mingham, and obviously suggested the plan described in the above specification,—a plan altogether fantastic, absurd, and unmanageable for the spinning of wool, cotton, or any other textile filaments. "The soft cord or sliver, after escaping from betwixt the first pair of rowlers, passes through a *succession* of other rowlers moving proportionably faster, so as to draw the rope into any degree of fineness." This succession implies clearly a series of several pairs of rollers—a complexity of construction and movement which never existed but in the brain of the patentee, impracticable with his means, and utterly destructive to woolly fibres had it been practicable. It will appear from subsequent evidence that this succession of rollers moving with successive velocities was merely a fine phrensy of imagination, and was never carried into effect. But the next member of the description exceeds in absurdity any thing to be found upon the specification rolls,—being a self-evident impossibility. "Sometimes these successive rowlers (not the first) have another rotation besides that which diminishes the thread, viz., that they give it a small degree of twist betwixt each pair by means of the thread itself passing through the axis and centre of that rotation." As the thread was inevitably pinched at two points, viz., between the first pair and last pair of rollers, any twisting of its intermediate parts was manifestly impossible. But we may ask any mechanic what rotation such a *roller* could have, besides the rotation upon its axis, which diminishes the thread; or how could the thread be made to pass through the axis and centre of that rotation without being instantly torn to atoms? The expression here used "betwixt each pair" insinuates

the existence of several successive pairs of rollers, all endowed with these impossible motions and functions; circumstances introduced either for the purpose of mystifying common minds, or derived from some vertiginous movements of the brain.

The last sentence, like the postscript of a lady's letter, contains the whole substance of the invention;—a pair of flatting rollers prefixed to the spindle and bobbin of a spinning-wheel; an ingenious fancy, no doubt, but not a mechanism capable, under any modification, of converting a carded sliver of wool or cotton into tolerably good yarn. Mr. Kennedy, a great authority among cotton-spinners, pronounced the following opinion upon a sample which had been spun by Mr. Wyatt's roller machine. "From examining the yarn I think it could not be said by competent judges that it was spun by a similar machine to that of Mr. Arkwright; for the fabric or thread is very different from the early production of Mr. Arkwright, and is, I think, evidently spun by a different machine, the ingenuity of which we cannot appreciate, as the model mentioned in the paper alluded to is unfortunately lost."*

Any one may readily conceive that yarn spun by the simultaneous drawing and twisting of a sliver delivered in a thick mass by one pair of rollers could not be level, but lumpy, very different from, and very inferior to, yarn spun by the twisting and drawing of an evenly-attenuated fine-roving of parallel filaments.

The specimen on which Mr. Kennedy gave judgment had been spun on "the spinning-engine without

* On the Rise and Progress of the Cotton Trade, in the Memoirs of the Manchester Society. 2d Series, vol. iii. p. 137.

hands," of Mr. Wyatt, about the year 1741; the engine being turned by two (or more) asses, walking round an axis in a large warehouse, near the well in the Upper Priory, at Birmingham.

From a manuscript journal of Mr. John Wyatt, obtained by Mr. Kennedy from the son of the ingenious and unfortunate patentee of the above engine, it appears that a spinning factory upon his plan had been established at Northampton about the same time, of which Mr. Cave, editor of the *Gentleman's Magazine*, so well known by Dr. Johnson's eulogy of his benevolence, was the proprietor. This factory consisted of several spinning-frames, containing altogether 250 spindles and bobbins, each of which was moved by a separate wheel and pinion, the one having sixty-four teeth and the other sixty-five, on purpose, no doubt, to cause the winding-on motion by the difference in velocity of the spindle and bobbin,—the whole being driven by a water-wheel.

Mr. Wyatt seems to have spent much of his time in London, inquiring into the prices of yarns, leaving the factory at Birmingham to be managed by Paul. He visited Mr. Cave's factory at Northampton in October, 1743, and wrote a number of remarks upon it, most probably for the information of that gentleman. Among others, he states that the agent, his wife, and two other women to assist him, received altogether a salary of £88 per annum,—a sum which would seem to imply superior merit in the agent, especially when it is compared with the wages of the other workpeople; for fifty carders, spinners, and supernumerary girls in the work, received for one week's wages £3, being only about 1*s.* 2*d.* apiece.

An interesting notice of Mr. Wyatt's contrivances for spinning cotton was published by his son, Mr. Charles Wyatt, in the *Repertory of Arts, Manufactures, and Agriculture*, for January, 1818, of which his brother, Mr. John Wyatt, was then editor. The following extracts contain the substance of the communication.

"In the year 1730, or thereabouts, living then at a village near Litchfield, our respected father first conceived the project, and carried it into effect; and in the year 1733, by a model of about two feet square, in a small building near Sutton Coldfield, without a single witness to the performance, was spun the first thread of cotton ever produced without the intervention of the human fingers, he, the inventor, to use his own words, '*being all the time in a pleasing, but trembling, suspense.*' The wool had been carded in the common way, and was *passed between two cylinders, from whence the bobbin drew it by means of the twist.*

"This successful experiment induced him to seek for a pecuniary connexion equal to the views that the project excited, and one appeared to present itself with a Mr. Lewis Paul, which terminated unhappily for the projector; for Paul, a foreigner, poor and enterprizing, made offers and bargains which he never fulfilled, and contrived, in the year 1738, to have a patent taken out in his own name for some additional apparatus, a copy of which I send you; and in 1741, or 1742, a mill turned by two asses walking round an axis was erected in Birmingham, and ten girls were employed in attending the work. Two hanks of the cotton then and there spun are now in my possession, accompanied with the inventor's testimony of the performance. Drawings of the machinery were sent, or

appear to have been sent, to Mr. Cave, for insertion in the *Gentleman's Magazine.*

"This establishment, unsupported by sufficient property, languished a short time, and then expired; the supplies were exhausted, and the inventor much injured by the experiment, but his confidence in the scheme was unimpaired. The machinery was sold in 1743. A work upon a larger scale, on a stream of water, was established at Northampton, under the direction of a Mr. Yeomen, but with the property of Mr. Cave. The work contained 250 spindles, and employed fifty pairs of hands. The inventor soon after examined the state of the undertaking, and found great deficiency and neglect in the management. At that time they had spun about 3,300 lbs. of cotton. On the observations which he then made he composed what he entitled *A Systematic Essay on the Business of Spinning*, which exhibits a clear view of the mechanical considerations on which an undertaking of that nature, of whatever magnitude, must be established, and apparently confines his humble pretensions to the profits on 300 spindles. It was not within human foresight to calculate the richness of the harvest to come from this little germ.

"This brings me to the conclusion of our father's connexion with the spinning business.

"The work at Northampton did not prosper. It passed, I believe, into the possession of a Mr. Yeo, a gentleman of the law, in London, about the year 1764, and, from a strange coincidence of circumstances, there is the highest probability that the machinery got into the hands of a person who, with the assistance of others, knowing how to apply it with skill and judg-

ment, and to supply what might be deficient, raised upon it, by a gradual acccession of profit, an immense establishment, and a princely fortune.

" In the year 1739, my father writes to one of his friends, '*that by this method,*' some new thought, '*the wool need be no more carded than to break the knots or mix it well, as with scribbles or stock cards, and being thus mixed and pressed down hard into a box, it may without any human touch be picked out almost hair by hair, and made into yarn.*'

" In 1748 Mr. Paul procured another patent, the title of which was for 'carding of wool and cotton;' but whether this was combined with the machinery then at Northampton, or where it was introduced, I know not. Such, or nearly such, being the early history of this invention, I thought the late Sir Richard Arkwright would be gratified by possessing the very model to which I have alluded, and I accordingly waited on him at Cromford with the offer, but my reception did not correspond with my expectations.

" To pretend, however, that the original machinery, without addition or improvement, would alone have produced the prodigious effects which we now behold, would be claiming improbable merit for the inventor, and degrading the talents and sagacity of his successors in the same field of enterprize, for it cannot be denied that a great fund of ingenuity must have been expended in bringing the spinning works to their present degree of perfection. The number of spindles now in use is supposed to exceed 5,000,000.

" If the author of the humble establishment at Birmingham gave birth to such a wonderful progeny, he ought at least to be acknowledged as a benefactor to

his country, and recorded amongst the men who, from an attachment to the science and practice of mechanics, open the paths of knowledge, and point out, but do not pursue, those which lead to profit and prosperity

"Connected with this subject I might with great propriety point out many eminent services that he rendered the public by his mechanical talents, but being mostly local, and absorbed by subsequent productions, they have lost their present interest.

"The machine, however, for weighing loaded carriages, coal particularly, ought to be distinguished as one of known and extensive utility. It was solely and exclusively his own; he erected the first at Birmingham about 50 years ago, and his own description of it is, '*That it would weigh a load of coal or a pound of butter with equal facility, and nearly with equal accuracy.* The present makers admit that the principle is incapable of improvement.

"The late Mr. Boulton, a man too eminent and too amiable to be mentioned without esteem and regret, nor on my part without affection, set a high value on my father's attainments and virtues, for it was universally acknowledged that he had the happiness to give a lustre and an interest to his genius and his knowledge by the purest probity, the most unaffected humility, urbanity, and benevolence. He was attended to the grave in 1766 by Mr. Boulton, Mr. Baskerville the celebrated printer, (who, from the peculiarity of his notions, arrayed himself on this occasion in a splendid suit of gold lace,) and four other gentlemen of eminence in Birmingham."

This vindication of his father's fame, while it is highly honourable to the heart of the writer, shows that the

original plan of Wyatt was to employ a pair of rollers for delivering, at any desired speed, a sliver of cotton to the bobbin-and-fly spindle, as in a flax-wheel. Then onsensical mystification of a succession of other "*rowlers*," and another rotation besides that which diminishes the thread, appears to have been introduced into the patent of 1738 by Lewis Paul, and never existed nor could exist in any machine.

The delivery-roller principle of Wyatt reappeared by itself in Paul's second patent of 1758. "The several rowes or filaments so taken off (the flat cards) must be connected into one entire roll, which being put between *a pair* of rollers or cylinders, is by their turning round *delivered* to the nose of a spindle, in such proportion to the thread made, as is proper for the particular occasions. From hence it is delivered to a bobbin, spole, or quill, which turns upon the spindle, and which gathers up the thread or yarn as it is spun. The spindle is so contrived as to draw faster than the rollers or cylinders give, in proportion to the length of thread or yarn into which the matter to be spun is proposed to be drawn."

This specification is identical with the concluding paragraph of the former, and therefore afforded no valid claim to new letters patent. In the first, the card-rolls were joined together into a kind of rope of raw wool; in the second, the several rows (of cardings) *must* be connected into one entire roll. The two patents are therefore entirely the same. The second is remarkable for the renunciation of the fantastic whim of successive rollers with certain whirligig inexplicable motions which cuts so conspicuous a figure in the first, and which was put there, like the Martello

towers on the Irish coast, for the purpose of puzzling posterity. The equable extension and attenuation of the thread by means of a pair of feeding-rollers, a pair of carrying-rollers, and a pair of drawing-rollers, cannot be traced in the preceding rude scheme, and they constitute the very essence of roller-spinning.

No wonder the work at Northampton did not prosper, since Paul, with an experience of more than twenty years, aided during a part of the time by the sagacity of Wyatt, had never been able to spin with all his roller-apparatus a single good thread. Had the yarn spun in the factory under him or Mr. Yeo, from the year 1748 to 1764, been but tolerable, it would have commanded a rapid sale, and secured to them large profits.

The use of *delivering*-rollers as heretofore exhibited, so far from helping an inventor into a right system of spinning, would most probably mislead him, and induce him to try various modifications of so plausible a scheme, instead of abandoning it altogether. This was exactly the dilemma of Paul, who appears from his carding patent of 1748 to have been a man of much ingenuity, and a good practical mechanic. He has an incontestable claim to the invention of the cylinder-card, an engine which plays one of the most important parts in a modern factory. Of this elegant contrivance some particulars will be mentioned in treating of the preparation-machines of a cotton-factory. If Mr. Charles Wyatt had studied more deeply the principles of cotton spinning, he would never have confounded a single pair of delivering-rollers, with a double or triple pair of drawing-rollers, nor would he have felt surprise at his indifferent reception from Arkwright,

when his errand was to tell the great master-spinnner of the age, that two things in his art so essentially unlike, were the same. Paul's carding invention, in fact, however valuable in preparing cotton for a good sysem of spinning, became nugatory to himself and his partners, by being linked to his vicious roller plan, which rendered the industry of his whole life unproductive, and plunged him, it is believed, in eventual ruin.

The three patents of 1738, 1748, and 1758, appear to have been much talked of at the time in the manufacturing districts; both Wyatt and Paul having done what they could to make them generally known, and to interest the world in their behalf. In the years 1739, 1740, 1741, 1742, and 1743, Mr. Wyatt was resident chiefly in London, visiting the principal manufacturers of cotton goods, who then worked up East India yarns, purchased at a high price; and he endeavoured, but apparently without success, to dispose of his machine-spun yarn to them. It is quite certain that if its quality had been merely tolerable, it would have commanded a ready sale and a remunerating price. He also paid a fruitless visit to Lancashire on the same errand. The machine was so radically bad that its two schemers, after working upon it the best part of their lives, from 1730 till 1764, let it drop into the hands of Mr. Yeo, a gentleman of the law, in London, who became proprietor of Paul's water-power spinning factory at Northampton, and who, finding it a hopeless concern, caused it to be dismantled. The disastrous result of roller-spinning being thus universally promulgated, would naturally deter prudent men from attempting to revive it. Supposing, therefore, that Arkwright, or any other person had got pos-

session of the whole of Paul's roller-machines, could he have made more of it than the baffled patentees had done? Indeed, the spinning project of Wyatt and Paul, instead of being instrumental to the construction of a rational roller system, must have proved the greatest b stacle to its contrivance, and made it be looked upon by men of business as a folly, with which it would be dangerous to have anything to do.

The grand mechanical problem which the cotton manufacture then offered to the solution of the ingenious may be stated as follows: To construct a machine in which one member should supply continuously and uniformly porous cords of parallel filaments in minute portions; a second member should attenuate these cords by drawing out their filaments alongside of each other by an imperceptible gradation; a third member should at once twist and extend these attenuated threads unremittingly as they advance; and a fourth should wind them regularly upon bobbins exactly in proportion as they are spun. When contemplated *a priori* in its delicate requirements, this problem must have appeared to be impracticable; a conviction strengthened by the total failure of Wyatt and Paul to produce good yarn, even at the highly remunerating price of that time. Their rank in the history of roller-spinning may be justly compared to that of the Marquis of Worcester in the history of the steam-engine—they gave birth to an idea which was quite erroneous for practical purposes, and which, being pursued, did, and could, produce nothing but disappointment and ruin to its authors, a result most unpropitious to the progress of invention in any line of industry.

That the roller-spinning scheme was one of common notoriety in Lancashire about the year 1766 appears from the evidence of the clock-maker, Kay, on the trial of Arkwright's patent in the Court of King's Bench, on the 25th of June, 1785. Kay lived at Warrington in 1767, when he first became acquainted with Mr. Arkwright.

"We were talking," Arkwright and he, "of different things, and this thing came up of spinning by rollers. He (Arkwright) said, that will never be brought to bear; several gentlemen have almost broke themselves by it." The testimony of this man must, no doubt, be taken with reserve, for when Arkwright returned next morning to Kay, and asked him (he says) if a roller-spinning model could be made at a small expense? "Yes," says I, "I believe, I can. Says he, if you will I will pay you." Thus, when Kay undertook this job for Mr. Arkwright, he made no mention of Thomas Highs, to whom, however, on the trial, in 1785, he ascribed the invention of the plan of drawing-rollers. He merely said, "I and another man have tried that method in Warrington." On the contrary, it transpires from Kay in the course of his examination by the same lawyer, that he had assumed to himself the original property of the drawing-roller invention, and no doubt availed himself, as far as he could, of the credit of it, to raise his reputation as a workman. When questioned, as follows, by Mr. Lee, "You must know whether at that time (1775) it was his own (Arkwright's) invention, or he had it of you," he replied, "James Hargrave told me I should have lodged a caveat."* What inference can

* This passage of the examination is quoted by Mr. Guest, at p. 65 of his *Compendious History of the Cotton Manufacture.* 4to. London, 1823.

be drawn from this advice of Hargrave, who, being a conscientious man, would not recommend an act of knavery, than that Kay had represented himself in the year 1775, after being long a working mechanic in Arkwright's pay, as the real inventor of the drawing-rollers, which his other testimony proves that he was not. Had the leading lawyers of that day been as well versant in manufacturing subjects as they are now, the evidence of Kay would have been entirely set aside. In fact, the above awkward admission, though quite fatal to his character for truth and fair dealing, is in perfect keeping with the circumstances of his absconding from Arkwright's employment with a charge of felony at his heels. Mr. Arkwright, amid the multiplicity of his concerns, did not choose to prosecute the charge against the miserable offender, who had fled to Ireland.

In the above-mentioned trial in the court of King's Bench, Thomas Highs, by trade a reed-maker, was brought forward to prove that he was the real inventor of the drawing-roller plan of spinning for which Arkwright had obtained a first patent in 1769, and a second patent, of a more complete and comprehensive nature, in 1775.

The testimony of Highs is extremely indistinct and confused, very unlike that of a man who had invented a really operative mechanism. He does not indeed pretend to have ever made a machine capable of doing work, but merely to have got Kay, the clock-maker, in 1767, to put together a slight toy containing two pairs of smooth wooden rollers, of which the one pair was to move five times quicker than the other.

"*Q.* (Mr. *Sergeant Bolton.*) I will take him to the

rollers: you see one is fluted, the other covered with leather. Was yours the same way?—*A.* Yes, mine was, two years after (after 1767) but not then.

Q. Not at first?—*A.* No.

Q. In 1769 yours were like it?—*A.* They were; mine had fluted work; fluted wood upon an iron axis; but the other roller was the same, only it was covered with shoe-leather, instead of that leather; *I am informed it is such as they make shoes of.*

Q. Whom did you employ when you first conceived this invention; whom did you employ to make it for you?—*A.* I employed one Kay, who came from Warrington.

Q. What trade was he?—*A.* He followed clock-making at that time. I employed him to make a small model with four wheels of wood to show him the method it was to work in, and desired him at the same time to make me brass wheels, that would multiply it about five to one.

Q. Who made you the wheels?—*A.* I made them myself."

When asked when and where he applied his rollers to roving and spinning, he replied, "In the town of Leigh. I did not follow this new manufacture; I was only improving myself, as I had a large family at that time, and was not able to follow it. I thought when I came a little abler, when I should get a friend to assist me; being poor, and having a large family; I was not willing any body should steal it from me."*

Highs shows himself here a sorry driveller, who had neither appreciated, nor tried to mature, the plan of

* Guest's *Compendious History*, p. 57.

drawing-rollers, supposing him to have schemed something of the kind, and which after the general talk about roller-spinning was a matter of no great merit. From anything which appears, however, Arkwright may have invented the drawing-rollers himself; for the testimony of Kay, a double-minded man, in open hostility with his late master, cannot be admitted to be of any weight. Highs swears, first, that the multiplying wheels of his model were made by Kay, and in a little after he swears, they were made by himself. Surely a person like Highs, so jealous of his little contrivances as to lay them aside rather than perfect them for fear of their being stolen from him, if he could have made these multiplying brass wheels, never would have employed a clock-maker to construct them for him, and more especially the wooden rollers which were far more easily made. Kay says, he made at the above period two roller models for Arkwright, the one a fortnight after the other, the last of which Arkwright took with him to Preston, the place of his residence.

Highs does not appear to have acted as the author of a valuable machine for spinning, so much sought after then, would have done; for in the year 1772, five years after his pretended invention of drawing-rollers, he was occupied in constructing an engine of a totally different description for a gentleman in Manchester, and met Arkwright there in a social manner at a tavern, without showing any symptoms of that indignation which an inventor would have naturally displayed against the plunderer of his genius. He told Arkwright, indeed, that he never would have had the rollers but for him, but he does not appear to have either thought, or done, anything more about them, in that most stirring

birth-day of the cotton manufacture. Had he possessed such a high character for mechanical ingenuity in Lancashire as has been affirmed by Mr. Guest, surely he might easily have found capitalists willing and able to patronize so useful an invention as that of spinning-rollers, had it been at all in a feasible form.

The great achievement of manufacturing good yarn by rollers was reserved for the sagacity and energy of Arkwright. This illustrious individual, persecuted and calumniated as all the signal benefactors of corrupt and invidious humanity have been, by contemporary rivals, was raised up by Providence from an obscure rank in life, to vindicate the natural equality of men. He was born at Preston, in Lancashire, on the 23d of December, 1732, the youngest of thirteen children, and received a very imperfect education. He was bred to the trade of a barber, which, being still incorporated with surgery in many towns, and deriving much profitable employment from the making of wigs, then worn by all people of condition, was no despicable vocation. Nor was he a mean or common-place practitioner of his art, for he became skilled in a superior process for dyeing hair, still one of the nicest operations of chemistry. According to the testimony of Mr. Richardson, hair-dresser of Leigh, the hair furnished by Arkwright was esteemed the best in the country.* In the purchase and sale of this valuable article he had occasion to travel a great deal, and being of an inquisitive mind became well acquainted with the necessities under which the cotton trade then laboured from a precarious supply of cotton-weft, and a total

* Communicated to Mr. Guest by Mr. Richardson. See "*Compendious History*, p. 21.

want of cotton-warp yarns. He appears to have been curious in mechanical combinations, and was, along with many other ingenious men in that dawn of rational mechanics, intent upon the discovery of the perpetual motion, for he employed the clock-maker Kay to make some brass wheels subservient to that project. This impossible problem, like that of the philosopher's stone, by exercising invention in endless shapes, gave birth to many discoveries. The evidence of his enemy Kay is conclusive on this point. It is probable, however, that Arkwright, aware of the importance of the spinning apparatus, which he was then concocting, may have disguised the purpose of his wheels under the name of a perpetual motion. Having realized the outline of his idea of drawing-rollers in a little model, made by Kay in 1767, he applied immediately to Mr. Atherton, a mechanist, then of Warrington and afterwards of Liverpool, to assist him in mounting a working machine upon the same plan. This gentleman declined taking any share in so hazardous an enterprize, as roller-spinning was then naturally held to be, after the failure of Wyatt and Paul, but he sent him two workmen, a smith and a watch-tool maker, to aid Kay in the construction of his apparatus. "In this way Mr. Arkwright's first engine, for which he afterwards took out a patent, was made."*

This straight-forward expedition in constructing a complex machine, affords unquestionably a conclusive proof that Arkwright must have thoroughly matured his plan of a drawing-roller frame before he ever called upon Kay, and that he employed this workman partly on account of his reputation as a clever clock-

* Aikin and Enfield's *General Biography.*

maker, but chiefly from his living at a distance from Bolton, where Arkwright resided, and where he would not wish any hints of his project to transpire.

