the highly gifted and ingenious son of Mr. Jedediah Strutt, to the editor of the *Beauties of England and Wales*. See vol. III. pp. 518, 541.

(9) This was certainly an untrue description, and Mr. Guest remarks upon it, that Arkwright "did not scruple to masquerade in the character and trade of John Kay". -Reply, p. 58.

(10) *Transactions of the Society of Arts*, vol. L PP- 314, 315.

(11) Ibid, vol. 1, p 26.

(12) Ibid, vol. I, pp. 33, 34

(13) Mr. Guest prefers a claim on the part of Thomas Highs, of Leigh, to the invention of the spinning-jenny, as well as of the water-frame. After attentively considering the evidence adduced, I am of the opinion that it is quite insufficient to establish the claim. At the trial on Arkwright's patent, when Highs was examined pretty largely as to his inventions, he did not even allude to the jenny, which it is almost certain he would, to prove his great inventive talent, had he been the inventor. It is true that two men, named Thomas Leather and Thomas Wilkinson, the one 69 and the other 75 years old when their evidence was taken, stated in 1823 and 1827, that they knew Highs, and that he made a spinning-jenny about the year 1763 or 1764. The former also stated, that the machine was called jenny after Highs's daughter Jane; and there is ample evidence that Highs had a daughter of that name. It is added, that Kay, the clockmaker, assisted in the construction of this machine, as well as in that of the water-frame. The last-mentioned circumstance leads me to the belief that the witnesses have confounded the two inventions. Moreover, as Highs undoubtedly made jennies at a later period, and also invented a double jenny with some new apparatus, this fact may have given rise to the belief that he was the original inventor. The recollections of two aged men, concerning precise dates, after the lapse of sixty years, and concerning the precise form of a machine seen by them in mere boyhood, are little to be relied upon, especially for the purpose of overturning the claims of a most ingenious man, the patentee of the invention, and whose pretensions were never disputed till the appearance of Mr. Guest's book. Highs, however, has a third claim as an inventor; he stated, on Arkwright's patent trial, that he made a perpetual carding in the year 1773, which was before any other person did the same thing. It is certain that he was an extremely ingenious man, and he continued to make spinning machines till he was disabled by a stroke of the palsy, about the year 1790. He was supported in his old age by the liberality of Peter Drinkwater, Esq., of Manchester, and others, and died on the 13th December 1803, aged eighty-four years.

(14) It is mentioned by Mr. Kennedy, that Crompton, the inventor of the mule, "learnt to spin upon a jenny of Hargreaves's make", in 1769.