The operative model being thus rapidly completed, the vigorous mind of the inventor did not delay an instant to verify its powers; but, repairing to Preston, his birth-place, he found among the companions of his early life one ready to assist him with heart and hand, Mr. John Smalley, a liquor-merchant and painter. This friendly man procured the use of the parlour of the house belonging to the Free Grammar School of that town, in order that Arkwright might fit up and work his spinning-frame. Being convinced by the trial, of its utility, they resolved to get other machines constructed on a still greater scale; but aware of the riots which had recently occurred at Blackburn against the spinning-jenny, the contemporaneous contrivance of James Hargreaves, they resolved to abandon their native county, then under violent fermentation.

The stocking frame of Lee had long afforded a method of making silk and worsted stockings by mechanism, much more beautiful and at a cheaper rate than the hand-knitter could do. But the manufacture of *cotton* hosiery, though highly prized, had hitherto languished for want of proper yarn. Hargreaves, and especially Arkwright, saw in their respective inventions, the means of supplying this much-wanted article, and accordingly they both in succession commenced their career in Nottingham, then, as still, the head quarters of the frame-work knitting trade. Messrs. Smalley and Arkwright applied to the Messrs. Wright, the eminent capitalists and bankers of that town, who readily joined in the enterprize. After a little time,

however, finding that the results of the machinery were not so advantageous or promising as they had expected, they took alarm, having the disasters of Northampton before their eyes, and withdrew from the concern. They introduced Arkwright in this new dilemma to Mr. Samuel Need, a considerable manufacturing hosier of Nottingham, who had for a partner that eminent mechanician and excellent man Mr. Jedediah Strutt, of Derby, the inventor of the only capital improvement ever made on Lee's stocking frame, that for making ribbed stockings, still named, from his place of residence, the Derby rib. Mr. Strutt discerned at once the sound principles of Arkwright's machine, and frankly declared his conviction that, with some slight mechanical adjustments, it would spin excellent hosiery yarn—the greatest desideratum in the cotton manufactures of that day; since the common hand-wheel yarn, as well as the jenny-yarn of Hargreaves, was too soft and loose for making good stockings.

Being now associated with capitalists of probity and enterprize, Arkwright tasked his faculties of mind and body to their utmost stretch to organize more completely the factory at Nottingham, which, with the aid of Smalley and Messrs. Wright, he had mounted so early as 1768, and driven by horse-power. On the 3d July, 1769, his first patent is dated, a year ever memorable also in the annals of industry for the patent invention of James Watt. In the following year, 1770, he was joined by Messrs. Need and Strutt. In 1771, this admirable triumvirate selected an excellent factory site at Cromford on the Derwent, where they erected the first water-spinning-mill,—the nursing-place

of the factory opulence and power of Great Britain. Here still may be seen at work the original frames of the inventor,—proofs demonstrative, were any wanted by the candid philosopher, that Arkwright was no plagiarist of other men's ideas, since he had then created a grand productive automaton, unlike everything else on the face of the earth. But many years of indefatigable labour passed over the inventor's head before the system was completed to his mind,—scarcely a week being barren of some valuable improvement. "About the years 1772 and 1773," says Mr. Guest, "his (Arkwright's) attempts at spinning had excited considerable interest in Leigh from his being so well known there, and it was common for the respectable inhabitants of the place to go and view his engines (at Cromford) and buy a dozen or two of pairs of stockings, made of yarn spun by them. I have in my possession a pair of stockings so bought at that period."*

"It seems that he (Highs) and Arkwright happened to be both in Manchester at that time (1772,) and that one Mr. Rothwell brought them into company together, in the parlour of a public house in that town, (Highs was then making an engine for a gentleman in Manchester, for which he received a premium,) and their conversation turned upon engines. He deposes that he told Mr. Arkwright he had got his, the witness's invention."†

"In 1770 or early in 1771, he (Highs) removed from Leigh to Camp Street, Manchester, where he constructed what may be termed a double jenny. This had twenty-eight spindles on each side, which were turned by a drum or roller placed in the centre. This

* *The British Cotton Manufactures*, by Richard Guest. Manchester, 1828, p. 15.

† Ibid. p. 29.

machine was publicly worked in Manchester Exchange in 1772, by his son Thomas Highs, then about ten years of age, and the manufacturers on that occasion, subscribed 200 guineas, and presented them to Highs as a reward for his ingenuity."* "In 1773, he removed to Bolton-le-Moors where he resided until 1776. In 1776, he returned to Manchester. In 1778 and 1779, he made machines at Kidderminster for various manufacturers, among others, Messrs. Pardoe, Lea, and Co."†

Such is Mr. Guest's account of Highs, at the most critical period of Arkwright's grand invention. If the drawing-rollers patented by Arkwright, at first in 1769, and, a second time in 1775, for spinning cotton, had been the invention of Highs, they never could have remained for one month in the state of a monopoly, since Highs was in the very focus of the cotton manufactures at Manchester, in high favour, and in confidential relations with the leading manufacturers of that district. The people of Leigh, on their return from their visit of wonder at Cromford, would have all risen in arms against the usurper of their townsman's invention, and have interested the public in his behalf provided there had been any good foundation for his claims. The spirited inhabitants of Manchester would not have suffered the ingenious man to whom they awarded so handsome a premium for doubling the jenny, to be robbed of another invention of far greater importance nor would they have failed to place him at once in the foreground of an attack upon Arkwright's patents. Priority of invention is so much more definite a plea than obscurity of description, in attacking a patent in a

* *The British Cotton Manufactures*, by Richard Guest. Manchester, 1828, p. 203. † Ibid. p. 205.

court of law, that if Highs of Leigh, a well-known and much-esteemed machine maker, in Manchester, had originally contrived a practicable set of drawing-rollers, he would have been able to exhibit them to his friends and admirers, and to have strangled Arkwright's patent in the very birth.

Round every schemer "much embryo, much abortion lies." That Highs had entertained a vague notion of drawing out cotton filaments by two pairs of rollers, one pair moving faster than the other, is possible; but it is certain from the above circumstances, that he had never realized it in anything of a workable form. I conclude, therefore, that the merit of a rational system of spinning and roving by rollers is entirely due to Arkwright, and that but for his high mental qualities, sagacity, decision, and his unwearied activity, the water-twist frame, with its offspring the throstle and mule, might not for ages have ennobled the industry of England.

It appears from the testimony given by Kay at the trial in 1785, that after he entered into the service of Arkwright, he left Warrington, and accompanied his master to Manchester, where he was employed by him for thirteen weeks in making a clock. Arkwright had occupied himself, we have seen, with the problem of the perpetual motion, and had no doubt studied with that view various kinds of clock movements. With a mind full of the project of roller-spinning, immediately after trying the model at Preston, would such a pushing man as Arkwright have employed his mechanic at high wages for thirteen weeks, in making an ordinary clock? No surely. He must have had some peculiar scheme of wheel-work for the measurement of time,

which he set Kay to work in realizing. After this experimental job was finished, Kay did nothing more for Arkwright, till he joined him and Smalley at Nottingham, for the purpose of co-operating in their factory-spinning enterprize.

As Mr. Arkwright had thus evidently directed his attention to clock-making, and naturally enough supposed himself the author of some improvements in that art, he chose to designate himself clock-maker in the drawing-roller patent of 1769, a very pardonable assumption, since he might have impaired his credit as the patentee of complex machinery, by appearing under the designation of a handicraft which he had now for ever renounced.

The specification of this patent is remarkably perspicuous. It mentions every essential element of a good water-twist or throstle-spinning machine of the present day, and is therefore in perfect accordance with the fact already stated, that some of the original spinning water-frames of Sir Richard Arkwright are still spinning good yarn at Cromford, the wooden teeth of the wheels and pinions having ground themselves into the best shapes for diminishing friction. In the preamble of the specification, dated 15th July, he truly says, 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 heretofore manufactured or made."

To no patent ever granted by a sovereign, could the above enunciation be with so much propriety prefixed. The following are his figure and description.

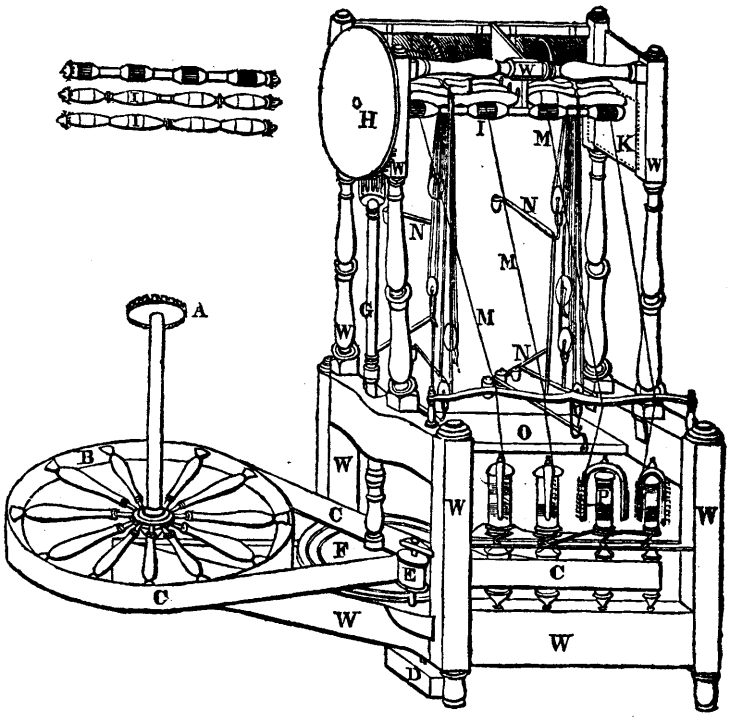

Fig. 18.—Arkwright's original patent Water-frame Spinning Machine of 1769.

"Now know ye that I, the said Richard Arkwright, do hereby describe and ascertain the nature of my said invention, and declare that the plan thereof drawn in the margin of these presents is composed of the following particulars, (that is to say). A, the cog wheel and shaft, which receive their motion from a horse. B, the drum or wheel which turns C, a belt of leather and gives motion to the whole machine. D, a lead weight which keeps F, the small drum steady to E,

the forcing wheel. G, the shaft of wood which gives motion to the wheel H, and continues it to I, four pairs of rollers, (the forms of which are drawn in the margin,) which act by tooth and pinion made of brass and steel nuts fixed in two iron plates, K. That part of the roller which the cotton runs through is covered with wood, the top roller with leather, and the bottom one fluted, which lets the cotton, &c., through it; by one pair of rollers moving quicker than the other draws it finer for twisting, which is performed by the spindles T. K, the two iron plates described above. L, four large bobbins with cotton rovings on, conducted between rollers at the back. M, the four threads carried to the bobbins and spindles by four small wires, fixed across the frame in the slip of wood V. N, iron levers with small lead weights hanging to the rollers by pulleys, which keep the rollers close to each other. O a cross piece of wood to which the levers are fixed. P, the bobbins and spindles. Q, flyers made of wood, with small wires on the sides which lead the thread to the bobbins. R, small worsted bands put about the whirl of the bobbins, the screwing of which tight or easy causes the bobbins to wind up the thread faster or slower. S, the four whirls of the spindles. T, the four spindles which run in iron plates. V, explained in letter M. W, a wooden frame of the whole machine.

There is no doubt that the above figure, as given in with the specification in 1769, is an exact portraiture of the model made at Warrington by the aid of Atherton's workmen, which was set up and tried in the schoolmaster's parlour at Preston; and it is sufficient to convince any competent judge of such matters, that the

author of the machine was a great master of the principles of mechanical combination, or, to borrow an expression from phrenology, that he was endowed in an eminent degree with the organ of constructiveness.

In December 1775, Mr. Arkwright obtained his second patent, which embraced the whole train of operations in a complete cotton-factory, admirably arranged in subordination to each other, but somewhat enigmatically described, in order, as the inventor afterwards said, to prevent such important discoveries as he was conscious of promulgating, from being pirated by foreigners. So few patents were sued for in those days, and the laws relating to them were so little understood by patentees, that a little mystification might be thought perfectly fair and patriotic to secure the invention to one's own countrymen. In this patent Arkwright was accused of having specified, as his own, the contrivances of others; but I conceive the charge has as little foundation as could be found in almost any other specification of complex machinery, were it canvassed with an equally censorious spirit as Arkwright's has been. This patent was for carding, drawing, and roving machines to be used "in preparing silk, cotton, flax, and wool for spinning." Had the inventor been under the guidance of a judicious patent-agent, he would have been able, with his own indisputable new combinations, to have framed a patent perfectly tenable, and exempt from reasonable challenge.

Sir Richard always acknowledged having received cylinder-cards from Northampton, of Paul's construction, where they had been used for carding sheep's wool in a manufactory of stuff hats. But they were very defective, and indeed essentially different from

the cards mounted at Cromford.* As for the drawing machine, a most important element of a spinning factory, it was entirely his own, and is clearly contained in his first patent, being his roller-series without the spindles and flyers. The roving apparatus as first invented by him, was nothing else but a modification of the first patent, in which he used larger drawing-rollers, and substituted for the bobbin a tall revolving tin can or cylinder into which the porous cord of cotton was laid in regular coils by centrifugal force and gravity combined.—*See* vol. ii. p. 59.

The specification of 1775 very properly affirms, therefore, that these new machines were constructed on easy and simple principles, very different from any that had ever yet been contrived.

Patentees are often injured by not defining strictly what they peculiarly claim; and by implicitly following the usual verbiage of specifications. Thus the phrases "first and sole inventor thereof," and that "the same had never been practised by any other person or persons whomsoever, to the best of his knowledge and belief," are regularly repeated in every specification, and must therefore be always liberally and candidly interpreted. Arkwright was unquestionably the first and sole inventor of the complete edifice in its improved state, though certain materials in general use and appropriated to no person in particular might be worked up in it.

One of the most elegant mechanisms in a cotton-factory is that of the crank and comb for stripping the thin fleece of cotton from the doffer cylinder of the carding engine. Several witnesses in the trial to re-

* See Vol. ii. pp. 29, 30.

duce Arkwright's second patent, swore that the above invention belonged to James Hargreaves, the author of the jenny. Even the widow and son of this ingenious man gave evidence to that effect, and the smith who made the crank and comb for Hargreaves confirmed it. Yet Mr. Baines, who had been so strongly biassed against Sir R. Arkwright, as to adopt, in his octavo History of Lancashire, Guest's apocryphal statement of Highs' counter-claims as a true narrative of factory invention, acknowledges that he has recently received decisive testimony in Arkwright's favour as to the crank and comb, from the son of Mr. James, the partner of Hargreaves.

"He (James Hargreaves) was not the inventor of the crank and comb. We had a pattern chalked out upon a table by one of the Lancashire men in the employ of Mr. Arkwright; and I went to a frame-smith of the name of Young, to have one made. Of this Mr. Arkwright was continually complaining, and it occasioned some angry feelings between the parties."*

Here is a confession from James, the very person who was the chief accessory to the piracy of Arkwright. From this specimen we may form a judgment of the rest of the evidence vamped up at the trial against Arkwright. If any one will candidly analyze his original model, he will see how natural it was for him to advance in the straight road of improvement to which the principles of his mechanism spontaneously led.

Arkwright had great reason to be disgusted with his Lancashire compatriots, when he found them flocking to him merely for the purpose of pilfering

* *History of the Cotton Manufacture,* by Edward Baines, jun. Esq. pp. 177, 178.

his plans, and communicating them to his piratical competitors, who, if left to their own resources, would never have made a single hank of good yarn. It was in this way that many of his most valuable contrivances, the fruits of much thought and exertion, were snatched up and spread abroad before he had time to mature them to his mind, and embody them in his second patent—so that he found his own ideas stolen and fraudulently turned against him by his adversaries in a court of justice.

The difficulties which Arkwright encountered in organizing his factory system, were much greater than is commonly imagined. In the first place, he had to train his work-people to a precision in assiduity altogether unknown before, against which their listless and restive habits rose in continual rebellion; in the second place, he had to form a body of accurate mechanics, very different from the rude hands which then satisfied the manufacturer; in the third, he had to seek a market for his yarns; and in the fourth, he had to resist competition in its most odious forms. From the concurrence of these circumstances, 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. One event has been adduced in evidence of the uncertainty of his condition, which ought to excite interest in his behalf. He parted from his wife in 1779, because she would not agree to join him in converting some landed property into money, for the sale of which her consent was required by law. The property was worth, it is said, little more than four hundred pounds. Mrs. Arkwright entertained a high esteem for her husband, and always

spoke of him with respect; yet she preferred separating from him, to the chance of being beggared by placing her dowry in so precarious a concern as she then thought the water-spinning frame to be. For some years after this event she lived altogether upon her own means. Mr. Arkwright was justly indignant at this want of sympathy in one so nearly related to him, and in consequence allowed her only thirty pounds a-year, out of his own pocket, even when he had realized great opulence. These particulars are given by Mr. Guest on the authority of Sir Richard Arkwright's niece, probably a disappointed and prejudiced person.*

The story has upon the whole an apocryphal air. There was certainly no scarcity of funds in 1779, to carry on the existing establishment at Cromford with the utmost vigour. Arkwright was, we own, a man of no common ambition. Perceiving at this period the means of placing money to prodigious advantage in other concerns which he projected, he might be mortified beyond measure at the want of spirit and confidence in his wife, and might have resented it as an insult to his understanding. Nor are we to suppose that his water-frame mechanism, though rude in aspect compared with the modern throstle, did not spin excellent twist. He, his son, and his partners, the Messrs. Strutt, with the machines of that time, turned off, by dint of superior tact and attention, warp and hosiery yarn as fine as 80's, or even 100's, which might bear a comparison with the firmest and most evenly water-twist of the present day. It is the glory of modern mechanics that their machines produce good yarn on automatic principles with hands

* *The British Cotton Manufactures*, by Richard Guest. 8vo. Manchester, 1828.

relatively unskilful, and with very little superintendence. A few old water-frames still exist, both at Cromford and Belper, which spin good hosiery and thread yarns of eighty hanks to the pound.

The malignity displayed against Arkwright by the cotton manufacturers of Lancashire, as soon as they recognised the superior quality of his yarn, and found they could not equal it by jenny-spinning, exceeds anything to be found in the history of commerce. They not only bribed away his best servants, but they fomented the evil passions of the mob into such a paroxysm of rage, as to cause a mill built by Arkwright, at Birkacre, near Chorley, to be burned, in the presence of a powerful body of police and military, without any of the civil authorities requiring their interference to prevent the outrage. But the most extraordinary piece of malevolence, which, if not well attested, would be incredible, was, the manufacturers of Lancashire combining not to buy his yarn, though it was acknowledged to be superior in quality to any in the market.

The following are extracts from the *Case* which Mr. Arkwright published soon after the first trial of his patent in 1781, when it was declared invalid, on the score of obscurity and defectiveness in the specification.

"Mr. Arkwright, after many years' intense and painful application, invented, about the year 1768, his present method of spinning cotton, but upon very different principles from any invention that had gone before it. He was himself a native of Lancashire; but having so recently witnessed the ungenerous treatment of poor Hargreaves, by the people of that country, he retired to Nottingham, and obtained a patent

in the year 1769, for making cotton, flax, and wool into yarn. But after some experience, finding that the common method of preparing the materials for spinning (which is essentially necessary to the perfection of good yarn) was very imperfect, tedious, and expensive, he turned his thoughts towards the construction of engines for that purpose; and in the pursuit spent several years of intense study and labour, and at last produced an invention for carding and preparing the materials, founded in some measure on the principles of his first machine. These inventions united, completed his great original plan. But his last machines being very complicated, and containing some things materially different in their construction, and some others materially different in their use from the inventions for which his first patent was obtained, he procured a patent for these also, in December 1775.

"No sooner were the merits of Mr. Arkwright's inventions fully understood, from the great increase of materials produced in a given time, and the superior quality of the goods manufactured; no sooner was it known that his assiduity and great mechanical abilities were rewarded with success, than the very men who had before treated him with contempt and derision, began to devise means to rob him of his inventions, and profit by his ingenuity. Every attempt that cunning could suggest for this purpose was made, by the seduction of his servants and workmen (whom he had with great labour taught the business). A knowledge of his machinery and inventions was fully gained. From that time many persons began to pilfer something from him; and then by adding something else

of their own, and by calling similar productions and machines by other names, they hope to screen themselves from punishment. So many of these artful and designing individuals had at length infringed on his patent right, that he found it necessary to prosecute several; but it was not without great difficulty, and considerable expense, that he was able to make any proof against them; conscious that their conduct was unjustifiable, their proceedings were conducted with the utmost caution and secrecy. Many of the persons employed by them were sworn to secrecy, and their buildings and workshops were locked up, or otherwise secured. This necessary proceeding of Mr. Arkwright occasioned, as in the case of poor Hargreaves, an association against him of the very persons whom he had served and obliged. Formidable, however, as it was, Mr. Arkwright persevered, trusting that he should obtain, in the event, that satisfaction which he appeared to be justly entitled to.

"A trial in Westminster Hall, in July last, at a large expense, was the consequence; when, solely by not describing so fully and accurately the nature of his last complex machines as was strictly by law required, a verdict was found against him. Had he been at all aware of the consequences of such omission, he certainly would have been more careful and circumspect in his description. It cannot be supposed that he meant a fraud on his country; it is on the contrary most evident that he was anxiously desirous of preserving to his native country the full benefit of his inventions. Yet he cannot but lament that the advantages resulting from his own exertions and abilities alone, should be wrested from him by those who

have no pretensions to merit; that they should be permitted to rob him of his inventions before the expiration of the reasonable period of fourteen years, merely because he has unfortunately omitted to point out all the minutiæ of his complicated machines." "In short, Mr. Arkwright has chosen a subject in manufactures (that of spinning), of all others the most general, the most interesting, and the most difficult. He has, after near twenty years' unparalleled diligence and application, by the force of natural genius, and an unbounded invention (excellences seldom united), brought to perfection machines on principles as new in theory, as they are regular and perfect in practice. He has induced men of property to engage with him to a large amount; from his important inventions united, he has produced better goods of their different kinds than ever were before produced in this country; and finally he has established a business that already employs upwards of 5,000 persons, and a capital, on the whole, of not less than £200,000,—a business of the utmost importance and benefit to this kingdom."

Mr. Arkwright's object at this time was to obtain from the Legislature an Act of Parliament to guarantee to him the patent right of which he had been deprived in a court of law; an object which he did not prosecute any further.

Let us now turn to another just ground of complaint stated in the *Case*.

"It was not till upwards of five years had elapsed after obtaining his first patent, and more than £12,000 had been expended in machinery and buildings, that any profit accrued to himself and partners." "The most excellent yarn and twist was produced; notwith-

standing which the proprietors found great difficulty to introduce it into public use. A very heavy and valuable stock, in consequence of these difficulties, lay upon their hands; inconveniences and disadvantages of no small consideration followed. Whatever were the motives which induced the rejection of it, they were thereby necessarily driven to attempt, by their own strength and ability, the manufacture of the yarn.* Their first trial was in weaving it into stockings, which succeeded; and they soon established the manufacture of calicoes, which promises to be one of the first manufactures in the kingdom. Another still more formidable difficulty arose; the orders for goods which they had received being considerable, were unexpectedly countermanded, the officers of excise refusing to let them pass at the usual duty of 3*d.* per yard, insisting upon the additional duty of 3*d.* per yard, as being (Indian) calicoes, though manufactured in England; besides these calicoes, when printed, were prohibited. By this unforeseen obstruction, a very considerable and very valuable stock of calicoes accumulated. An application to the commissioners of excise was attended with no success; the proprietors therefore had no resource but to ask relief of the Legislature, which, after much money expended, and against a strong opposition of the manufacturers in Lancashire, they obtained."†

Of this opposition it may be said, the force of envy and hatred could carry tradesmen no further than for the purpose of harassing a prosperous rival, to keep themselves and their trade in a most galling

* To work it up into cotton cloths and hosiery.

† *Case in Arkwright's Patent Trial*, p. 99.

and ruinous bondage under bad laws. Mr. Baines reprobates this malignant spirit with just severity: "The prohibition of English-made calicoes was so utterly without an object, that its being prayed for by the cotton manufacturers of this country is one of the most signal instances on record of the blinding effects of commercial jealousy. The Legislature did not yield to the despicable opposition offered to the reasonable demand of Mr. Arkwright and his partners (Messrs. Need and Strutt), but on the contrary, passed a law in 1774, sanctioning the new manufacture, and rendering English calicoes subject to a duty of only 3*d.* per square yard on being printed."*

We may now form some estimate of the formidable obstacles with which the Genius of factory industry had to contend during the greater part of his illustrious career, and of his transcendent merit in triumphing over them all. Nothing certainly could be more vexatious than to find the greatest channel to national wealth ever laid open by inventive enterprise, forthwith dammed up by the folly of fiscal legislation. Though zealous patriots had for more than a century been exclaiming against the ascendency of Indian cotton goods over our home-made linens and woollen stuffs, yet at length, when the means of rivalling them in quality and of outstripping them in cheapness are found, they cannot be exercised! and the inventors are to be ruined unless they possess sufficient wealth and influence to get the preposterous laws repealed!

Parliament was pleased in 1774 to recognize the propriety of permitting genuine cotton fabrics to be made, without intermixture of linen warp, and thus

* *History of the Cotton Manufacture*, p. 167.

removed one of the numerous shackles which their wise predecessors had placed upon industry. In tracing the history of the British cotton trade, a brief outline of this *Act for ascertaining the duty on printed, painted, stained, or dyed stuffs wholly made of cotton, and manufactured in Great Britain; and for allowing the use and wear thereof, under certain regulations,* deserves a place. Its preamble states, that "Whereas a new manufacture of stuffs, wholly made of raw cotton wool (chiefly imported from the British plantations), hath been lately set up within this kingdom, in which manufacture many hundreds of poor persons are employed; and whereas the use and wear of printed, &c., stuffs wholly made of cotton and manufactured in Great Britain, *ought to be allowed under proper regulations;* and whereas doubts have arisen whether the said new manufactured stuffs ought to be considered as calicoes, and as such, if printed, &c., liable to the inland or excise duties laid on calicoes when printed by the existing statutes, whether the use or wearing of the said new manufactured stuffs, when the same are printed, &c., are not prohibited by an Act passed 7 Geo. II., intituled, An Act to preserve and encourage the woollen and silk manufactures of this kingdom, and for more effectually employing the poor by prohibiting the use and wear of all printed, &c., calicoes in apparel, household stuff, furniture, or otherwise, after the 25th of December, 1722. For obviating all such doubts for the future, be it enacted, that no greater or higher duty than three-pence for every yard in length, reckoning yard wide, shall be imposed on the said manufactured stuffs wholly made of cotton spun in Great Britain when printed.

"And be it further enacted, that it shall be lawful for any person to wear any new manufactured stuffs wholly made of cotton when printed.

"And be it further enacted, that in each piece of the said calicoes, there shall be wove in the warp in both selvages through the whole length thereof three blue stripes, each stripe of one thread only; and that each piece when printed be stamped at each end by an excise officer with the words *British Manufactory.*'

Persons who sold such stuffs without the stamp were liable to a fine of £50 for each piece, besides its forfeiture; those who imported them were liable to £10 on each piece, besides the forfeiture; and whoever counterfeited the stamp, or sold goods so counterfeited, was punishable by death. This Act, which did not extend to cotton velvets, velverets, and fustians, is of itself a complete demonstration of Arkwright's peculiar merit, for it was framed solely to suit the new style of goods of which his water-twist warp was the characteristic constituent. Nobody can pretend that at this period, and for several years thereafter, any factory except those erected and superintended by Arkwright produced cotton yarn fit to form the warp of a good printing calico.

The field of enterprise in cotton spinning being now left free by the Legislature, Arkwright, who had been since 1771 organizing the several members of his factory system at Cromford, in co-operation with Mr. Strutt, brought forth, as we have said, the patent specification of it in 1775, but its constituent parts had been undergoing for the three preceding years daily experimental probation, exposed to invidious *espionage* and petty piracy, as exemplified in the crank and comb.

"Most of these improvements (relative to the carding engine) are to be ascribed to Arkwright, and he showed his usual talent and judgment in combination, by putting all the improvements together, and producing a complete machine, so admirably calculated for the purpose that it has not been improved upon till the present day."* I entirely concur in this sentiment. On the subject of the cards, which constitute the main novelty in Arkwright's patent of 1775 (for the drawing and roving principles are clearly developed in the first patent), the claims of Highs will appear not only futile but ludicrous to any one who will candidly consider the silly answers which he made upon the trial in 1785.

"*Q.* Have you actually ever made, or not, any of these carding engines?—*A.* I have made carding machines, but not with these individual things as this is; there are various forms.

Q. What did you do with them; did you sell any of them?—*A.* Yes, Sir, I sold them.

Q. How many did you?—*A.* I suppose four or five, but then I never made but one in this method; I tell nothing but the truth.

Q. You never made but one of that kind?—*A.* No, I did not.

Q. It did not answer?—*A.* It did not answer the end the gentleman wanted it for; *you know it is nothing to me. I had nothing to do but to work as I was ordered.*"†

* *History of the Cotton Manufacture,* by Edward Baines, jun. Esq. p. 179.

† *A Compendious History of the Cotton Manufacture,* by Richard Guest, p. 59.

How unlike are these statements to those of a practical man who had constructed a really operative machine? He makes only one card, even that not from his own invention, but as he was ordered—and, after all, it did not answer. Such were Highs' exploits in 1772 or 1773, when Mr. Arkwright was bringing beautiful hosiery twist into the market, in the preparation of which his improved cards, with a perpetual fleece taken off by the crank and comb, were employed. This continuity of the fleece also proves the priority of his claim in the feed-cloth to Wood and Pilkington, for though they used the same thing before the patent of 1775 was obtained, they might most easily have procured the plan from some of his stray workmen, or have obtained hints of what had been done at Cromford in 1772, and thus have stolen a march upon him. The claim made by them goes no further back than the year 1774. Mr. James, the living witness to the fact of the crank and comb being Arkwright's invention, before 1772, is worthy of all credit, since, according to Mr. Baines, at 83 years of age, he still enjoys a most retentive memory.* We may therefore receive, without any hesitation, the statement given in the *Case* that they were his own series of inventions which Arkwright "sold to numbers of adventurers residing in the different counties of Derby, Leicester, Nottingham, Worcester, Stafford, York, Hertford, and Lancaster; and that, upon a moderate computation, the money expended in consequence of

* Mr. Guest says, at p. 19 of his *Compendious History*, that Hargreaves invented the crank and comb in 1772; but as Mr. James declares that his partner Hargreaves pirated the invention from Arkwright, its invention, by the latter, must have been of an earlier date.

such grants (or patent licences) before 1782, amounted to at least £60,000. He and his partners also expended, in large buildings in Derbyshire and elsewhere, upwards of £30,000, and he himself erected a very large and extensive building in Manchester, at the expense of upwards of £4,000, forming altogether a business which already employed upwards of 5,000 persons, and a capital on the whole of less than £200,000."

Mr. Kennedy, in his instructive memoir on the Rise and Progress of the Cotton Trade, makes the following observations:—"During a period of ten or fifteen years after Mr. Arkwright's first mill was built (in 1771) at Cromford, all the principal works were erected on the falls of considerable rivers; no other power than water having then been found practically useful; there were a few exceptions, where Savary's and Newcomen's steam-engines were tried. But the principles of these machines being defective, and their construction bad, the expense in fuel was great, and the loss occasioned by frequent stoppages was ruinous."*

We cannot better conclude this investigation into the origin of the factory system than by the following judicious remarks of Mr. Bannatyne, author of the interesting article Cotton, in the *Encyclopædia Britannica*. "The originality and comprehensiveness of Sir Richard Arkwright's mind was perhaps marked by nothing more strongly than the judgment with which, although new to business, he conducted the great concerns his discoveries gave rise to, and the systematic order and arrangement which he introduced into every

* *Memoirs of the Manchester Literary and Philosophical Society*, vol. iii., 2d series.

department of his extensive works. His plans of management, which must have been entirely his own, as no establishment of a similar nature then existed, were universally adopted by others, and, after long experience, they have not yet in any material point been altered or improved."

In another work* I have said, " It required a man of a Napoleon nerve and ambition to subdue the refractory tempers of workpeople accustomed to irregular paroxysms of diligence, and to urge on his multifarious and intricate constructions in the face of prejudice, passion, and envy. Such was Arkwright, who, suffering nothing to stay or turn aside his progress, arrived gloriously at the goal, and has for ever affixed his name to a great era in the annals of mankind,—an era which has laid open unbounded prospects of wealth and comfort to the industrious, however much they may have been occasionally clouded by ignorance and folly. Prior to this period manufactures were everywhere feeble and fluctuating in their development, shooting forth luxuriantly for a season, and again withering almost to the roots, like annual plants.'

That Arkwright derived useful hints and aids from many quarters in his wonderful career, is undeniable, and that he most skilfully adapted the scattered fragments of ingenuity to his grand factory system, redounds much to his honour. He was, however, the original architect, as well as the master-builder of his new edifice. Like Columbus he meditated many years on the erratic excursions of his predecessors in the narrow seas of industry, and having convinced himself that a new world replete with wealth might

* *Philosophy of Manufactures*, p. 16.

be reached by a bolder navigation, he fearlessly embarked his life and fortunes in quest of it, with means little commensurate to the dangers, difficulties, and magnificence of the enterprise. Fortunately for the Englishman, he did not depend on the patronage of princes and courts, but with the co-operation of two or three spirited fellow-citizens he advanced with unfaltering energy towards his object, living in affluence, and dying in honour. The Genoese, after wasting many painful years as a needy supplicant to kings, obtained but a paltry equipment for his heroic expedition, and was rewarded at last by disgrace, poverty, and a prison. Richard Arkwright, on the other hand, within eighteen years of constructing his first model, had risen to such estimation in the great county of Derby, that he was elected to the dignity of High Sheriff, and soon thereafter received the honour of knighthood from King George III., no indifferent judge of mechanical merit. Although athletic in form and power, his corporeal frame never possessed firm health; during the greater part of his factory exertions he laboured under asthmatic ailments, and in the year 1792, the sixtieth of his life, he sunk under a complication of maladies.

The powerful men who have been raised up by Providence from time to time, to move the stagnant waters of civilization, such as Luther, Calvin, and Knox, have been regarded by their torpid compatriots as coarse and turbulent spirits, because they reprobated the unprofitable, frivolous, and corrupt practices prevalent in their day. In like manner the intrepid reformer of industry, Arkwright, has been accused of roughness, because, impatient of the slovenly habits of

workpeople, he urged on their labours with a precision and vigilance unknown before. But a gentler or more timid master would have been unequal to the task he took in hand; hence, even his failings on this account may be said to have leaned to virtue's side, and to have been of incalculable service to his country, and to mankind.

His career in manufactures may be compared not unappropriately to that of Newton in science. The English philosopher has never been reproached for making use of the prior researches of Copernicus, Kepler, and Galileo, but has obtained immortal renown by uniting and perfecting them into one great system of doctrine. His precursors had conceived that in all the bodies of the universe there exists a reciprocal attractive force; but their attempts to ascertain the law of the decrease of this force, by distance, were unavailing, from the defect of their powers of generalization. Descartes first conceived the bold idea of referring to a single cause the phenomena of both the heavens and the earth; but Newton had the honour of demonstrating its nature and effects. Attraction proportional directly to the mass, and inversely to the square of the distance, became in his hands the main spring of the universe. A body may be weighed at the surface of the earth, but were it transported to the surface of Jupiter, Saturn, or the Sun, what weight would it have then? Before the end of the 17th century this problem would have been regarded as incapable of solution, and its proposer would have passed for a fool.

It excited, therefore, no small astonishment when Newton solved it in a satisfactory manner. He discovered the proportion between the masses of the Sun,

Jupiter, and the Earth by combining the above law of attraction with one of Kepler's laws; and as the proportion which exists between the diameters of the orbit of Jupiter and the Earth was approximately known before his time, he found, by division, the ratios of the weights of the same body placed successively on the surfaces of these spheres. Descartes ascribed to the pressure of the moon the periodical oscillations daily displayed by the waters of the ocean, and Galileo referred them to the rotation of the earth, combined with its movement in the ecliptic; but these vague and random explanations were incapable of lifting up the veil which covered the phenomenon. Newton studied its causes with the aid of geometry, and showed how all the attendant circumstances proceeded spontaneously from his great principle of gravitation. When the moon passes the meridian the particles of the sea nearer this luminary than the centre of our globe, are more powerfully attracted than that centre, and hence rise and recede from the earth in obedience to that excess of attractive force exercised by the moon. The particles of the sea, situated in the corresponding point of the opposite hemisphere being less powerfully attracted by the moon than the centre of the earth, on account of their greater distance, will be attracted more feebly towards that luminary than the centre of the earth. Thus the particles of the ocean will rise from the earth at the two extremities of its diameter in the direction of the moon, constituting high water or the flux. Invidious cavillers might easily find, in writers before Newton's time, hints of both planetary attraction and of the lunar influence on the tides, but they would be laughed to scorn by

all judicious critics. In like manner automatic spinning by cards and rollers was attempted prior to Arkwright, but in a random, ill-digested, and unsystematic manner.

In the neighbourhood of Preston, during the juvenile years of Arkwright, there was a considerable manufacture of linen and cotton goods mixed, with the operations of which he had an opportunity of becoming intimately acquainted; and being a man of uncommon natural powers, he directed his thoughts to the improvement of the mode of spinning. The first hint respecting the means of effecting this improvement, he said, he accidentally received from seeing a red-hot iron bar elongated by being passed through iron rollers.* Between this operation and that of elongating a thread as now practised in spinning, there is no mechanical analogy; yet the hint being pursued, has produced an invention, which, in its consequences, has been a source of individual and national wealth, unparalleled in the annals of the world.

The difficulties which Mr. Arkwright experienced before he could bring his machine into use, even after its construction was sufficiently perfect to demonstrate its value, would, perhaps, have for ever retarded its competition, if his genius and application had been less ardent. His circumstances were by far too unfavourable to enable him to commence business upon his own account, and few were willing to risk the loss of capital in an untried establishment.

Soon after the erection of the mill at Cromford, he

* Samuel Crompton ascribed his first idea of roller-spinning to the same observation; and it is probable that Wyatt got his suggestion in the same way.

made many improvements in the mode of preparing the cotton for spinning, and invented a variety of ingenious machines for effecting this purpose in the most correct and expeditious manner; for all of which he obtained a patent in the year 1775; and thus completed a series of machinery so various and so complicated, yet so admirably combined, and well adapted to produce the intended effect, in its most perfect form, as to excite the admiration of every person capable of appreciating the difficulties of the undertaking.

That all this should have been accomplished by the single efforts of a man without education, without mechanical knowledge, or even mechanical experience, is most extraordinary; and is, perhaps, equal to any example existing, of the wonderful powers exhibited by the mind, when its efforts have been steadily directed to one object. Yet this was not the only employment of this eminent man. He was introducing into every department of the manufacture a system of industry, economy, order, and cleanliness, till then unknown in any great establishments where many people were employed together; but which he so effectually accomplished, that his example may be regarded as the pattern of almost all subsequent improvements. When it is considered, that during this entire period, he was afflicted with a grievous disorder (a violent asthma), which was always extremely oppressive, and sometimes threatened immediately to terminate his existence, his unceasing industry must excite astonishment. In speaking of his inventions, Arkwright expressed ideas of their importance, which to persons less acquainted with their merits appeared hyperbolical. They are all now more than realized.

Several years before his death, Sir Richard Arkwright gave up to the present Richard Arkwright, Esq., of Willersly Castle, his mill at Bakewell. Here the son displayed talents worthy at once of the father from whom he had sprung, and of the manufacturing establishment of Cromford, where he had been trained. I was informed by an indisputable authority,* that Mr. Arkwright then spun water-twist yarns of as high a count as 80*s*. of excellent quality, whereby he realized by his skill and assiduity in that factory alone no less than £20,000 per annum. This circumstance proves, beyond all controversy, the perfection to which cotton machinery had been brought by the hands of this distinguished family.

In the year 1754 Mr. Jedediah Strutt, then a farmer, being informed by his wife's brother, who was a hosier, and well acquainted with the stocking frame, of some unsuccessful attempts that had been made to manufacture ribbed stockings upon it, was induced to investigate the operations of that curious and complicated machine, in the hope of effecting what others had attempted in vain. Accordingly, after much time, labour, and expense, having succeeded, he obtained, in conjunction with his brother-in-law, a patent for the invention, and removed to Derby, where he established an extensive manufacture of ribbed stockings, which was successfully carried on by himself and partners for more than half a century. About the year 1771 Mr. Strutt entered into partnership with Sir R. Arkwright. In 1775 he began to erect the cotton works at Belper

* This circumstance was told me by George Benfield Strutt, Esq., of Bridge Hill, Belper, during my visit to his hospitable mansion, in August 1834.

and Millford, at each of which places he resided a considerable time; but as his health declined he retired to Derby, where he died in 1797, in the seventy-first year of his age. His three sons had conducted his great cotton spinning concerns for many years before his death with progressive enterprise and intelligence.

William, the eldest, had the honour of co-operating with Sir Richard Arkwright at the very commencement of his great factory career, and being a well educated and highly gifted mechanician, was able to appreciate the character of that extraordinary man. Had Arkwright's schemes been mere plagiarisms of other men's ideas, as some of his modern defamers would have us believe, they could not have escaped the discernment, but would infallibly have revolted the candid spirit, of Mr. Strutt. Yet no man estimated more highly than he did the inventive genius and excellent judgment of Sir Richard Arkwright, of which he afforded the best evidence in the account of the Cromford cotton works, which was drawn up by him for Mr. Brayley, and inserted in vol. iii. of this learned gentleman's *Beauties of England and Wales*—under the article 'Derbyshire.'

"The establishment of the mill at Cromford village," says Mr. Strutt, "proved a source of much legal contention; for the manufacturers of Lancashire, apprehensive of what has actually been the result, that it would supersede the use of the hand machines then employed, formed a strong combination to impede its success, and endeavoured to destroy the validity of the patent, by contesting the originality of the invention; and though in two instances they obtained a favourable verdict,

from particular circumstances, and lost it in a third, there cannot be a doubt that *every really essential* part of the machinery derived its structure from the powerful genius of Mr. Arkwright. A great quantity of the cotton spun by this machinery is used by hosiers, who find it more suitable to their purpose than any other they can procure."

Mr. Brayley has kindly put into my hands the original manuscript of the above narrative, in Mr. Strutt's handwriting.

We have already described the dangers which the factory system experienced in its infancy from ruffian violence. The year 1779 was remarkable for a general assault upon spinning machinery in several counties of England. Though there was no scarcity of employment at good wages, and though much pains had been taken to convince the populace that their condition would be improved by the increased facilities of manufacture,* yet a notion was artfully instilled into their minds, that the new machines would ere long entirely supersede manual labour. Under the influence of such illusions, a third and more formidable set of mobs assembled in Lancashire, which destroyed all the carding and spinning machinery moved by

* Particularly by Dorning Rasbotham, Esq., an enlightened magistrate near Bolton, who circulated a printed address among the weavers and hand spinners, explaining to them that every contrivance for cheapening production would increase the demand for their goods, and, consequently, the employment of their labourers. The upper orders also fermented these anti-factory outrages, from an apprehension that the multiplication of machinery would throw a number of idle hands upon the parish funds. When Arkwright made his working model at Warrington, probably not more than 30,000 persons were occupied with the manufacture of cotton; now there are many more than a million, and at equal average wages

water or horses, as also the hand jennies containing more than twenty spindles; the maximum prescribed by the demagogues. This riot was most active in the neighbourhood of Blackburn, then the focus of the cotton industry of the county. Jennies mounted with twenty spindles and under being reckoned laudable inventions were respected; but those of greater size were either cut down, Procrustes-wise, to the standard, or if refractory to the amputation, they were consigned to the flames. Mr. Peel, afterwards Sir Robert, the father of our illustrious statesman, had his machinery at Altham totally demolished, the fragments thrown into the river, and his person placed in imminent danger from a licentious mob. He consequently withdrew in disgust from the county, transferring the benefits of his capital, skill, and public spirit to Burton, in Staffordshire, on the banks of the Trent, where he established a cotton factory, and where he continued to reside for many years. Thus the populace, by violence, drew down conspicuous retribution on themselves; nor was it till a more gentle spirit prevailed that Mr. Peel, and other refugee capitalists, ventured to resume their enterprises among them.

The water-twist frame, as used by Sir R. Arkwright, at Cromford, and the Messrs. Strutt's at Belper, is represented in figure 19.

A is a bevel wheel fixed upon a horizontal axis, which extends through the whole length of the mill. This wheel turns a smaller one upon a vertical axis, B, which has a drum, C, at the lower end. Round this drum the strap, *a*, runs, which actuates directly all the spindles, and indirectly the whole machine. Another strap, *b*, runs to the right hand, to work another frame, not shown here. The axis B passes down through

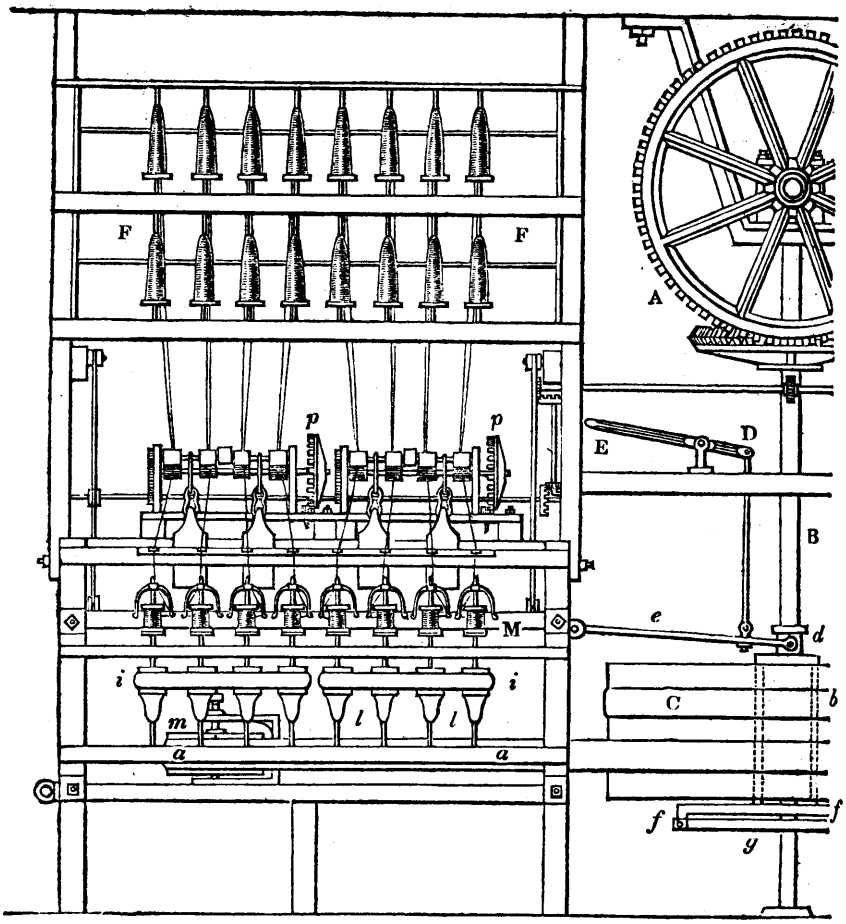

Fig. 19.—Water-Twist Frame, as used at Cromford and Belper.

the drum C, with a circular fitting, so that it slips freely round within it, without giving motion to the drum, till it be put in gear by two locking bolts, which are fixed into a socket piece, *d*, made to slide up and down the axis. It has a groove formed round it, in which a fork at the end of a lever, *e*, is received, so that the fork embraces the piece, *d*, in the groove, and when lifted, raises the two locking bolts with it. This lever is raised by the power of a second lever, D, E,

whose extremity, E, being depressed, raises the lever, *e*, and unlocks the drum from its vertical shaft, B, by withdrawing the locking bolts from their contact with an arm, *f*, of a wheel, *g*, fixed to the shaft below the drum, so as to turn with it; the locking bolts being let down, that their ends may project through the drum, and intercept the cross arm, *f*, of the wheel, the drum and all the machinery are set in motion.

The endless strap *a*, *a* passes the whole length of the frame, makes a turn round the pulley *m*, and comes back again. The pulley *m* is fitted in a frame, and by means of a screw can be strained to make the strap tight.

The bobbins of rovings are set loose on skewers in the creel of two shelves at F. The rovings pass then down to the drawing-rollers, which are turned by the contrate wheels *p*, *p*. The attenuated threads delivered by the front rollers are twisted by the rotation of the spindles and flyers, and wound by friction round the bobbins, which are made to traverse up and down for the distribution of the spun yarn upon their barrels, by the rise and fall of the copping-rail M. *i*, *i* shows a band or belt passing over the whorls of the spindles to drive them. Under *l*, *l* the lower conical ends of the spindles are seen supported in steps, lubricated with oil.

Arkwright's system of machinery was most advantageously applied to spin warp and hosiery yarns, of a hard and compact fabric, of any grist up to seventy or even eighty hanks in the pound; Hargreaves' to spin soft weft-yarn of somewhat inferior numbers, which answered well for filling the surface of calico cloth; and on these two independent plans the whole cotton

yarn used in the kingdom was spun for a good many years. The jenny was, however, eventually superseded by a very beautiful apparatus, invented by Samuel Crompton, of Bolton, to which, as being the offspring of the above two distinct machines, and as combining their respective features, the name of Mule, or Mule Jenny, was fancifully, but not inappropriately given. This curious complex combination was contrived by its humble author about the year 1776, but it was not so perfected and made public as to come into general use till about the year 1786. Indeed, had not Sir Richard Arkwright's patent of 1775 been abrogated, the mule, as embodying his system of drawing-rollers, must have remained in abeyance upon his monopoly. In the place of Arkwright's bobbins and flyers, Mr. Crompton used the spindle carriage of Hargreaves' jenny to receive, attenuate, twist, and wind on the threads, after their emergence from the drawing-rollers. The particular description of this admirable machine belongs, however, to a subsequent chapter of this work. The mule enabled the spinner to make a prodigious advance in the fineness as well as rapidity of his work; and it may be considered as the parent of the muslin manufacture, destined in a short time to render Europe the successful competitor of the hitherto unrivalled productions of Hindostan.

John Kennedy, Esq., one of the most scientific manufacturers of the kingdom, fortunately for Mr. Crompton's fame, has favoured the world with an account of his life and labours; a memoir which does equal honour to its author's head and heart. This interesting paper was read before the Literary and Philosophical Society of Manchester, February 20, 1830.

Samuel Crompton was born on the 3d December, 1753, at Firwood, in Lancashire, where his father held a farm of small extent; and, according to the custom of those days, employed a portion of his time in carding, spinning, and weaving. Hall-in-the-wood, a picturesque cottage near Bolton, became the residence of the family during the son's infancy, and the memorable scene of his juvenile inventions. His father died when he was very young. The care of his education devolved on his mother, a pious woman, who lived in a retired manner, and imparted her own sincere and contemplative turn of mind to her son. In all his dealings through life Samuel was strictly honest, patient, and humane.

When about sixteen years old, namely, about 1769, he learned to spin upon a jenny of Hargreaves' make, and occasionally wove what he had spun. Being dissatisfied with the quality of his yarn, he began to consider how it might be improved, and was thus naturally led to the construction of his novel spinning machine. He commenced this task when twenty-one years of age, and devoted five years to its execution. As he was not, properly speaking, a mechanic, and possessed only such simple tools as his little earnings at the jenny and the loom enabled him to procure, he proceeded but slowly with the construction of his mule, but still in a progressive manner highly creditable to his dexterity and perseverance.

He often said that what annoyed him most was that he was not allowed to employ his little invention by himself in his garret; for, as he got a better price for his yarns than his neighbours did, he was naturally supposed to have mounted some superior me-

chanism, and hence became an object of the prying curiosity of the country people for miles around; many of whom climbed up at the windows to see him at his work. He erected a screen in order to obstruct their view; but he continued to be so incommoded by crowds of visiters, that he resolved at last to get rid of the vexatious mystery by disclosing the whole contrivances before a number of gentlemen and others, who chose to subscribe a guinea a-piece for the inspection. In this way he collected about £50, and was hence enabled to construct another similar machine, upon a better and larger plan. The first contained no more than from thirty to forty spindles.

About the year 1802 Mr. Kennedy and Mr. Lee, of Manchester, set on foot a subscription for him, whereby they obtained £500; which formed a little capital for the increase of his small manufactory at Bolton. As a weaver, also, he displayed great ingenuity, and erected several looms for the fancy-work of that town. Being fond of music, he built himself an organ, with which he entertained his leisure hours in his cottage. Though his means were slender, he was such a master of domestic economy, as to be always in easy circumstances. In 1812 he made a survey of all the cotton districts in England, Scotland, and Ireland, and obtained an estimate of the number of spindles at work upon his mule principle—then amounting to between four and five millions, and in 1829 to about seven. On his return, he laid the result of his inquiries before his generous friends Messrs. Kennedy and Lee, with a suggestion that Parliament might possibly grant him some recompense for the national advantages derived from his invention. A memorial was accordingly

drawn up, in the furtherance of which the late George Duckworth, Esq., of Manchester, and the principal manufacturers in the kingdom, to whom his merits were made known, took a lively interest. He went to London himself with the memorial, and had the satisfaction to see a bill pass through parliament for a grant to him of £5000, without deduction for fees or charges.

This sum was advanced to his sons in order to carry on a bleaching concern, for the support of the family. But they mismanaged the business, lost the money, and became bankrupt, reducing their father and sister to poverty. Mr. Kennedy, with Messrs. Hicks and Rothwell, the eminent civil engineers of Bolton, and a few other gentlemen, raised, by a second subscription, a sum which purchased for Mr. Crompton a life annuity of £63. He enjoyed this benevolent pittance only two years, for he died on the 26th of January, 1827, leaving his daughter without any provision.

It would appear that the inventor of the mule had constructed, without having seen Arkwright's drawing rollers, the same kind of roller-beam as exists in his water-twist frame. "Indeed," says Mr. Kennedy, "we may infer that he had not, otherwise he would not have gone thus rudely to work; and indeed the small quantity of metal which he employed, proves that he could not have been acquainted with Mr. Arkwright's superior rollers and fixtures in iron, and their connexion by clock-work. Even the rollers were made of wood, and covered with a piece of sheep-skin, having an axis of iron with a little square end, on which the pulleys were fixed. Mr. Crompton's rollers were supported upon wooden cheeks or stands. He finally put dents of brass-reed

wire into his under rollers, and thus obtained a fluted roller. But 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 corner-stone of the merits of his invention."

A few machines only were made exactly on Crompton's plan. The first deviation was that of an ingenious mechanic, Henry Stones, of Storwich, near Bolton, who introduced Arkwright's metallic rollers, with clockwork, and a chain to convey motion to the rollers from the fly-wheel, as also some self-acting contrivance to stop the rollers from giving out more attenuated roving than was desired. Hargreaves' spinning-jenny had spread through a circuit of forty miles in extent, round Manchester, including Blackburn, Oldham, Ashton, and Stockport, so as to supersede the single spindle wheel of these districts; but after Crompton's mule became known, the jenny was rapidly laid aside. Up to the year 1783, there were not, in Mr. Kennedy's opinion, one thousand spindles in existence upon Crompton's construction. Soon after the opening up of Arkwright's patent, the preparation machines included in it became available to the trade, and gave mule spinning an extraordinary development.

Among the co-operative aids of this time was the billy, a combination of the jenny and the mule, con-

trived by a person at Stockport, to whom the jenny spinners gave a premium for his ingenuity.

Fig. 20 is a perspective view of the slubbing-billy in common use. A, A is the wooden frame, within which is the moveable carriage, D, D, which runs upon the lower side rails at *a*, *a*, on friction wheels, 1, 2, to make it glide more easily backwards and forwards from one end of the frame to the other. The carriage contains a number of steel spindles, marked 3, 3, which receive a rapid rotation from a long cylinder, F, by means of separate cords passing round the pulley or whorl of each spindle; the cylinder F is a long drum of tin plate, which extends across the whole breadth of the carriage. The spindles are placed in a frame, so as to stand nearly upright, at about four inches apart; their lower ends are pointed conically, they turn in brass sockets, called steps, and are retained in their position by a smaller collar of brass for each, which embraces the spindle about the middle of its length; the upper half of each spindle projects above the frame. The drum lies horizontally before the spindles, with its centre a little lower than the line of the whorls; the drum receives motion by a pulley at one end, with an endless band from a wheel E, made like the large domestic wheel formerly used in spinning wool by hand, and of similar dimensions. The wheel is placed on the outside of the main frame of the machine, having its axle supported by upright standards, erected from the carriage D; and it is turned by the spinner placed at Q, with his right hand applied to a winch (as plainly shown in the drawing). This gives motion to the drum, and thereby causes the spindles to revolve with great velocity.

Each spindle receives a soft slab or slubbing, which comes through beneath a wooden roller, C, C, at one end of the frame; this is the so much talked of *billy-roller;* the slabs thence proceed to the row of spindles standing in the carriage, so that they are extended in a nearly horizontal plane, advancing to, and receding from, the roller C, so as to extend any required length of slubbing in any degree.

The cardings of wool which are to be spun into slubbings are laid straight, side by side, upon an endless cloth, which is strained in a slanting position between two horizontal rollers, of which one, B, is shown in the figure. One card-end is allotted to each spindle, and the number of spindles may vary from fifty to one hundred in one machine. The roller C rests on the card-ends, which move with the cloth, and as it should press very gently, it is made of light wood; immediately in front of this roller there is a horizontal wooden rail, G, or long bar, with another beneath it, fitted to each other, across the frame. The card-end is conducted between these two rails, the upper or movable one being raised to let it through; when this bar is again let down it pinches the card-end fast, and hence this cloven mechanism is called the clasp; it is precisely what was originally used by Hargreaves in his cotton-jenny.

The upper or moveable rail G is guided between sliders, and a wire, 7, descends from it to a lever, 6. When the carriage D is wheeled close home to the end of the machine, a wheel, 5, lifts up the end 6 of the lever, and this, by the wire 7, raises the upper rail G, so as to open the clasp and release all the card-ends. In this state of things if the carriage be drawn back from the clasp-bar, it will necessarily pull the card-ends

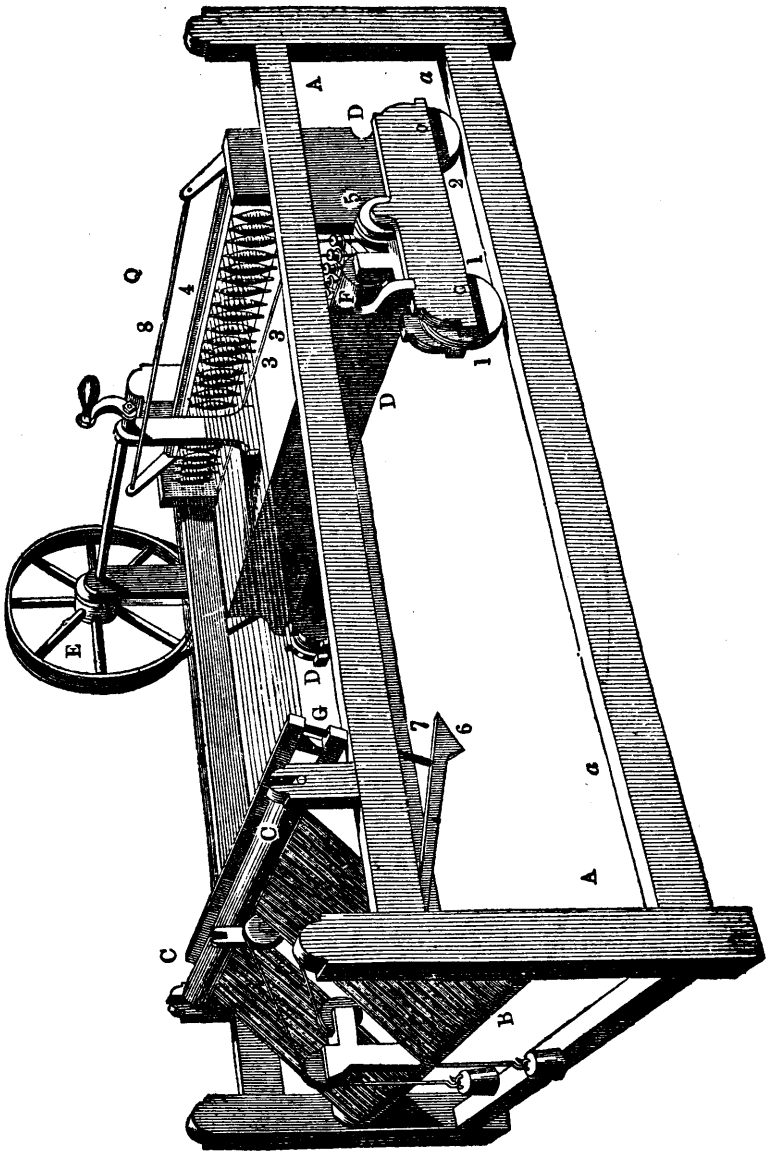

Fig 20.—Slubbing Billy.

forward on their inclined plane. There is a small catch which receives the upper bar, G, of the clasp, and keeps it from falling till the carriage has receded to a certain distance, and has drawn out about eight inches in length of the card-ends; a stop on the carriage then comes against the catch and withdraws it, so as to allow the upper rail to fall and pinch the card-end, while the carriage continues to recede, drawing out or stretching that portion of the roll which is between the clasp and the spindle. Meanwhile the wheel has been turned to keep the spindles in motion, and to give the proper twist to the card-ends in proportion as they are extended, in order to prevent them from breaking.

It might be supposed that the slubbing threads would be apt to coil round the spindles, but as they proceed in a somewhat slanting direction from the clasp, they merely receive a twisting motion, always slipping over the points of the spindles without being wound upon them. Whenever the slubber has given a due degree of twist to the rovings, he prepares to wind them upon the spindles in a conical shape, by pressing down with his left hand the faller-wire 8, so as to bear them away from the points of the spindles and place them opposite to their middle part. He now causes the spindles to revolve slowly, and at the same time pushes in the carriage, so as to wind the slubbing upon the spindles into a conical cop.

The wire 8 is made to regulate the winding-on of this whole row of slubbings at once, and is placed at the proper depression for this purpose, by its connexion with the horizontal rail 4, which turns on pivots at its ends in brasses fixed on the standards, which rise from

the carriage D; by turning this rail on its pivots the wire 8 is raised or lowered to any desired degree; the slubber, seizing the rail 4 with his left hand, thereby draws the carriage out, but, on its return, he depresses the faller-wire at the same time that he pushes the carriage before him.

As the card-ends are exceedingly tender, they would readily draw out or break by friction if dragged up the inclined plane. To save the necessity of this traction, a cord is applied round a groove in the middle part of the upper roller, and, after passing over proper pulleys, as shown in the figure, it has a weight suspended at the one end, and another, but smaller, at the other; the small weight serves merely to keep the rope stretched, but the large weight tends to turn the rollers with their endless cloth or apron round in such a direction as to bring forward the card-ends without putting any strain upon them. Every time that the carriage is pushed home, the large weight gets wound up by a piece of wood projecting from the carriage, and seizing a knot in the cord at the part which lies horizontally; this pushes the cord back a certain distance, so as to draw up the great weight, while the endless cloth cannot run backwards, by reason of a ratchet and click at the end of one of its rollers; the rope, therefore, slips round upon the roller. When the carriage retires, the greater weight turns the roller and advances the endless apron, so as to deliver the card-ends at the same rate as the carriage, by coming out, takes them up; but when the proper quantity is delivered, the knot in the rope arrives at a fixed stop, which does not permit it to move any farther, and at the same instant the oller 5 quits the lever 6, and

allows the upper rail, G, of the clasp to fall, and pinch the card-end fast; the wheel E being then put in motion makes the spindles revolve, and the carriage being drawn out extends the slubbings while under the influence of twisting. In winding-on of the slubbings, the operative must take care to push in the carriage and to turn the wheel round at such rates that the spindles will not take up faster than the carriage moves on its railway.

Thus the essence of Crompton's invention, which was the carriage, became of the greatest importance towards other constructions; as also (when modified in the billy) to the original machine itself, though not primarily intended for this purpose. The long tin-roller, as seen in the jenny and the billy, being difficult to make with the requisite truth of motion for the mule, was replaced by a series of upright drums mounted in the carriage.

The art of spinning with Crompton's machine soon became widely known among work people of all descriptions, from the higher wages which it procured above those of other artisans; such as shoe-makers, joiners, hatters, &c.; many of whom were thereby induced to change their employment, and to become mule spinners. Hence it happened, among this motley gang, that if any thing went amiss with their machine, each of them endeavoured to supply the deficiency with some expedient borrowed from his former trade; the smith introduced a piece of iron, the shoemaker had recourse to leather, and the hatter to felt; whereby valuable suggestions were obtained. The roving department was, however, for some time a distinct business in the hands of those who possessed Arkwright's

system of carding and roving machines, by whom the *roove* was sold to the hand-mule spinners.

Mr. Arkwright had commenced his operations at Nottingham, because he could there obtain tranquillity to work and a demand for his compact yarn in the stocking trade. The whole produce of his machines was for some time absorbed in hosiery. The yarn for this fabric requires to be particularly smooth and equal, in order to pass readily through the needles of the stocking frame. To ensure its possessing this quality in the highest degree, it is spun from two rovings in place of the one used for calico warp; and is hence called *double* spun twist. The introduction of the fine article by Messrs. Need and Strutt produced a vast improvement in the stocking manufacture; it superseded completely the hand spun yarn, and it produced stockings which supplanted the thread ones previously in vogue.

The oldest cotton mill in Manchester is that on Shude Hill, which was erected about the year 1780, by Messrs. Arkwright, Simpson, and Whitenburgh; being one of the numerous speculations into which the active author of the factory system entered. It was remarkable for its motive power, which was a hydraulic wheel furnished with water by a single-stroke atmospheric pumping steam-engine.

In his valuable paper on the rise and progress of the cotton trade, Mr. Kennedy justly remarks that the introduction of Watt's admirable steam-engine imparted new life to this business. Its inexhaustible power and uniform regularity of motion supplied what was most urgently wanted at the time; and the scientific principles and excellent workmanship dis-

played in its construction, led those who were interested in this trade to make many and great improvements in their machines and apparatus for bleaching, dyeing, and printing, as well as for spinning. Had it not been for this new accession of power and scientific mechanism, the cotton trade would have been stunted in its growth, and, compared with its present state, must have become an object of only minor importance in a national point of view.*

The first instance of the application of steam to cotton spinning was at Papplewick, in Nottinghamshire, where Boulton and Watt erected an engine in 1785, for the spirited proprietors Messrs. Robinson. In 1787, they erected one engine for Messrs. Puls, cotton spinners, at Warrington, and three others in Nottingham. Hitherto the hosiery trade gave the principal demand for power-spun cotton. It was not till 1789, that the calico trade of Manchester gave birth to a factory moved by steam, when Mr. Drinkwater mounted a handsome mill with one of Watt's engines. In 1790 Sir Richard Arkwright followed his example, in a mill erected at Nottingham. The same year a second engine, for cotton spinning, was fitted up in Manchester, for Mr. Simpson, and also at Papplewick for Messrs. Robinson. It ought to be mentioned that Sir Richard had tried steam power at an earlier period, but, out of an ill-judged economy, he had adopted Newcomen's machines, rendered rotatory by a heavy fly-wheel; but seeing his error, he replaced them by engines of Watt's construction.

The following detailed narrative of the successive im-

* *Memoirs of the Literary and Philosophical Society of Manchester* vol. iii., 2d series.

provements in mule-spinning, drawn up by one of its greatest masters, both in theory and practice, will be perused with much interest by all who love to trace the mighty streams of our factory wealth up to their fountain head:—(*See also Mule Spinning*, vol. ii. p. 148).

"The introduction of metal rollers and clockwork soon enabled the mule to be extended to a considerable length, up to 100 or 130 spindles, but this extension again was soon at its limit. The tin rollers, which were difficult to make, being ponderous and of great vibration, another contrivance was produced to obviate this inconvenience, viz. by placing vertical cylinders or drums in the carriage. The first attempt was made, as above stated, by Baker of Bury.

"Originally he placed upright pullies in the carriage with nicks to carry six or eight spindles, with the rim-band passing over a pulley upon the vertical shaft, so placed as to give motion to them; this was soon extended to a cylinder or drum as it is now called, (first made in wood, then in tin,) to embrace twenty-four to thirty spindles, the wharves being put on like the strings of a harp to embrace the whole breadth of the drum. By this means the carriage was soon extended to a much greater length, and the better construction of the rollers and their fixtures on the beam, facilitated the enlargement of the whole machine. The greatest improvement was the giving motion to the rollers by a diagonal shaft from the rim to the rollers, which dropped out of geer at the rim when the rollers were to stop. This was also a contrivance of Baker.* By this time, (1786,) there was

* "The bevelled geer was at this time made of wood, probably cut by his own pocket knife.

a great variety of methods for measuring the number of revolutions of the front rollers, in order to give out the required length before the stretching commenced.

"James Hargreaves of Toddington contrived the first method of bringing out the carriage, by a very ingenious invention. It consisted of a parallel scroll, with a small conical one attached to the same, for the band, connected with the carriage, to wind upon; the whole deriving its motion from the wheel axis. Of course there were many contrivances to effect the same purpose, such as a wheel with a pulley upon it, which was forced into a toothed wheel upon the front roller, with a band upon the pulley connected with the carriage, which produced a similar effect, and was disengaged when the rollers were stopped. This was continued for some time; the spinner completing the second draw by the hand and knee, which was more or less, according to the fineness he was spinning.

"The difficulty of obtaining rollers,* spindles, in short all the metal parts of these machines, and the preparing machinery for rovings, added to the want of experienced workmen of every kind, retarded the progress of the spinning trade much less than might be supposed. The fear of over-production then existed, and did exist afterwards from time to time, which caused a suspension of increase of means, and sometimes even a diminution of produce by the means that were in existence. This is the case with every infant trade or manufacture; an obstinate resistance to a reduction of prices existing, until some enterprising

* "Spindles were obtained from the manufacturers of wool-combs, and heckles for dressing flax, for the machines of both Hargreaves and Crompton.

spirit attempts to meet the market by some simplification, and better arrangement of the means of production, so as to enable the individual to offer the article produced at a lower price. This principle will hold in all our manufactures, and in such seasons of depression, the greatest improvements have always been made.

"It would be vain to enumerate all the little additions to Crompton's original machine; also, as they arose so much out of one another, it is impossible to give to every claimant what is exactly his due for improvements.* It is therefore only necessary to mention those who have well authenticated claims to the addition of parts of great importance to the machine. But the circumstance of the interval being very short, in making the machine tolerably correct, shews that many heads must have been at work. What led to the enlargement and the forming of the parts of the mule, with additional strength and accuracy, was the application of artificial power, which was first introduced in 1790, by Mr. Kelly, of Glasgow,† formerly of the Lanark Mills. The way in which Kelly applied this artificial power to the usual hand-mule, was simply by a loose pulley, to which a catch was attached, which could be made at pleasure to seize another catch fixed to the axis; on this axis was placed

* "The roving-making then became a distinct business, and in this state the cotton was sold to the little spinners. This was common till power was applied to the turning of the mule. Mills were then built of a suitable width, and in the course of a few years the hand-mule was entirely superseded.

† "Two years after this, he took a patent for a self-acting mule.—See his letter to me, January 8th, 1829, in the *Encyclopedia Britannica.*

a screw, which worked into a wheel, the number of whose teeth governed the number of revolutions of the rim, by disengaging the rope from the fast to the loose pulley. Immediately after the introduction of this power, Mr. Wright, an ingenious machine maker of Manchester, an apprentice and workman of Sir R. Arkwright's, constructed the double mule, embracing the advantages of Kelly's application of artificial power. The double mule was constructed by placing the rim in the middle of the frame or rollers. I believe he had four hundred spindles in this mule, and his experiment of its success was with a horse-gin or mill, so that Wright's double mule gradually superseded the use of the single mule; as, by his manner of placing them, the spinner could superintend and operate upon four times the quantity of spindles, compared with the former method.*

"A few years after this, Benjamin Butler, of Bolton, dispensed with the framing of the rim or wheel, extended the axis to the middle of the roller-beam, and connected it by geering with a little coupling shaft, which the front roller coupled each way. The shaft or axis of the rim was engaged and disengaged every stretch, to enable the rim to effect the necessary revolutions of the spindle to complete the thread. To put up the spun thread, he attached a small rim to the carriage about the middle of it, and brought the drum-band over it; thus the little rim was connected with that band which gave motion to the spindles, and had a handle upon it, by which the spinner could govern

* "The squaring band, though insignificant in itself, was of no little importance to the mule. It acts like a parallel rule in guiding out the carriage.

the spindles in the act of wrapping up the thread. This was called the fanny wheel or mule, but since that time various modifications of this kind have been constructed by successive artisans. About 1790, the muslin trade received a great stimulus at Stockport, from the efforts of the late Samuel Oldknow, whose spirit of enterprise extended this branch of our manufacture. He took new ground by copying some of the fabrics imported from India, which at that time supplied this kingdom with all the finer fabrics, and which the mule spun yarn alone could imitate.

"He was very successful in carrying on the ingenious processes which he had devised; but the French revolution creating a panic and general stagnation for a time, he abandoned this branch of the trade, and betook himself to his large water-mill at Mellor, which was built in the year 1790. On his retiring from the manufacturing of fine muslin, Messrs. Horrocks, who had just established themselves at Preston as mule spinners, took up what he had laid down. They became extensive manufacturers of cloth, similar to that made by Oldknow, and supplied the same market, London. This gave a new stimulus in that district, and immediately upon the subsiding of the panic caused by the French revolution, a market sprung up on the Continent for yarns of all kinds, but principally for muslin yarns, up to the highest numbers that could be produced. This gave a general stimulus all through the kingdom, and Watt's and Savary's steam-engine supplied power for the mule spinner, which was soon generally embraced instead of Kelly's application of water power, the use of which can only be local.

"The mule spinning now took the lead, and became

important and extensive. The profits being very considerable the increase was rapid. It was not until 1793 that any attempts were made in spinning fine yarns, say from 100 hanks upwards, by power, when I observed the process very carefully. The rollers, according to the fineness of the thread, would only admit of a certain velocity per minute, for instance, with 200^{ds} the rollers could only go at the rate of twenty-five or twenty-six per minute, and the spindle about 1,200. But when the rollers ceased to move, then the spindle was accelerated by the spinner to nearly double its former speed. In what manner the acceleration of the speed of the spindle might be effected by machinery without the aid of the spinner, was suggested to me, by observing in Mr. Watt's steam engine, that one revolution of the beam, (if I may use the expression,) acting upon the fly-wheel by means of the sun and planet wheel, produced a double velocity.

"The difficulty, however, of making the necessary apparatus at that time, induced me to use the more complicated method of four wheels of unequal sizes for producing the same effect. The description is as follows:—Two of the wheels were less and two larger; upon the rim-axis were placed one of the small and one of the large, and the two others were fixed in a frame which carried the axis upon which they were placed, and which had a shank or axis growing to it. This was placed in a vertical position, so that when the carriage was put up, an arm projecting from this vertical shank was connected by a wire with a catch which kept the lying shaft that turned the rollers in geer. In the elongating process the smaller wheel was in contact

with the larger wheel upon the rim, but when, by the disengagement of the catch, the rollers became still or stationary, at that moment the larger wheel, by means of a weight, came in contact with the lesser wheel upon the rim or axis, to which it communicated a double velocity. The shaft with its large and small wheels working alternately, had a pulley with a catch upon it, and was driven by the mill work, and was forced into a corresponding catch upon the said little shaft when the mule was to be set in motion by the steam power (the power in this instance was Savary's). There was a worm upon the rim axis with a wheel upon it, the number of whose teeth determined the revolutions of the rim, as described in Kelly's single speed.

"The second drawing, which had generally been performed by hand, had also to be performed by the machine itself. This had been done in a few instances before power had been applied. From the simplest of these methods I took the hint; by driving a shaft from the rim, by a strap from a small pulley upon the rim-axis, and a large one upon the little axis, which had a small pinion upon it; so that when the drawing-out wheel and band were disengaged from the front roller, they fell back into the little pinion, whose axis was revolving at a very slow speed, and consequently gave a much slower speed to the second stretch or draw, (as it was called,) the speed of which was more or less according to the numbers to be spun. Messrs. A. & G. Murray at that time (like myself and partners) were machine makers, and to a small extent were engaged in fine spinning by hand. They fitted up, on the principle described, a few pairs of hand mules, which they had previously made, wherein

they adopted these contrivances, for one of their customers in Derbyshire, who had artificial power.

" Mr. Drinkwater, of Manchester, was the most extensive fine spinner at the time of which I speak. He was one of the early water spinners, and in possession of the most perfect system of roving making. His large mill in Piccadilly was filled with mules of 144 spindles, each of which was worked by men's hands.

" Mr. Owen was then his manager, and they came to see the new machine in 1793. They approved of it, and thought it practical. Mr. Humphries, of Glasgow, who was a good mechanic, and succeeded Mr. Owen as manager, also approved of the scheme, and got instructions to apply this system of power to his fine work produced by the mules in Piccadilly mill; and, to make its advantages available, he coupled these 144 together, so that he saved one-half of the steam geering, and obtained a reduction in the price of spinning, the spinner having double the number of spindles to operate upon. Mr. H. made an improvement in the four wheels already described, by keeping them always in geer with a loose clutch between the two wheels on the rim shaft, which was alternately fastening the little driving wheel, and then relieving it and fastening the larger, which accelerated the speed of the rim, with a loose pulley as already described in my first. This prevailed for some years, when I thought that this might be simplified, which was done by adopting three pullies, namely one on the small wheel, and another on the larger wheel, with a loose pulley; and by removing the driving strap, which was on the loose pulley when the mule was at rest, to the pulley on the smaller wheel when the rollers were to work. Then the strap was removed to the pulley on

the larger wheel, which accelerated the rim and spindles until the thread was completed, and the strap being removed to the loose pulley, the whole machine came to rest, and the thread was put up by the spinner in the ordinary way. I was now able to construct the sun and planet wheel for the acceleration of the speed of the spindle, which was as follows:—the sun and planet wheel had only two wheels and one pulley, with a clutch that fastened the sun wheel, when the accelerated motion was required. Many other modifications were introduced, but the four wheels prevailed, some of which for convenience I constructed by making them bevils, and placing their axes vertically to get motion from an upright shaft, which produced the same effect as the spur wheels. This was suggested to me by Mr. Lee of Salford, and I made him a model of one in 1800.

"Having thus briefly explained the principal modifications of fine spinning by power; I have only to add, that they produced a great change in the value of the fine yarn, and, consequently, a great extension of its use. The Scotch in Lanarkshire and Renfrewshire, being long in the habit of weaving fine cambric from flax yarn and silk gauzes, had also turned their hands to the manufacture of fine cotton fabrics, principally from the fine yarns produced by Hargreaves's, and other subsequent machines. The Lancashire manufacturers followed them in the thicker and firmer fabrics."*

What a warning voice does the fate of Hargreaves

* A Brief Memoir of Samuel Crompton, by John Kennedy, Esq. Read before The Literary and Philosophical Society of Manchester, February 20th, 1830.

and Crompton send forth to inventors and improvers of the useful arts! how strongly does it justify the sound sense and self-respecting energy of Arkwright! Until man, the slave of selfishness, be regenerated by the spirit of Christian philanthropy, it is folly akin to fatuity for an industrious operative to surrender to the comparatively rich, without a fair equivalent, the fruits of his ingenious toils in hopes of requital from the world at large. How absurd such expectations are, we daily see exemplified in the scandalous effrontery with which avarice appropriates to its insatiable desires discoveries which its dark spirit could never have elicited, acting in defiance, not merely of honour and honesty, but of the most positive sanctions of law. What shabby tricks, nay, what infamous perjury does not almost every case of patent litigation display!

No contrivance was better entitled to the reward of an exclusive privilege for a certain number of years than the mule of Crompton. How many individuals, far his inferior in mechanical, moral, and intellectual merit, has it enriched! Had he received but 1*s.* per annum for each spindle worked on his elegant plan during fourteen years, a contribution which no honest manufacturer should have grudged, such an income would have been placed at the disposal of the worthy contriver, as, while it provided him with a dignified independence, would have done honour to his compatriots, and have encouraged genius in every coming age. It is, in fact, as much for the interest of society, to protect property in invention, as under any other form.

Some idea may be had of the pecuniary value of Crompton's machine, even in its rudest state, from the following facts:—Immediately on completing it, in

1775, he obtained 14*s.* per pound for the mere preparation and spinning of No. 40, whereas, in 1833, a pound of No. 40 mule-weft could be bought for 1*s.* altogether, of which the cotton wool cost 8*d.*, leaving only 4*d.* for spinning. The price now paid for spinning one pound of cotton into thirty-six hanks weft, and returning one pound of yarn, (there being one ounce and a half waste per pound,) is only *five pence!** A short time after the above date, Crompton was paid £1 5*s.* for spinning a pound of yarn, No. 60, and at the rate of £2 2*s.* a-pound for a small experimental quantity of No. 80; in 1786, 10*s.* a-pound were paid for the mere spinning, exclusive of the preparation, of No. 100, but in 1790 the price fell to less than 4*s.*; about 8*d.* per pound is now paid for the spinning and preparation of such yarn.

The first water-mill erected in Ireland for spinning cotton twist was built in the neighbourhood of Belfast. In the year 1771, at which time there was not a single cotton-loom in the whole north of Ireland, the late Robert Joy conceived the scheme of introducing into that then desponding kingdom the cotton manufacture, which has proved a source of industry and considerable opulence to the sister island. Having, in conjunction with Thomas M'Cabe, suggested that the spinning of cotton yarn might, as an introductory step to the establishment of the manufacture, be a fit and profitable employment for the children in the Belfast poor-house, several of them were set to work on the common wheel; but the novel machinery in England, giving that country so great a superiority, it was

* Mr. George Smith—Committee on Manufactures, p. 569.

found that no benefit could be gained without the introduction of it there. A spinning machine was therefore made in Belfast, under the direction of Mr. N. Grimshaw, cotton and linen printer from England, who had some time before settled in Ireland; and shortly after, an experienced spinner was brought over by Mr. Joy, from Scotland, to instruct the children in the poor house; also, under the same direction, and at the expense of the gentlemen mentioned, a carding machine was erected at Mr. Grimshaw's, to go by water, which was afterwards removed to the poor house, and wrought by hand. A firm was now formed of the original projectors and others, under the name of Joys, M'Cabe, and M'Cracken, who contracted with the same charitable institution for the employment of a number of its children, as well as for the use of its vacant rooms. They also dispatched a skilful mechanic to England, who, at personal risk and considerable expense, procured a minute knowledge of the improved machinery there, which the proprietors and inventors wished to have kept secret from the continent as well as Ireland. But so far from confining their hopes of gain to themselves, these gentlemen encouraged the public to avail itself of their improvements; they exposed the machinery to open view, permitted numbers even from distant parts to be taught in their apartments, without any charge for such indulgence, and promoted the progress of the manufacture of cottons, dimities, and Marseilles-quilting, equally by example and instruction. These exertions were in time followed on an enlarged scale by Messrs. Nathaniel Wilson and Nicholas Grimshaw; to the talents, property, and adventurous spirit of the former

of these gentlemen, and to the practical knowledge, genius, and industry of the latter, Ireland stands very highly indebted. The first mill for spinning twist by water there was built by them in the year 1784, from which year the Irish cotton manufactures were considered to be firmly established.

In the year 1800, only twenty-three years from the origin of the enterprise by Joy and M'Cabe, it appeared in evidence before Parliament that the cotton manufacture which they had thus introduced gave employment to 13,500 working people, and including all manner of persons, occupied in various ways, to 37,000, within a circuit of only ten miles, but comprehending within its bounds the towns of Belfast and Lisburn. In less than ten years from their first introduction into the country, several thousand looms were employed in the manfacture of cotton in the towns of Belfast, Lisburn, and Hillsborough; at present there are eight very large cotton mills in Belfast and its immediate vicinity, and seven others in different neighbouring towns; and, although it be difficult to estimate the number of hands engaged in these mills, it is calculated that those in and about Belfast, give employment to 30,000 individuals.*

At the period of the remarkable development of the cotton trade in 1787, it happened, unluckily for the British manufacturers, that the East India Company had a very great stock of piece goods in their warehouses, which caused a general depreciation of their value; the manufacturers became alarmed, and presented to the Committee of the Privy Council

* Hardy's Northern Tourist.

for Trade a memorial, charging the said Company with having augmented the quantity of their imports of cotton fabrics, and with lowering their prices, in order to ruin the home establishments, and destroy British industry in favour of their subjects in Hindostan and of their European commerce.

The accusation being transmitted by the Committee of the Privy Council to the Company, it received so complete an answer as to convince the Committee that if any restrictions were imposed on the Company's sales, their trade would be thrown into the hands of foreigners, and thereby give occasion to very extensive smuggling for home consumption. And, indeed, when we consider that these East India goods were always sold by public auction, it is evident that the demand must regulate the price, which is fixed by the buyers themselves, for the Company would always take the highest price they could obtain. Neither was the glut of goods which now overwhelmed the market, and pressed so hard upon the manufacturers of small capital, permanently hurtful to the cotton trade, but, on the contrary, of the greatest eventual advantage, for it caused a vast number of new channels of sale and consumption to be opened, thus diffusing a taste for those fine fabrics in the remotest villages of the kingdom, where they had been quite unknown before. Hence the way was paved for a widely extended demand for the productions of both the British and the Indian workshops, by which the regular sales were increased twenty-fold. Women of all ranks, from the highest to the lowest, began to be clothed in British cotton manufactures, from the muslin cap upon the crown of their head to the stocking under the sole of their foot.

The taste and skill of the calico printers kept pace with the ingenuity of the spinners and weavers, and produced patterns of coloured goods, exceeding in beauty and durability of wear every thing imported from the East.

On occasion of the abovementioned panic a pamphlet was published, to warn the country of its danger from the competition of the East Indies in the cotton trade. The author of this work seems as a partisan to have greatly exaggerated the extent of the business at the time, and must therefore be followed with many modifications. He states that about the year 1768 the whole cotton trade of Great Britain did not return £200,000 to the country for the raw material, combined with the labour of the people, and that before the introduction of the jenny and water twist-machines the production of the single-thread wheel could not exceed that of 50,000 spindles. Here he certainly underrates the extent of the manufacture, for at the period in question 4,000,000 lbs. of cotton wool were consumed per annum, and their value must have been more than doubled by labour, constituting a total value of at least £500,000.

In 1787 the number of cotton spinning-mills in England and Wales is rated by the pamphlet writer at 145, and their cost at £715,000, an amount much beyond the truth; for, though many mills were worth more than £5,600, yet that sum certainly far exceeded their average value. There were said to be at the same time 550 mule frames and 20,700 jennies, containing, together with the water-twist frames, 1,951,000 spindles, the cost of which, and of the auxiliary machinery, was

reckoned to have been at least £285,000, constituting a total value vested in spinning mills of £1,000,000 sterling.

These establishments, when in full activity, were estimated by him to be capable of producing as much cotton-yarn as 1,000,000 persons could spin when diligently employed at the domestic wheel; yet, instead of diminishing the occupations of the people, as had been apprehended, they gave vast numbers the means of a comfortable livelihood.

Spinning and its subsidiary labours gave employment, according to the same pamphleteer, to

26,000 men, 31,000 women, and 55,000 children;

Weaving, calico-printing, &c., gave employment to

133,000 men, 59,000 women, and 48,000 children:

making an aggregate of

159,000 men, 90,000 women, and 101,000 children;

or of 350,000 individuals altogether.

If we take one-half of the above numbers we shall be tolerably near the truth.

The cotton wool imported in the year 1787 amounted to 23,250,268 lbs., whereas in 1781 it was little more than 5,000,000. The cotton consumed in the manufactures of 1787 was of the following descriptions:—

British West India	estimated at	6,600,000 lbs.
French and Spanish Colonies		6,000,000
Dutch Colonies		1,700,000
Portuguese ditto		2,500,000
East India, *via* Ostend		100,000
Smyrna and Turkey		5,700,000
		22,600,000

The distribution of the raw material among the different manufactures was estimated to be as follows :—

Candle-wicks	1,500,000 lbs.
Hosiery	1,500,000
Silk and linen mixtures . . .	2,000,000
Fustians	6,000,000
Calicoes and muslins . . .	11,600,000
	22,600,000

The weight of the manufactured articles would be less by fully 10 per cent. from waste in the processes.

It is a curious fact that muslins were manufactured at Zurich and St. Gall, in Switzerland, long before they were made in this country; but, when our mule-jennies came into play, they soon enabled England to outstrip and crush all foreign competitors in that fine fabric. It has been computed that in the year 1787 not less than 500,000 pieces of muslin, with shawls and handkerchiefs, were produced in Great Britain.

Muslin weaving was attempted at Paisley so long ago as the year 1700, but it was soon suppressed, in consequence of the large importations of that article from India. The germ, after lying dormant for eighty years, rapidly expanded into a flourishing business, showing a singular aptitude in the people of that town for this elegant branch of the cotton trade.

CHAPTER II.

General View and Analysis of a Modern Cotton Factory.

THERE is no textile substance whose filaments are so susceptible of being spun into fine threads of uniform twist, strength, and diameter, as cotton wool. It derives this property from the smoothness, tenacity, flexibility, elasticity, peculiar length, and spiral form of the filaments; hence, when a few of them are pulled from a heap with the fingers and thumb, they lay hold of and draw out many others. Were they much longer they could not be so readily attenuated into a fine thread, and were they much shorter the thread would be deficient in cohesion. Even the differences in the lengths of the cotton staple are of advantage in adapting them to different styles of spinning and different textures of cloth.

If we take a tuft of cotton wool in the left hand, and, seizing the projecting fibres with the right, slowly draw them out, we shall perceive with what remarkable facility they glide past each other, and yet retain their mutual connexion, while they are extended and arranged in parallel lines, so as to form a little riband, susceptible of considerable elongation. This demonstration of the ductility, so to speak, of cotton wool, succeeds still better upon the carded fleece, in which the filaments have acquired a certain parallel-

ism; for in this case the tiny riband, in being drawn out by the fingers to a moderate length, may, at the same time, receive a gentle twist, to preserve its cohesion, till it becomes a fine thread.

Hence we may imagine the steps to be taken or the mechanical processes to be pursued in cotton-spinning. After freeing the wool of the plant from all foreign substances of a lighter or a heavier nature, the next thing is to arrange the filaments in lines as parallel as possible, then to extend them into regular ribands, to elongate these ribands by many successive draughts, doubling, quadrupling, or even octupling them meanwhile, so as to give them perfect equality of size, consistence, and texture, and at the same time to complete the parallelism of the fibres by undoing the natural convolutions they possess in the pod. When the rectilinear extension has been thus carried to the fineness required by the spinner, or to that compatible with the staple, a slight degree of torsion must accompany the further attenuation; which torsion may be either momentary, as in the tube roving machine, or permanent, as in the bobbin-and-fly frame. Finally, the now greatly attenuated soft thread called a *fine roving* is drawn out and twisted into finished cotton yarn, either by continuous indefinite gradations of drawing and twisting, as in the throstle, or by successive stretches and torsions of considerable lengths at a time, as in the mule.

Mechanical spinning consists in the suitable execution of these different processes by a series of different machines. After the carding operation, these are made to act simultaneously upon a multitude of ribands and spongy cords or threads by a multitude of

mechanical hands and fingers. However simple and natural the above described course of manufacture may appear to be, innumerable difficulties stood for ages in the way of its accomplishment, and so formidable were they as to render their entire removal of late years in the cotton factories of England one of the greatest and most honourable achievements of human genius.

The modern art of spinning cotton by machinery, which has long since supplanted that by the hand-wheel throughout civilized Europe and America, consists of the following operations:—

1. The *cleaning* and opening up or loosening the flocks of cotton wool, as imported in the bags, so as to separate at once the coarser and heavier impurities as well as those of a lighter and finer kind.

2. The *carding*, which is intended to disentangle every tuft or knot, to remove every remaining impurity which might have eluded the previous operation, and finally to prepare for arranging the fibres in parallel lines, by laying the cotton first in a fleecy web, and then in a riband form.

3. The *doubling* and *drawing out* of the card-ends or ribands, in order to complete the parallelism of the filaments, and to equalize their quality and texture.

4. The *roving* operation, whereby the *drawings* made in the preceding process are greatly attenuated, with no more twist than is indispensable to preserve the uniform continuity of the spongy cords; which twist either remains in them, or is taken out immediately after the attenuation.

5. The *fine roving* and *stretching* come next; the

former operation being effected by the fine bobbin-and-fly frame, the latter by the stretcher mule.

6. The *spinning* operation finishes the extension and twist of the yarn, and is done either in a continuous manner by the water twist and throstle, or discontinuously by the mule; in the former the yarn is progressively drawn, twisted, and wound upon the bobbins; in the latter it is drawn out and twisted in lengths of about 56 inches, which are then wound all at once upon the spindles.

7. The seventh operation is the *winding*, doubling, and singeing of the yarns, to fit them for the muslin, the stocking, or the bobbin-net lace manufacture.

8. The *packing-press*, for making up the yarn into bundles for the market, concludes this series.

9. To the above may be added the operations of the dressing-machines, and,

10. The power-looms.

The site of the factory ought to be carefully selected in reference to the health of the operatives, the cheapness of provisions, the facilities of transport for the raw materials, and the convenience of a market for the manufactured articles. An abundant supply of labour, as well as fuel and water for mechanical power, ought to be primary considerations in setting down a factory. It should therefore be placed, if possible, in a populous village, near a river or a canal, but in a situation free from marsh malaria, and with such a slope to the voider stream as may ensure the ready discharge of all liquid impurities. These circumstances happily conspire in the districts of Stockport, Hyde, Stayley Bridge, Duckenfield, Bury, Blackburn, &c., and have eminently favoured the rapid extension of the cotton manufactures for which these places are pre-eminent.

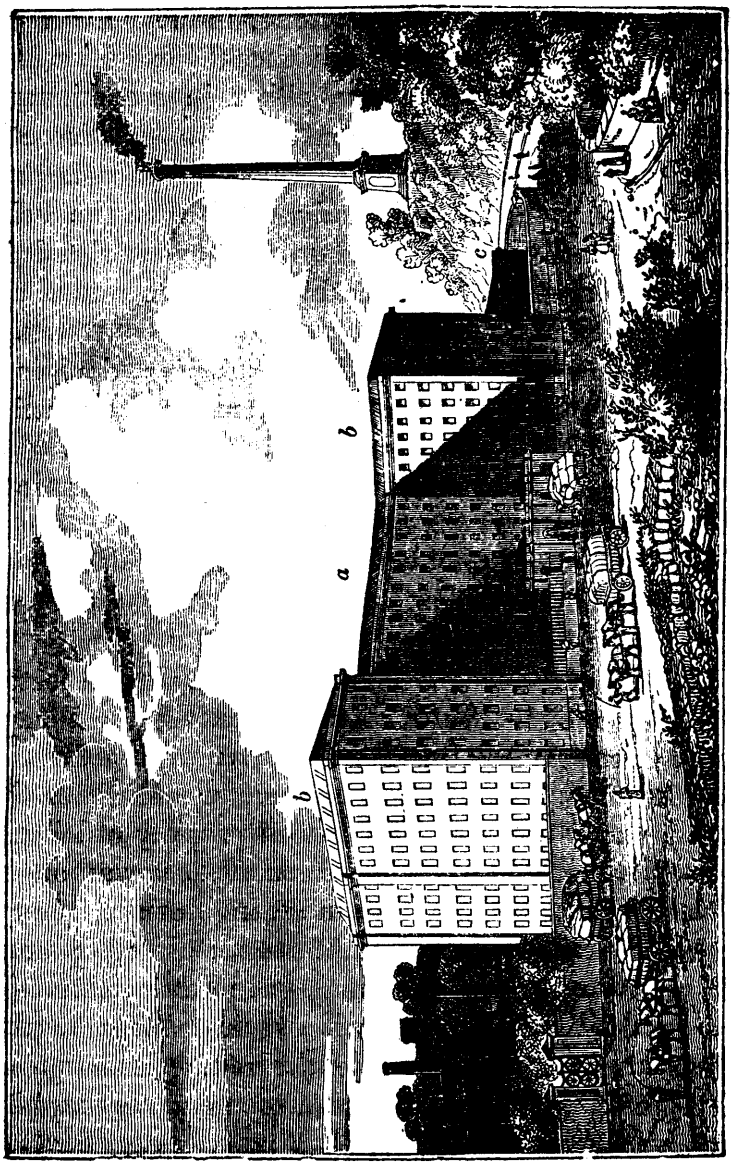

Fig 21.—Perspective View of a modern Cotton Factory. Mr. Orrell's Great Mill, near Stockport.

The situation chosen by Mr. Orrell for the factory represented in perspective in fig. 21 is particularly good. It stands about half a mile from Stockport, in a beautiful meadow, stretching along a branch of the Mersey, the grand river feeder of the cotton trade of England. At a little distance the ground rises in gentle eminences, and affords a convenient knoll for sustaining the great chimney stalk of the boiler flues, sufficiently distant from the spinning factory to free it entirely from smoke. The mill consists of a main body, *a*, with two lateral wings, *b*, *b*, projecting forwards, the latter being appropriated to store-rooms, a counting-house, rooms for winding the yarn on bobbins, and other miscellaneous purposes. The building has six floors, besides the attic story. The ground plan comprehends a plot of ground 280 feet long by 200 feet broad, exclusive of the boiler sheds, or the low building seen to the right hand in the perspective view.*

The right-hand end A, plate I†, of the principal building, is separated from the main body by a strong wall, and serves in the three lower stories for accommodating two ninety-horse steam-engines, which are supplied with steam from a range of boilers, as above said, contained in a low shed, *c*, fig. 15, exterior to the mill.

The three upper stories over the steam-engine gallery are used for unpacking, sorting, picking, cleaning, willowing, batting, and lapping the cotton wool. Here are the willow, the blowing, and the lap machines, in a descending order, so that the lap machine occupies the lowest of the three floors, being thus most judi-

* The artist has taken a little licence in the sketch, by giving it seven stories instead of six.

† See plate I, at the end of the volume.

ciously placed on the same level with the preparation-room of the building. On the fourth main floor of the factory there are, in the first place, a line of carding engines arranged, near, and parallel to, the windows, as shown at B, B, in the ground plan, plate I; and, in the second place, two rows of drawing frames, and two of bobbin-and-fly frames, in alternate lines, parallel to each other, as indicated by D, C, D, C, for the drawing frames, and E, E, E, E, for the bobbin-and-fly frames in the ground plan. The latter machines are close to the centre of the apartment.

The two stories next *under* the preparation-room are occupied with throstle frames, distributed as shown at F, F, in the ground plan. They stand in pairs alongside of each other, whereby two may be tended by one person. These principal rooms are 280 feet long, and nearly 50 feet wide. The two stories *over* the preparation-room, viz., the fifth and sixth floors from the ground, are appropriated to the mule jennies, which are placed in pairs fronting each other, so that each pair may be worked by one man. Their mode of distribution is shown at G, G, in the ground plan. The last single mule is seen standing against the end wall, with its head-stock projecting in the middle.

The ground floor of the main building, as well as the extensive shed abutted behind it, marked by N, H, H, in the plan, is devoted to the power-looms, the mode of placing which is plainly seen at H, H, H.

The attic story accommodates the warping mills, and the warp dressing machines subservient to power-weaving.

The winding machines, and some extra mules (self-

acters), are placed in the wings; the five winding machines being in the two top rooms of the left wing.

We shall briefly sum up the references in the ground plan as follows:—

A, the grand apartment for the steam-engines.

B, the distribution of the carding engines, the moving shaft or axis running in a straight line through them, with its pulleys for receiving the driving bands.

C, C, the drawing frames.

D, D, the jack, or coarse bobbin-and-fly frames.

E, E, the fine roving or bobbin-and-fly frames.

F, the arrangement of the throstle frames, standing in pairs athwart the gallery, in the second and third flats.

G, the mules are here represented by their roller beams, and the outlines of their head-stocks, as placed in the fifth and sixth stories.

H, the looms, with their driving-pulleys projecting from the ends of their main axes. Sometimes the looms are placed in parallel straight lines, with the rigger-pulleys of the one alternately projecting more than the other, to permit the free play of the driving-belts; sometimes the looms are placed, as generally in this engraving, alternately to the right and left, by a small space, when the pulleys may all project equally. The former plan is the one adopted in Mr. Orrell's mill.

I, represents the cast-iron girders which support the floors of this fire-proof building.

K, K, are closets placed in each floor, in the recesses of a kind of pilasters built against the outside of the edifice. These hollow shafts are joined at top by horizontal pipes, which all terminate in a chest con-

nected with the suction axes of a fan, whereby a constant draught of air circulates up the shafts, ventilates the apartments, and prevents the reflux of offensive effluvia from the water-closets, however careless the work-people may be. The tunnels towards the one end of the building are destined for the men—towards the other for the women.

L, L, are the staircases, of a horse-shoe form, the interior space or shaft in the middle being used for the teagle or hoist, as figured and described at page 47, *et. seq.*, of the "Philosophy of Manufactures." In the posterior part of the shaft a niche or groove is left for the counterweight to slide in, out of the way of the ascending and descending platform.

M, M, are the two porters' lodges, connected to the corner of each wing by a handsome iron balustrade. They are joined by an iron gate.

It will be observed that the back loom-shed has only one story, as shown in section plate 2.

In the ground plan of the shed,

N represents the roofing, of wood-work.

The rafters of the floors rest at their ends upon an iron plate, or shoe with edges (as it is called), for the girders to bear upon.

The two steam-engines, of fully ninety-horse power each, operate by cranks, which stand at right angles upon the shaft marked *a*, both in the plan and section plates 1 and 2. In the centre, between the bearings, is a large cog-wheel, driving a smaller one upon the shaft marked *b* in both plates, to which the fly-wheel *c* belongs. That prime motion wheel is magnificent, and possesses a strength equal to a strain of 300 horses. From this shaft motion is given to the main

or upright shaft *d* in the section by two bevel-wheels, visible at the side and on the top of the great block of stone, about five tons weight, plate 2, which gives a solid basis to the whole moving apparatus.

The velocity of the piston in these steam-engines is 240 feet per minute.

The first shaft makes 44·3 revolutions per minute.

The main upright shaft 58·84 ditto, ditto.

The steam-engines make 16 strokes per minute; and the length of their stroke is 7 feet 6 inches.

As the one engine exerts its maximum force when the other has no force at all, and as the one increases as the other diminishes in the course of each pair of strokes, the two thus co-operate in imparting an equable impulsion to the great geering and shafts, which, being truly made, highly polished, and placed in smooth bearings of hard brass, revolve most silently and without those vibrations which so regularly recurred in the older factories, and proved so detrimental to the accurate performance of delicate spinning-frames.

To the horizontal ramifications from the upright shaft any desired velocity of rotation may be given by duly proportioning the diameters of the bevelled wheels of communication between them: thus—if the wheel on the end of the horizontal shaft have one-half or one-third the diameter of the other, it will give it a double or a triple speed.

In the lowest floor the second bevel-wheel above the stone block drives the horizontal shaft *e*, seen in the ground plan; and thereby the horizontal shaft *f*, at right angles to the former, which runs throughout the length of the building, as the other did through its

breadth, backwards. The shaft *f* lies alongside of the back-window wall, near the ceiling; and from it the transverse slender shafts proceed to the right and left in the main building, and to the shed behind it, each of them serving to drive two lines of looms. These slender or branch shafts are mounted with pulleys, each of which drives four looms by four separate bands.

In the second and third floors, where the throstles are placed, the shaft *d* is seen in the section plate to drive the following shafts :—

Upon the main upright shaft, *d*, there are in each of these stories two horizontal bevel-wheels, with their faces fronting each other (shown plainly over *d, d*), by which are moved two smaller vertical bevel-wheels, on whose respective axes are two parallel shafts, one over each other, *g, g*, which traverse the whole length of the building. These two shafts move therefore with equal velocities, and in opposite directions. They run along the middle space of each apartment; and wherever they pass the rectangular line of two throstle frames (as shown at F in the ground plan) they are each provided with a pulley; while the steam-pulleys on the axes of two contiguous throstles in one line are placed as far apart as the two diameters of the said shaft-pulleys. An endless strap goes from the pulley of the uppermost horizontal shaft, *g*, round the steam or driving pulley of one throstle frame; then up over the pulley of the second or lower shaft, *g* ; next over the steam-pulley of a second throstle; and, lastly, up to the pulley of the top shaft, *g*.—See *g, g*, in the throstle floors of the cross section, plate 2.

In the preparation-room three horizontal shafts

are led pretty close to the ceiling, through the whole length of the building. The middle one, *h*, (see the plan, plate I.), is driven immediately by bevel-wheels from the main upright shaft, *d*, (plate 2.) The two side ones, *i*, *i*, which run near the window walls, are driven by two horizontal shafts, which lead to these side shafts. The latter are mounted with pulleys, in correspondence with the steam-pulleys of the two lines of carding-engines, as seen between the cards in the plan. The middle shaft, *h*, drives the two lines of bobbin-and-fly frames, E, E, E, E, (see cross section); and short shafts, *i*, *i*, seen in the cross section o this floor, moved from the middle shaft, *h*, turning in gallows fixed to the ceiling, over the drawing and jack frames, give motion to the latter two sets of machines. See C, D, in the cross section, plate 2.

To drive the mules in the uppermost story, a horizontal shaft, *k*, (see longitudinal and cross sections, as well as ground plan,) runs through the middle line of the building, and receives motion from bevel-wheels placed on the main upright shaft, *d*, immediately beneath the ceiling of the uppermost story. From that horizontal shaft *k*, at every second mule, a slender upright shaft, *l*, passing through both stories, is driven. (See both sections.) Upon these upright branch-shafts are pulleys in each story, one of which serves for two mules, standing back to back against each other. To the single mules at the ends of the rooms the motions are given by still slenderer upright shafts, which stand upon the head-stocks, and drive them by wheel-work, the steps (top bearings) of the shafts being fixed to brackets in the ceiling.

In the attic, a horizontal shaft, *m*, *m*, runs length-

wise near the middle of the roof, and is driven by wheel-work from the upright shaft: this shaft, *m*, gives motion to the warping-mills and dressing machines.

This cotton-mill having been recently erected, according to plans devised and executed by that very eminent engineer Mr. Fairbairn, of Manchester, may be justly reckoned a model of factory architecture. It was calculated for, and will be mounted with, eleven hundred power-looms, of which one hundred require steam-power equivalent to twenty-five horses to impel them, inclusive of the preparation and spinning operations competent to supply the looms with yarn. A third steam engine will be added.

Ten looms, with the requisite dressing, without spinning, are considered to be equivalent to one horse's power in a steam-engine.

Steam-power equivalent to one horse will drive

500 mule spindles,
300 self-actor spindles,
180 throstle spindles, of the common construction,

in which estimate the requisite preparation processes are included.

	Spindles.
In Mr. Orrell's mill there are 6,474 spindles in each of the throstle-frame floors,	12,948
And fourteen pairs of mules in each of the two mule floors—containing altogether	24,928
Nineteen self-actors in the wing—containing	7,984
Total yarn spindles	45,860

One of the most compact and best-regulated mo-

dern factories, on the small scale, which I visited in Lancashire, consisted of the following system of machines :—

One willow, one blowing machine, one lap machine, capable, together, of cleaning and lapping 9,000 pounds of cotton per week, if required.

Twenty-one cards, breakers, and finishers, which carded 5,000 pounds of cotton every week of 69 hours' work, being about 240 pounds per card.

3 drawing frames, of 3 heads each.
3 coarse bobbin-and-fly frames.
7 fine do. do. No stretcher mule.
12 self-actor mules, of Sharp and Roberts's construction, of 404 spindles each = 4,848 mule spindles.
10 throstle frames, of 236 spindles each = 2,360 spindles.
7 dressing machines.
236 power-looms.
2 warping-mills.
300 winding spindles for winding the warp.

The rovings have four hanks in the pound, and are spun into yarn No. 38, on the throstle, as well as the mule.

One bobbin of the roving (compressed) lasts five days on the self-actors, and six days on the throstles.

According to the estimate of Peile and Williams, of Manchester, 66 horses' power of a steam-engine are equivalent to 396 power-looms, including 16 dressing machines; the cloth being 36 inches wide upon the average; and the yarn varying in fineness from 12's to 40's, the mean being 26's. Here, the spinning and preparation not being included, the allowance of power

will appear to be high. The estimate given above assigns ten looms, with the requisite dressing, to one horse; but the latter assigns no more than six.

For the following experimental results, carefully made with an improved steam-engine *indicator*, upon the principle of Mr. Watt's construction, I am indebted to Mr. Bennet, an eminent engineer in Manchester. His mode of proceeding was to determine, first of all, the power exerted by the factory steam-engine when all the machines of the various floors were in action; then to detach, or throw out of geer, each system of machines, and to note the diminution of force now exercised. Finally, when all the machines were disengaged, he determined the power requisite to move the engine itself, as well as the great geering wheels and shafts of the factory.

He found at the factory of J. A. Beaver, Esq., in Manchester, that

500 calico-looms (without dressing) took the power of 33 horses, which assigns 15 looms to one horse power.

At Messrs. Birlie's factory, in Manchester, he found that

1,080 spindles in 3 self-actor mules took 2.59 horses, being 417 spindles for one horse power; that

3,960 spindles in 11 self-actors took 8.33 horses, being 475 spindles, per horse power;

1,080 spindles in 3 self-actors took 2 horses, being 540 spindles, per horse.

At Messrs. Clarke and Sons', in Manchester, that

585 looms for weaving fustians of various breadths took 54 horses' power, exclusive of dressing machines; being 11 looms to 1 horse.

At J. A. Beaver's, on another occasion, he found that

1,200 spindles, of Danforth's construction, took 21 horses, being 57 spindles per horse power; and that in a second trial the power of 22 horses was required for the same effect; being 54 Danforth spindles per horse power.

An excellent engine of Messrs. Bolton and Watt, being tried by the indicator, afforded the following results in a factory:—

A 60-horse boat-engine (made as for a steam-boat) took 14½ horses' power to drive the engine with the shafts . .	14.5
3½ blowing machines, with their three fans	21.55
10 dressing machines	10.25
12 self-actor mules, of 360 spindles each (720 spindles per horse power) . .	6.00
6 Danforth throstle frames, containing 570 spindles (96 in each), being 93 spindles to a horse power	6.20

At Bollington, in a worsted-mill, he found that

106½ spindles, including preparation, took one horse power upon throstles. N.B. There is no carding in the long wool or worsted manufacture for Merinos.

At Bradford, in Yorkshire, he found that

A 40-horse power boat-engine, of Bolton and Watt's, drove 598 calico-looms,

6 dressing machines (equivalent to dress warp for 180 of the said looms), and

1 mechanic's workshop, which took 2 horses' power.

Other engineers estimate 200 common throstle spindles, by themselves, to be equivalent to the power of one horse.

The shafts which drive the cards revolve about 120 times per minute, with a driving pulley of from 15 to 17 inches in diameter.

The shafts of the drawing, and the bobbin-and-fly frames, revolve from 160 to 200 times per minute, with pulleys from 18 to 24 inches in diameter.

The shafts of throstle frames in general turn at the rate of from 220 to 240 times per minute, with driving pulleys 18 inches in diameter, when they are spinning yarn of from No. 35's to 40's. The shafts of mules revolve about 130 times per minute, with pulleys 16 inches in diameter.

The shafts of power looms revolve from 110 to 120 times per minute, with pulleys 15 inches in diameter.

The shafts of dressing machines revolve 60 times per minute, with pulleys 14 inches in diameter.

Before quitting the generalities of the cotton manufacture I may state the following facts, communicated also by Mr. Bennet:—

A waggon-shaped boiler, well set, will evaporate 12 cubic feet of water with 1 cwt. of coals; and a steam-boiler with winding flues will evaporate 17 cubic feet with the same weight of fuel: $7\frac{2}{10}$ pounds of coals to the former boiler are equivalent to a horse's power exerted for an hour, estimating that a horse can raise 33,000 pounds 1 foot high in a minute.

The first cotton-mill upon the fire-proof plan was erected, I believe, by the Messrs. Strutt, at Belper, in the year 1797; that of Messrs. Phillips and Lee, at Manchester, in 1801; that of H. Houldsworth, Esq., of Glasgow, in 1802; and that of James Kennedy, at Manchester, in 1805; since which time all good factories have been built fire-proof, like Mr. Orrell's.

The heating of the apartments of cotton-factories is effected by a due distribution of cast-iron pipes, of about seven or eight inches diameter, which are usually suspended a little way below the ceilings, traverse the rooms in their whole length, and are filled with steam from boilers exterior to the building. It has been ascertained that one cubic foot of boiler will heat fully more than two thousand cubic feet of space in a cotton-mill, and maintain it at the temperature of about 75° Fahr. If we reckon twenty-five cubic feet contents of water in a waggon-shaped steam-boiler as equivalent to a horse's power, such a boiler would be capable of warming fifty thousand cubic feet of space; and therefore a ten-horse steam-boiler will be able to heat five hundred thousand cubic feet of air, from the average temperature, 50° of our climate, up to 75°, or perhaps even to 80°, Fahr.

It has been also ascertained that, in a well-built cotton-mill, one superficial foot of exterior surface of cast-iron steam-pipe will warm two hundred cubic feet of air. In common cases, for heating churches and public rooms, I believe that one-half of the above heating surface will be found adequate to produce a sufficiently genial temperature in the air. The temperature of the steam is supposed to be the same with that in Mr. Watt's low-pressure engines, only a few degrees above 212°,—the boiling point of water.

The pipes must be freely slung, and left at liberty to expand and contract under the changes of temperature, having one end at least connected with a flexible pipe of copper or wrought iron, of a swan-neck shape. Through this pipe the water of condensation is allowed to run off. The pipes should not

be laid in a horizontal direction, but have a sufficient slope to discharge the water. The pipes are cast from half an inch to three quarters thick in the metal. In practice the expansion of steam-pipes of cast iron may be taken at about one-tenth of an inch in a length of ten feet, when they are heated from a little above the freezing to the boiling point of water. The upper surface of a horizontal steam-pipe is apt to become hotter than the bottom, if the water be allowed to stagnate in it; the difference being occasionally so great, as to cause a pipe sixty feet long to be bent up two inches in the middle.

In arranging the steam-pipes provision ought to be made not only for the discharge of the water of condensation, as above stated, but for the ready escape of the air; otherwise the steam will not enter freely. Even after the pipes are filled with steam, a little of it should be allowed to escape at some extreme orifice, to prevent the re-accumulation of air discharged from the water of the steam-boiler. In consequence of water being left in the pipes serious accidents may happen; for, the next time the steam is admitted into them, the regularity of heating and expansion is impeded, some part of the pipe may crack, or a violent explosion may take place, and the joints may be racked to a very considerable distance, every way, from the place of rupture, by the alternate expansions and condensations. The pipes should therefore be laid, so as to have the least possible declivity, in the direction of the motion of the steam.

Formerly, when drying-rooms in calico print works were heated by iron stoves, or cockles, their inmates were very unhealthy, and became emaciated; since

they have been heated by steam-pipes the health of the people has become remarkably good, and their appearance frequently blooming.

The following analytical estimate exhibits the equipment and cost of two of the most recent and complete cotton factories in England.

1st. Mr. Orrell's mill, when mounted, as it will presently be, with 1,100 power-looms and a third steam-engine, will have cost £85,000. It will contain the following system of machines.

I. Cotton cleaning machines:

	Revolutions per minute.
1. Two of Lillie's great conical willows; speed of steam pulley	350
2. Five blowing or scutching machines	1,600
3. Five lapping machines	1,600

II. Preparation machines:

1. 168 carding engines	114
2. Twenty-four drawing frames.	
	Spindles.
3. Twenty-four coarse bobbin-and-fly frames, containing	1,152
4. Fifty fine bobbin-and-fly or jack frames	3,204

III. Spinning machines:

1. Seventy-eight throstle frames, containing 12,948 spindles, which are capable of producing 9,000lbs. of from 36's to 40's in a week of 69 hours, being at the rate of 25 hanks of 38's per spindle in that time.

	Spindles.		lbs.
2. Fifty-six hand mules, containing	24,928,	producing	18,000
Nineteen self-actors, ,,	7,984,	,,	7,000
	32,912		25,000

Total spindles, 45,860

3. The hand mules produce 26 hanks of 36's in 69 hours.
The self-actors produce 31½ ditto ditto.

4. Five winding machines of 1,200 spindles, which are placed in the two uppermost rooms of the left wing.
5. 1,100 power-looms, averaging each 5¾ pieces in 69 hours' work, with a speed of 120 picks per minute. In another factory, in Stockport, several of the same looms are working well at the rate of 130 picks per minute.
6. Thiry-two dressing machines.

For driving the whole of the above machines a power of 250 horses is required.

	s.	d.	
The price of warp-yarn 36's is	1	6½	per lb.
Ditto weft-yarn ,, ...	1	4	,,
The cotton-wool of the warp costs . . .	0	11	,,
Ditto of the weft costs	0	9¾	,,

The prices now received for yarn ready made up in packages for exportation are—

	s.	d.	
For 30's twist or warp	1	6½	per lb.
32's ,, ...	1	7	,,
36's ,, ...	1	8½	,,
38's ,, ...	1	9¼	,,
40's ,, ...	1	10	,,

There is a great difference in the wages paid to spinners, according to the size of the mule, as will be more fully explained in Book IV. The general and most approved number of spindles in mules for spinning yarns from 32's to 40's is from 400 to 500; and the price paid to the spinner is 3¼*d.* per 100 hanks.

The cost of the above machines, of the best construction, at Manchester, is at present:

	£.	s.
The conical willow	70	0
The blowing machine	70	0
The lap machine	70	0
Carding engine, unclothed	42	0
Clothing (furniture) of ditto	24	0
Drawing frame	37	10

	£.	s.	d.	
Bobbin-and-fly frame (coarse) . .	2	6	0	per spindle.
Ditto (fine) . . .	1	11	10	,,
Hand mule	0	4	9	,,
Self-actors, about	0	8	0	,,
Throstles	0	10	6	,,

The warp of a piece, thirty-six yards in length, of twenty-seven inch wide calico, for printing, made from 36's, will take about four pounds four ounces of yarn, and eight or nine ounces of flour for dressing it.

In a great fustian factory at Manchester, each girl weaves at the power-looms fifty pounds of cloth per week; in another factory of calicoes, nearly the same weight; in a third of finer goods, thirty-five pounds.

Mr. Fairbairn has very recently erected a spinning and weaving factory, upon the most improved plan, for Messrs. Bailey, of Stayley Bridge, of which the following is the estimated cost:—

	£.
Buildings for containing the machinery . . .	30,000
Engine-house, boiler-house, and gas-house . . .	3,000
Two steam-engines, of 110 horse power each, with mill geering	8,800
Steam pipes for heating the mill, and gas pipes with gas apparatus	2,400
40,000 mule spindles	11,500
Preparation machines, including cotton cleaning and opening	12,000
1,280 power-looms, with appurtenances	18,000
Contingencies	2,300
Total cost of the factory . . .	£88,000

Or, probably, £90,000.

An additional weaving shed is proposed, which will increase the looms to 1,480, and the outlay to £100,000. The power of these united steam-engines is conveyed

from the rim of the fly wheel, which is a new plan of geering mills,—one already tried by Mr. Fairbairn in another mill, and found to exceed his most sanguine expectations of steady impulsion. Thus the fly wheel becomes, in fact, the great spur wheel, so as to serve the double purpose of regulating the motion of the engines, and transmitting the power to the mill shafts.

List of PATENTS *for Improvements in Cotton-Spinning, &c., from January* 1800, *to March* 1836, *both inclusive.*

Name.	Date.	
Ward, J. S.	Dec. 30, 1800	Doubling
Wood, J.	June 14, 1803	Spinning and reeling
Johnson, Thomas . .	Feb. 28, 1803	Preparing; dressing cotton-ways
Wood, J.	Jan. 10, 1804	Spinning
Heppenstall, John . .	June 2, 1804	Spinning and twisting
Johnson, Thomas . .	June 2, 1804	Dressing
Huddart, Joseph . .	Sept. 21, 1804	Manufacturing and spinning
Margrave, Thomas . .	Dec. 19, 1804	Throwing; spinning; doubling and twisting
Dundonald, Earl of . .	Nov. 19, 1805	Spinning
Clark and Bugby . .	June 19, 1806	Ditto
Robertson, Matthew . .	Oct. 30, 1806	Combining machinery
Thomson, Archibald .	Feb. 20, 1807	Spinning
Ditto ditto . .	April 2, 1807	Ditto
Williams, Samuel . .	April 8, 1807	Ditto
Laybourn and Milbourn	Dec. 9, 1807	Roving
Bradbury, John Leigh .	Dec. 24, 1807	Spinning
Dumbell, John . . .	Aug. 25, 1808	Flax-spinning
Harkey, Musgrave and Farmery	Nov. 8, 1808	Roving; slubbing and spinning; twisting & doubling
Thomson, Archibald .	Feb. 7, 1809	Spinning
Stead, John	Feb. 9, 1809	Making cards for carding
Rutt, Tretton, and Webb	Nov. 21, 1809	Ditto
Varley, Richard . . .	July 7, 1810	Roving; spinning; doubling and twisting
Rutt, Tretton, and Webb	Oct. 8, 1810	Making cards
Cranfield, Thomas . .	May 7, 1811	Spinning and roving
Dyer, J. C.	Oct. 30, 1811	Cards
Dyer, Joseph C. . .	Nov. 1, 1813	Spinning hemp
Rayner, Joseph . . .	Jan. 1, 1813	Roving and spinning
Courtauld, George . .	Aug. 4, 1814	Spindle
Dyer, J. C.	Dec. 15, 1814	Cards
Wood, John	Feb. 4, 1815	Preparing and spinning
Palmer, William . .	April 4, 1815	Twisting
Wood and Wordsworth .	March 2, 1816	Spinning
Bradbury, John Leigh .	March 9, 1816	Ditto

Name.	Date.	
Welch, John . . .	Aug. 3, 1816	Making roll ers
Simpson, Wm. Henry .	July 10, 1817	Spinning
Hall, Samuel . . .	Nov. 3, 1817	Singeing
Whitham, George . .	April 8, 1818	Grinding & dressing spindles
Homfray, Thomas . .	May 28, 1818	Bobbins
Eaton, William . . .	June 18, 1818	Roving; spinning
Main, Joseph . . .	Jan. 15, 1820	Preparing; spinning
White, James . . .	July 11, 1820	Ditto
Chell, P.	Feb. 18, 1823	Drawing; roving; spinning
Crighton, Wm. . . .	Mar. 18, 1823	Carding cylinders
Hall, Samuel . . .	April 18, 1823	Singeing
Taylor, Joseph . . .	April 29, 1823	Spinning; doubling; throwing
Green, John . . .	June 26, 1823	Roving; spinning; twisting
Leach, Thomas . . .	Aug. 18, 1823	Spinning and doubling
Donkin, Bryan . . .	Sept. 11, 1823	Singeing
Gimson, T. F. . . .	Nov. 6, 1823	Twisting; doubling
Buchanan, Archibald .	Dec. 4, 1823	Carding
Boot, Jarvis . . .	Dec. 13, 1823	Singeing
Heathcoat, John . .	Mar. 20, 1824	Spinning
Bradbury, John Leigh .	July 3, 1824	Twisting; spinning; throwing
Jefferies & Drakeford .	July 29, 1824	Swift
Price, John	Aug. 5, 1824	Spinning
Chell, P.	Oct. 14, 1824	Drawing; roving; spinning
Bodmer, John George .	Oct. 14, 1824	Cleaning; carding; drawing; roving; spinning
Hirst, William . . .	Jan. 11, 1825	Slubbing; spinning
Andrew, Tarlton, and Shepley	Jan. 11, 1825	Throstle
Booth and Bailey . .	Jan. 13, 1825	Spinning; doubling; throwing
Badnall, Richard . .	Feb. 10, 1825	Winding; doubling; spinning
Roberts, Richard . .	Mar. 29, 1825	Spinning
De Jongh, Maurice . .	Mar. 29, 1825	Preparing; spinning
Smith, John Frederick .	June 21, 1825	Drawing; roving; spinning; doubling
Hirst, Wm. and Henry	July 16, 1825	Scribbling; carding
Hurst and Carter . .	July 16, 1825	Mules and billies
Dyer, J. C.	July 16, 1825	Winding
Brooke and Hardgrave .	July 26, 1825	Scribbling; carding
Kay, James	July 26, 1825	Spinning; preparing
Lamb and Suttill . .	Nov. 17, 1825	Preparing; drawing; roving; spinning
Edmonds, Ezekiel . .	Dec. 3, 1825	Scribbling; carding

Name.	Date.	
Dyer, J. C.	Dec. 9, 1825	Wire cards
Houldsworth, Henry .	Jan. 16, 1826	Roving
Smith, John Frederick .	Jan. 19, 1826	Drawing; roving; spinning
Goulding, John . . .	May 2, 1826	Carding; slubbing; roving; spinning
Molineux, Francis . .	May 23, 1826	Spinning; twisting; roving
Bayliffe, Edward . .	July 14, 1826	Drawing; roving; spinning
De Jongh, Maurice . .	Dec. 18, 1826	Roving; spinning; twisting
Heisch, Phiiip . . .	Feb. 20, 1827	Spinning
Whitaker, James . .	April 24, 1827	Carding; slubbing; spinning
Daniell, J. C. . . .	June 8, 1827	Wire cards
Dexter, Lambert . .	June 16, 1827	Spinning
Church, William . .	July 13, 1827	Ditto
De Jongh	Dec. 4, 1827	Ditto; doubling; twisting; roving
Ford, John	May 13, 1828	Carding; roving; spinning
Sharp, William . . .	Aug. 19, 1828	Spinning; roving
Rhodes, Joseph . . .	Sept. 18, 1828	Ditto; twisting
Lee, George William .	May 2, 1829	Spinning
Brooks, Charles . .	June 4, 1829	Ditto
Hutchison, John . .	July 30, 1829	Ditto
Lane, William . . .	Aug. 5, 1830	Roving frames
Molineux and Bundy .	Sept. 21, 1830	Roving; spinning; twisting
Sands, Thomas . . .	Nov. 18, 1830	Spinning
Needham, William . .	Dec. 13, 1830	Spinning; doubling; twisting
Wood, Charles . . .	Mar. 11, 1831	Ditto
Potter, John and James	Mar. 21, 1831	Ditto; twisting
Knowles, Thomas . .	May 23, 1831	Mules, self-acting
Lambert, Samuel . .	June 2, 1831	Throstle; spindles
Milne, John	July 13, 1831	Roving
Lang, James . . .	Sept. 24, 1831	Spreading; drawing; roving; spinning
Bates, Joshua . . .	Oct. 27, 1831	Roving; twisting; spinning
Selden, David . . .	Nov. 22, 1831	Carding; slubbing
Gore, Henry . . .	Dec. 22, 1831	Throstle; frames
Jellicorse, John . .	Jan. 28, 1832	Spinning
Shankland, Alex. Beattie	April 13, 1832	Ditto
Montgomery, Robert .	April 26, 1832	Ditto
Bolton, Hugh . . .	June 5, 1832	Carding
Wordsworth, Joshua .	July 26, 1832	Drawing; roving; spinning
Jones, James . . .	May 25, 1833	Roving; spinning; doubling
Newton, William . .	July 11, 1833	Roving
Howard, John . . .	Sept. 21, 1833	Ditto
Robertson, John . .	Sept. 21, 1833	Ditto; spinning
Travis, John, jun. . .	Nov. 1, 1833	Spinning

Name.	Date.	
Ewart, Peter . . .	Nov. 9, 1833	Mule-spinning
Dobson, Sutcliff, and Threlfall	Feb. 6, 1834	Roving; spinning
Smith, James . . .	Feb. 20, 1834	Preparing; spinning
Ditto	Feb. 27, 1834	Carding
Walton, James . . .	Mar. 27, 1834	Cards
Simpson, Richard . .	June 3, 1834	Roving; slubbing
Bridson, Thomas R. .	June 10, 1834	Drying cotton
Wilson, Charles . .	June 17, 1834	Spinning
Higgins, William . .	July 7, 1834	Roving
Wright, Peter . . .	July 17, 1834	Spinning; twisting
Slater, James . . .	Aug. 23, 1834	Bleaching
Sharp and Roberts . .	Oct. 8, 1834	Spinning and doubling
M'Gregor, Malcolm .	Oct. 20, 1834	Slubbing; roving; spinning
Jones, James . . .	Oct. 20, 1834	Roving; spinning; doubling
De Bergue, Charles . .	Nov. 15, 1834	Spinning; twisting
Fairbairn, Peter . .	Dec. 23, 1834	Preparing; slivering; roving
Whitworth, Joseph .	April 14, 1835	Spinning; doubling
Bodmer, John George .	May 27, 1835	Preparing; roving; spinning
Kean, James . . .	July 3, 1835	Throstle; flyer
Dyer and Smith . .	July 17, 1835	Winding
Faulker, Samuel . .	Aug. 6, 1835	Carding
Barber, Richard . .	Oct. 22, 1835	Reels
Horsfall and Kenyon .	Dec. 9, 1835	Carding
Houldsworth, John . .	Dec. 9, 1835	Drawing; slubbing
Hyde, John	Dec. 31, 1835	Carding
Champion	Jan. 6, 1836	Spinning; twisting; doubling
Ramsbottom . . .	Jan. 6, 1836	Roving; spinning; doubling
Ashworth & Greenough	Feb. 5, 1836	Preparing; spinning

NOTES.

Note A.—p. 9.

The commentaries of schoolmen upon the notices of natural history and the arts which occur in the classics, are often no less amusing from their ignorance than their dogmatism. Virgil has in particular suffered severely at their hands, notwithstanding their pretended reverence for his learning. He is universally allowed to be the most exact of ancient authors in describing the productions of nature, and in selecting epithets appropriate to their qualities; for he was a proficient in all the philosophy of his age. Addison says, "We receive more strong and lively ideas of things from his words than we could have done from the objects themselves." His language is so graphic as to lead another critic to say, "that he found out living words." Of all literary compositions, ancient or modern, his Georgics are reckoned to be the most highly finished, displaying a vividness of conception, a regularity of thought, a felicity of diction, an accuracy and extent of information, which could have resulted only from the deepest study, animated by the brightest genius. Virgil was peculiarly conversant with the appearances, properties, and geography of the animal and vegetable tribes. His description of the cotton plant in the couplet quoted in the text is no less picturesque than philosophical, including also two of its most remarkable localities,—Ethiopia, and the country of the Seres, or Bochyra. How strangely has the *learned* Warton travestied the original in the following doggrel rhyme: —

> "From Æthiop's woods, where *woolly leaves* increase,
> How Syrians comb the vegetable fleece!"

Woolly leaves, and the Syrians combing the woods of Ethiopia! What a pity he had not gone to school with Mrs. Malaprop and become acquainted with the *contagious* places. It was the Seres of whom Virgil speaks, an Indian people far enough from Syria, who were famous then, as they are now, for the growth and manufacture of cotton.

Martyn, in his learned edition of Virgil, Oxford, 1829, thus comments upon the line "Velleraque ut foliis depectant tenuia Seres."

"The Seres were a people of India who furnished the other parts of the world with silk; the ancients were generally ignorant of the manner in which it was spun by the silkworm, and imagined that it was a sort of down gathered from the trees."

There is no evidence that the Seres supplied the world with silk, though there is, that they supplied it with muslin robes. But who that ever saw a silk cocoon enclosed in its entangled net-work of floss, would think of *combing it* out, or would charge Virgil with the folly of applying the word *depectant* to it; whereas to the fleece of cotton-wool, waving tress-like from its opened pods, the term *depectant* is most appropriate. The phrase, *tenuia vellera*, or delicate fleece, also corresponds to the character of cotton-wool as known to the Romans, and as described by Pliny, but is quite inapplicable to the silkworms' coils. The poet and the naturalist probably derived their knowledge of cotton plants from the same source—ambassadors and other distinguished travellers who came to Rome from Eastern Asia.

Note B.—p. 189.

For the following important document I am indebted to James Cosmo Melville, Esq., the accomplished Secretary of the East India Company:—

Statement of the Quantity of Cotton Yarn imported from India in each Year from 1700 *to* 1760.

1700, 1701, 1702	The General Books for these years are missing.		lbs.
1703	114,100 lbs.	1731	20,496
1704	72,938	1732	46,405
1705	39,155	1733	70,976
1706	48,120	1734	5,924
1707	219,879	1735	91,394
1708, 1709, 1710, 1711, 1712	The General Books for these years do not particularize the goods imported; the Subsidiary Books, from which the information could be supplied, are missing.	1736	40,274
		1737	2,083
		1738	3,024
		1739	8,445
		1740	3,339
		1741	20,055
		1742	11,366
1713	135,546 lbs.	1743	9,904
1714	12,768	1744	14,593
1715	nil	1745	nil
1716	nil	1746	nil
1717	nil	1747	nil
1718	37,714	1748	nil
1719	nil	1749	nil
1720	21,350	1750	14,112
1721	50,624	1751	4,704
1722	10,800	1752	336
1723	24,025	1753	nil
1724	21,588	1754	nil
1725	5,809	1755	37,632
1726	54,300	1756	6,061
1727	27,254	1757	4,357
1728	11,424	1758	12,869
1729	18,816	1759	4,390
1730	32,351	1760	2,814

East India House, March 23, 1836.

The above Table shows that during the early part of the last century the cotton yarn imported from Hindostan bore a very considerable relation to the whole cotton wool imported into Great Britain. Thus in 1710 the total importation of cotton wool was 715,008 lbs. while in 1707 that of Indian yarn was 219,879 lbs, and in 1713, 135,546 lbs. The quantities of yarn imported by the Company seem to have suffered extraordinary vicis-

situdes ill accordant with the regular course of the home manufactures into which they entered. It is reasonable, therefore, to infer that there must have been in the intervals very large importations of these yarns through the contraband traders, who are known to have supplied the European markets, to a great extent, with the highly prized and then inimitable muslins and calicoes of the Eastern world.

Average Price of Cotton Yarn per lb., from 1700 *to* 1760, *as sold by the East India Company.*

	s.	d.		s.	d.
1700 to 1705	.	.	No particulars of these years can be given.		
1706	2	2¾			
1707	1	11¼			
1708 to 1728	.	.	Ditto, ditto.		
1729	1	10½			
1730	2	4¾			
1731	2	2½			
1732	2	3¾			
1733	2	2¼			
1734	2	4½			
1735	3	0			
1736	2	3¼		s.	d.
1737	3	5½	Some few bales sold at	8	1
1738	3	9¼	Ditto	8	8
1739	5	5½	Ditto	21	2
1740	.	.	None sold.		
1741	4	5½	Some few bales sold at	17	2
1742	5	6¼	Ditto	14	7
1743	7	2¼	Ditto	12	8
1744	4	7½	Ditto	8	1
1745	6	0½			
1746 to 1748	.	.	None sold.		
1749	4	11¾			
1750	3	5½			
1751	.	.	Ditto.		
1752	4	5½			
1753	6	8¼			
1754	.	.	Ditto.		
1755	3	10			
1756	4	0¼			
1757	2	9¾	Some few bales sold at	15	0
1758	2	11½	Ditto	15	0
1759	4	8	Ditto	14	0
1760	.	.	None sold.		

For the above Table I am also indebted to the courtesy of James C. Melville, Esq. The duty, as would appear from the following letter of J. D. Hume, Esq., Secretary of the Board of Trade, was about 4½*d.* per lb.

15, *Russell Square*, April 3, 1836.

DEAR SIR,—I have looked back to some old Custom-house books, and see that in 1757 the duties on cotton yarn were,—East Indian, the pound 4½*d.* and a very small fraction, and all other yarn a fraction under 3*d.* the pound. The fractions arose from the gross duty being formed of various rates, and also various per-centages, additions upon some of these rates,—so that scarcely any gross duty on any article conformed to our coinage.

As the duty above given is quoted from a book published in 1757, I cannot say how long it had stood at that amount; and considering that, previous to Mr. Pitt's first consolidation in 1787, the sums payable were always composed of numerous duties, added from time to time to some ancient first duty, it would be hardly possible at this day to trace them back so as to find how they stood at still earlier periods. *I should have thought that the East India House must have had records of their imports and payments, so as to have cleared up the question by reference to actual transactions.* I am, dear sir,

Yours very truly,

Dr. URE. J. D. HUME.

APPENDIX.

EXPORTATIONS OF COTTON MANUFACTURES AND COTTON TWIST, FROM THE UNITED KINGDOM.

COUNTRIES.	1827.					1828.				
	Entered by the Yard.		Hosiery, Lace, and Small Wares. Declared Value.	Cotton Twist and Yarn.		Entered by the Yard.		Hosiery, Lace, and Small Wares. Declared Value.	Cotton Twist and Yarn.	
	Quantities.	Declared Value.		Quantities.	Declared Value.	Quantities.	Declared Value.		Quantities.	Declared Value.
	Yards.	£.	£.	lbs.	£.	Yards.	£.	£.	lbs.	£.
Russia	4,258,508	155,932	23,704	12,070,675	933,204	2,502,267	93,454	24,210	14,882,644	958,242
Sweden	65,569	2,620	820	250,290	18,365	21,864	1,060	310	321,294	20,449
Norway	214,400	8,386	1,200	9,294	599	364,505	14,546	1,799	14,865	847
Denmark	270,338	8,288	505	265,824	19,064	248,416	7,686	351	164,207	10,945
Prussia	20,543	1,006	626	55,779	4,888	9,100	357	175	48,360	4,055
Germany	43,675,688	1,539,826	205,495	17,028,354	1,351,508	39,501,640	1,325,828	277,455	17,233,115	1,250,791
Holland, Belgium	13,734,445	550,587	281,347	6,295,493	580,937	13,277,621	506,518	275,406	7,056,293	621,933
France	365,100	16,055	7,906	15,722	1,580	79,196	5,945	13,433	32,116	3,680
Portugal, Proper	25,472,135	733,546	16,874	193,456	16,253	18,309,401	485,392	10,597	130,007	10,659
,, Azores	385,583	11,604	185	. .	. .	424,980	12,073	247	1,424	80
,, Madeira	388,942	12,542	589	13	2	386,253	12,398	1,212		
Spain and the Balearic Islands	340,516	14,546	1,246	21,365	1,591	327,662	13,138	2,548	5,907	616
,, Canaries	638,571	25,297	758	1,048	108	685,764	22,188	711	1,632	81
Gibraltar	17,202,891	593,131	19,233	105,262	8,866	18,507,940	638,965	22,038	53,832	5,229
Italy and the Italian Islands	28,113,538	905,330	27,641	4,457,476	267,920	32,822,686	993,652	36,488	5,153,295	263,554
Malta	3,275,227	100,297	1,344	250,794	13,267	4,466,526	128,190	2,021	417,964	22,126
Ionian Islands	105,894	3,757	167	11,952	990	106,855	3,731	202	21,320	1,517
Turkey and Continental Greece (exclusive of the Morea) Morea & Greek Islands	11,560,172	364,108	570	647,094	39,694	4,719,481	129,381	832	156,860	10,834
Egypt (Ports on the Mediteranean)	1,966,654	48,715	50	. .	. .	959,580	23,668			

Tripoli, Barbary, and Morocco	183,395	4,666	. .	1,500	70	406,712	10,327			
Western Coast of Africa	1,026,584	41,870	208	50	19	1,536,861	57,376	189	50	5
Cape of Good Hope	1,748,556	60,838	7,105	2,182	289	2,353,346	74,929	4,780	3,716	375
Cape Verd Islands	. .	. .	. .	. .	. .	74,318	2,046	50		
St. Helena	44,932	1,824	157	112	12	42,412	1,594	130		
Isle of Bourbon	. .	. .	. .	. .	. .	1,000	40			
Mauritius	1,696,516	67,435	5,482	. .	. .	1,477,886	57,253	5,337		
East India Company's Territories & Ceylon	36,167,952	1,355,153	40,993	3,063,556	273,990	37,566,836	1,394,681	48,344	4,549,219	390,344
China	1,581,353	66,345	935	300	25					
Sumatra and Java	2,342,207	87,987	1,697	. .	. .	4,680,371	153,238	1,138	37,836	2,790
Philippine Islands	887,244	36,902	2,791							
New South Wales, Van Diemen's Land, and Swan River	1,105,957	41,309	4,900	3,813	370	1,242,285	43,548	8,190	5,704	445
New Zealand and South Sea Islands	. .	. .	. .	. .	. .	3,672	158			
Ports of Siam	. .	. .	. .	. .	. .	. .	. .	. .	.	. .
British North American Colonies	6,616,812	224,467	13,875	35,568	2,200	9,202,255	304,328	18,679	66,520	3,518
British West Indies	26,730,096	888,661	51,202	7,680	744	21,096,050	689,291	41,038	5,327	521
Hayti	4,288,244	145,085	2,763	. .	. .	5,009,333	167,731	1,437		
Cuba and other Foreign West Indies	9,779,788	360,300	14,801	. .	. .	8,004,786	292,214	11,717	370	180
United States of America	52,856,809	2,257,955	269,075	8,914	1,547	36,200,427	1,612,466	185,021	100,285	6,515
Mexico	13,687,021	507,336	28,235	9,460	1,068	5,331,635	227,514	9,210	150	41
Guatemala	9,174	400	150	. .	. .	109,083	4,199	340	4,000	200
Columbia	3,987,030	139,322	6,472	110	40	5,081,948	163,663	10,496		
Brazil	37,195,322	1,119,344	39,600	8,961	2,145	63,098,012	1,967,643	62,386	13,340	2,072
States of the Rio de la Plata	2,076,897	69,527	6,159	25,208	761	4,903,450	160,576	12,574		
Chili	5,825,700	203,722	27,349	13,846	1,509	13,206,412	461,680	29,483	14,652	1,560
Peru	2,917,056	114,866	14,977	14,040	1,501	4,129,112	166,808	29,810	5,160	606
Isles of Guernsey, Jersey, Alderney, & Man	683,445	57,148	15,366	3,583	459	848,492	51,776	20,379	4,287	601
Total	365,492,804	12,948,035	1,144,552	44,878,774	3,545,578	363,328,431	12,483,249	1,165,763	50,505,751	3,595,405

EXPORTATIONS OF COTTON MANUFACTURES AND COTTON TWIST (*continued*).

COUNTRIES.	1829.					1830.				
	Entered by the Yard.		Hosiery, Lace, and Small Wares.	Cotton Twist and Yarn.		Entered by the Yard.		Hosiery, Lace, and Small Wares.	Cotton Twist and Yarn.	
	Quantities.	Declared Value.	Declared Value.	Quantities.	Declared Value.	Quantities.	Declared Value.	Declared Value.	Quantities.	Declared Value.
	Yards.	£.	£.	lbs.	£.	Yards.	£.	£.	lbs.	£.
Russia	2,453,676	94,872	23,146	17,921,369	1,062,225	4,194,962	142,463	13,512	18,555,753	1,087,662
Sweden	12,986	538	205	320,660	18,929	8,868	217	88	322,850	17,702
Norway	574,650	20,543	2,296	16,242	890	601,322	18,003	1,738	17,635	1,010
Denmark	352,097	8,439	429	85,161	5,222	399,118	8,539	177	96,718	5,467
Prussia	17,725	517	405	42,878	3,792	246	13	39	41,040	3,370
Germany	41,019,652	1,137,532	279,355	24,055,423	1,585,979	43,816,980	1,174,620	303,950	21,730,661	1,449,531
Holland, Belgium	11,399,792	443,705	214,681	7,878,249	673,714	10,533,793	402,363	244,326	7,254,258	612,925
France	509,030	15,462	3,335	19,500	1,486	139,465	7,055	2,946	5,582	391
Portugal, Proper	24,701,993	631,125	12,385	159,567	14,083	21,372,740	592,759	12,471	221,383	14,024
,, Azores	466,326	13,108	521	1,400	63	397,930	10,596	365	3,012	252
,, Madeira	502,631	14,602	616	12	1	448,994	13,348	572		
Spain and the Balearic Islands	11,018,689	326,708	12,978	17,620	1,475	6,146,471	190,836	10,318	7,590	694
,, Canaries	712,424	21,767	1,206	3,054	224	597,977	17,973	959	700	32
Gibraltar	10,242,089	310,723	10,052	21,873	2,194	4,758,662	139,632	5,772	14,835	1,044
Italy and the Italian Islands	36,808,440	1,081,461	44,849	6,355,154	317,580	53,286,586	1,706,324	52,601	8,371,944	433,754
Malta	4,628,367	105,995	1,869	438,640	21,528	2,899,773	73,044	1,295	381,430	19,296
Ionian Islands	96,028	3,141	66	15,100	859	222,555	6,381	580	45,440	2,700
Turkey and Continental Greece (exclusive of the Morea)	15,536,350	392,725	1,431	662,538	39,918	33,458,077	858,132	3,627	1,528,271	86,148
Morea & Greek Islands	. .	. .	. .	. .	. .	350,265	7,452	. .	20,700	1,261
Egypt (Ports on the Mediterranean)	1,875,161	43,410	. .	28	2	2,953,343	71,404	190	164,980	8,946

Tripoli, Barbary, and Morocco	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Western Coast of Africa	1,910,940	70,104	115	. .	. .	2,506,266	96,042	229	370	54
Cape of Good Hope	2,520,127	75,310	6,368	3,331	339	3,973,967	115,487	6,758	19,860	1,296
Cape Verd Islands	. .	. .	. .	. .	. .	21,716	534			
St. Helena	31,597	1,048	173	1	1	33,499	1,129	391	38	1
Isle of Bourbon	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mauritius	1,658,937	53,150	7,845	. .	. .	1,875,762	64,914	3,031	56	7
East India Company's Territories and Ceylon	39,733,698	1,267,216	28,395	3,185,639	210,182	52,179,844	1,549,730	12,844	4,941,995	333,286
China										
Sumatra and Java	3,502,163	121,036	447	. .	. .	2,792,143	102,512	4,153	19,680	2,040
Philippine Islands	93,279	4,448	. .	. .	. .	1,926,095	62,275	1,315	19,300	1,440
New South Wales, Van Diemen's Land, and Swan River	476,065	19,067	3,498	4,805	479	1,187,640	39,352	6,325	11,999	848
New Zealand and South Sea Islands	2,008	80	. .	. .	. .	3,037	90			
Ports of Siam	. .	. .	. .	. .	. .	204,701	7,644	100		
British North American Colonies	8,671,237	261,546	16,191	84,760	4,477	11,434,448	349,256	26,341	213,394	8,803
British West Indies	33,319,295	997,408	52,872	1,230	195	18,955,323	608,099	37,669	6,909	698
Hayti	6,654,839	207,630	3,065	616	144	7,216,267	209,452	4,293		
Cuba and other Foreign West Indies	11,447,514	395,288	11,906	50	5	9,016,085	318,744	9,315		
United States of America	32,552,062	1,346,023	155,334	30,182	1,928	49,351,574	2,055,658	249,507	48,980	3,598
Mexico	6,007,047	204,677	9,441	97,320	6,660	17,535,351	631,003	29,543	560,020	32,026
Guatemala	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Columbia	4,277,904	132,526	5,918	. .	. .	4,165,789	141,947	4,696	1,740	80
Brazil	50,077,739	1,437,963	50,369	5,300	679	46,204,428	1,369,041	47,126	5,560	650
States of the Rio de la Plata	15,429,383	485,381	24,657	5,460	506	10,805,990	324,305	20,005	5,831	587
Chili	16,972,286	570,863	22,508	2,735	327	10,153,279	363,435	9,175		
Peru	3,465,460	143,798	15,689	800	48	5,365,828	216,521	17,129		
Isles of Guernsey, Jersey, Alderney, & Man	785,510	55,312	17,269	4,554	741	1,079,339	51,446	29,682	4,828	2,128
Total	402,517,196	12,516,247	1,041,885	61,441,251	3,976,874	444,578,498	14,119,770	1,175,153	64,645,342	4,133,741

EXPORTATIONS OF COTTON MANUFACTURES AND COTTON TWIST (*continued*).

COUNTRIES.	1831.					1832.				
	Entered by the Yard.		Hosiery, Lace, and Small Wares. Declared Value.	Cotton Twist and Yarn.		Entered by the Yard.		Hosiery, Lace, and Small Wares. Declared Value.	Cotton Twist and Yarn.	
	Quantities.	Declared Value.		Quantities.	Declared Value.	Quantities.	Declared Value.		Quantities.	Declared Value.
	Yards.	£.	£.	lbs.	£.	Yards.	£.	£.	lbs.	£.
Russia	1,960,634	68,412	7,252	13,959,666	790,371	3,024,369	110,456	12,721	19,587,781	1,136,787
Sweden	18,280	615	216	708,510	34,885	35,165	1,306	421	743,747	38,355
Norway	434,744	13,704	1,829	34,440	1,553	146,573	3,924	1,117	13,035	610
Denmark	312,461	6,213	992	118,316	5,716	295,658	5,702	360	71,680	2,320
Prussia	1,456	80	20	19,448	1,556	333	24	33	26,241	2,001
Germany	41,520,616	940,441	205,527	20,435,442	1,195,718	51,479,478	1,162,875	336,500	29,959,427	1,796,987
Holland, Belgium	13,285,524	333,127	214,123	9,091,238	794,536	22,432,994	596,957	250,086	10,345,649	890,423
France	946,660	35,357	13,613	2,616	1,127	826,487	29,127	35,869	8,437	1,314
Portugal, Proper	23,377,245	373,916	13,454	281,096	17,534	13,461,688	286,386	10,906	37,230	2,899
,, Azores	780,099	17,126	383	3,240	149	1,028,861	20,032	712	28,603	1,228
,, Madeira	569,794	14,577	677	. .	. .	355,166	7,955	582	54	5
Spain and the Balearic Islands	4,756,652	129,778	9,503	36,170	3,147	2,940,969	72,076	2,877	10,430	771
,, Canaries	631,079	15,646	515	2,500	131	377,938	9,497	338	1,200	56
Gibraltar	9,909,009	238,732	6,158	39,196	3,178	11,888,333	281,024	13,241	95,922	7,040
Italy and the Italian Islands	38,164,564	1,035,748	44,172	8,444,518	438,834	47,695,264	1,115,839	41,874	7,641,928	381,948
Malta	1,967,953	49,504	1,403	312,740	13,468	1,328,070	35,084	970	205,450	10,382
Ionian Islands	216,159	5,210	615	62,450	3,643	785,007	16,261	682	55,665	3,048
Turkey and Continental Greece (exclusive of the Morea)	24,565,580	585,473	3,335	1,735,760	99,015	24,206,969	632,394	1,046	1,361,913	69,440
Morea & Greek Islands	344,893	6,540	. .	11,000	600	116,748	4,631	. .	1,200	50
Egypt (Ports on the Mediterranean)	2,354,628	56,088	26	93,600	6,000	2,559,930	55,950	66	199,280	19,319

Tripoli, Barbary, and Morocco	7,810	123	. .	. .	. .	7,090	205	2		
Western Coast of Africa	2,384,000	75,058	446	280	34	3,878,034	97,542	364	1,070	169
Cape of Good Hope	2,904,106	83,612	3,807	193	19	3,464,586	93,710	6,065	1,355	126
Cape Verd Islands	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
St. Helena	73,371	2,173	254	. .	. .	53,368	1,434	118	169	12
Isle of Bourbon	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mauritius	2,432,894	65,185	3,400	. .	. .	2,365,555	68,973	3,925	2,500	126
East India Company's Territories and Ceylon	43,385,852	1,182,574	13,972	6,624,823	467,861	51,833,913	1,311,773	18,697	4,316,645	302,379
China										
Sumatra and Java	5,915,088	194,889	1,730	312,000	22,653	2,671,698	85,046	503	102,500	6,920
Philippine Islands	1,132,583	33,639	13	18,800	1,796	2,106,177	72,666			
New South Wales, Van Diemen's Land, and Swan River	1,905,428	61,567	8,380	7,233	380	1,744,606	58,836	7,905	9,411	509
New Zealand and South Sea Islands	5,014	135	. .	. .	. .	3,200	100	45		
Ports of Siam	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
British North American Colonies	15,618,106	413,737	25,536	307,997	10,376	16,166,875	411,230	30,606	260,699	8,633
British West Indies	21,975,459	606,923	31,568	14,416	835	25,631,940	628,920	30,040	4,973	485
Hayti	6,828,576	178,743	4,731	320	30	11,563,084	321,224	13,767	252	20
Cuba and other Foreign West Indies	11,569,441	364,547	11,329	200	10	15,802,809	373,839	10,590	500	50
United States of America	68,587,893	2,518,824	344,427	317,392	19,063	31,508,744	1,049,375	193,109	82,104	5,045
Mexico	12,150,426	471,208	23,712	784,215	37,972	3,425,301	101,062	5,608	467,323	29,537
Guatemala	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Columbia	5,757,562	177,559	9,060	28,880	1,580	7,877,984	183,746	5,676	100	8
Brazil	26,271,527	681,461	20,540	2,740	334	60,577,822	1,280,061	33,028	11,460	1,676
States of the Rio de la Plata	6,242,134	176,874	9,743	800	30	17,256,838	391,591	33,344		
Chili	12,793,220	431,323	26,851	4,800	130	13,861,434	368,920	32,047	1,700	160
Peru	6,312,931	222,708	19,605	. .	. .	3,468,734	113,724	16,918	640	80
Isles of Guernsey, Jersey, Alderney, & Man	1,013,852	44,364	35,755	4,405	755	789,711	39,053	22,245	8,880	1,841
Total	421,385,303	12,163,513	1,118,672	63,821,440	3,975,019	461,045,503	11,500,630	1,175,003	75,667,150	4,722,759

EXPORTATIONS OF COTTON MANUFACTURES AND COTTON TWIST (*continued*).

COUNTRIES.	1833.					1834.				
	Entered by the Yard.		Hosiery, Lace, and Small Wares.	Cotton Twist and Yarn.		Entered by the Yard.		Hosiery, Lace, and Small Wares.	Cotton Twist and Yarn.	
	Quantities.	Declared Value.	Declared Value.	Quantities.	Declared Value.	Quantities.	Declared Value.	Declared Value.	Quantities.	Declared Value.
	Yards.	£.	£.	lbs.	£.	Yards.	£.	£.	lbs.	£.
Russia	2,656,997	98,649	9,036	19,311,877	1,164,996	1,779,836	66,546	4,212	16,241,363	1,037,533
Sweden	31,173	1,029	591	557,595	31,711	52,090	1,605	590	499,550	30,013
Norway	481,474	13,157	1,906	55,562	2,893	567,531	14,602	1,925	62,423	3,575
Denmark	299,875	6,053	779	16,814	1,092	326,520	6,362	227	23,650	1,317
Prussia	. .	. .	6	21,007	1,692	4,608	220	199	24,342	2,017
Germany	49,534,158	1,183,534	252,315	23,653,904	1,593,467	50,527,498	1,293,617	207,105	26,492,890	1,793,458
Holland	20,610,649	491,778	46,770	11,242,705	971,719	21,189,927	549,084	49,718	13,084,898	1,122,337
Belgium	3,192,579	128,457	251,648	103,558	11,829	4,180,466	155,921	170,012	65,514	8,009
France	1,544,075	46,247	36,320	98,193	10,212	2,317,607	60,774	67,385	101,908	22,527
Portugal, Proper	25,278,084	540,842	18,499	50,062	3,366	42,004,094	899,862	19,895	241,937	19,955
,, Azores	1,228,931	24,751	776	13,565	626	1,361,159	30,661	914	30,612	1,112
,, Madeira	621,687	12,619	686	56	4	573,181	12,284	442	89	7
Spain and the Balearic Islands	328,263	9,288	1,218	2,550	447	456,670	12,184	1,053	2,646	350
,, Canaries	637,583	15,602	853	625	52	748,669	18,765	581	850	60
Gibraltar	9,403,461	216,439	5,091	10,920	910	13,130,134	312,729	7,927	12,909	1,071
Italy and the Italian Islands	47,672,152	1,088,073	40,756	6,956,453	376,835	60,683,663	1,563,243	52,844	9,888,968	543,808
Malta	2,238,974	57,887	935	136,330	6,940	4,560,503	122,156	1,821	531,840	28,887
Ionian Islands	233,692	5,504	368	54,440	2,955	1,747,855	36,313	958	129,622	8,888
Turkey and Continental Greece (exclusive of the Morea)	30,237,127	750,604	2,089	1,767,731	90,052	28,621,490	828,245	3,546	1,989,851	109,735
Morea & Greek Islands	316,897	12,311	345	. .	. .	460,984	17,493	870	1,581	140
Egypt (Ports on the Mediterranean)	2,682,903	54,743	10	177,850	11,028	3,929,444	95,874	296	531,714	29,900

Tripoli, Barbary, and Morocco	1,465	80	140	. .	. .	590,362	9,992	793		
Western Coast of Africa	4,964,666	118,872	386	690	107	4,975,433	129,584	607	570	120
Cape of Good Hope	4,536,727	115,567	9,882	1,164	80	4,006,311	100,328	9,527	2,370	174
Cape Verd Islands	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
St. Helena	87,579	2,018	328	. .	. .	110,372	3,124	321	36	2
Isle of Bourbon	. .	. .	. .	. .	. .	98,240	1,194	36		
Mauritius	794,562	22,582	3,524	. .	. .	2,496,345	70,453	6,671	340	34
East India Company's Territories and Ceylon	45,755,910	1,152,486	21,153	4,783,794	324,353	38,972,059	943,504	15,717	4,267,653	315,583
China						6,381,018	152,395	10,503	952,440	56,839
Sumatra and Java	11,091,558	316,264	1,813	247,450	15,446	10,118,790	290,901	1,863	328,970	17,443
Philippine Islands	2,812,719	87,807	455	7,600	570	1,794,438	54,053	1,146	20,300	1,115
New South Wales, Van Diemen's Land, and Swan River	1,823,859	53,428	7,655	11,960	593	3,724,420	101,701	11,584	11,433	652
New Zealand and South Sea Islands	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ports of Siam	. .	. .	. .	. .	. .	519,025	11,416	30	22,000	1,565
British North American Colonies	14,210,060	339,143	29,314	216,806	9,915	10,225,392	263,291	20,357	194,692	6,458
British West Indies	27,507,930	661,340	43,166	8,640	590	30,246,315	728,756	40,584	5,584	455
Hayti	7,224,810	219,983	6,367	1,000	110	7,166,854	212,587	5,936	4,300	505
Cuba and other Foreign West Indies	12,889,249	323,338	9,465	540	34	21,174,586	511,887	13,424	10	1
United States of America	45,141,989	1,385,957	340,835	112,575	6,255	45,630,862	1,394,057	277,652	107,443	6,693
Mexico	5,745,446	201,428	16,527	968,720	53,694	6,823,964	251,177	7,878	463,546	27,364
Guatemala	53,127	1,800	. .	11,000	765	870,001	23,797	111	23,155	1,775
Columbia	3,210,761	66,743	3,312	. .	. .	5,315,157	114,022	3,262	35,600	3,453
Brazil	68,903,398	1,607,735	59,848	11,434	1,073	65,424,332	1,427,029	58,555	57,730	3,795
States of the Rio de la Plata	12,731,734	280,292	23,311	300	26	20,942,118	449,831	33,313	9,258	446
Chili	20,191,482	490,805	28,846	4,220	430	23,474,954	606,054	20,814	5,689	860
Peru	6,819,029	195,496	12,400	1,000	90	4,504,492	127,828	8,760		
Isles of Guernsey, Jersey, Alderney, & Man	687,302	45,329	41,683	5,471	2,067	896,040	49,051	33,255	6,192	984
Total	496,352,096	12,451,060	1,331,317	70,626,161	4,704,024	555,705,809	14,127,352	1,175,219	76,478,468	5,211,015

1835—Exportations of Cotton Manufactures; Declared Value £16,394,590
" " Cotton Yarn 5,709,044

TABLES EXTRACTED FROM THE RETURNS TO THE LANCASHIRE FORMS OF INQUIRY BY MR. S. STANWAY.

COTTON MILLS.

LIST I.—(Comprehending 151 Mills from which Complete Returns were made.)

Table extracted from the Returns to the Tabular Forms issued at Manchester on the 17th and 20th May, and 20th June, 1833.

	Name of Firm.	Town or Place in or near which the Mills are situate.	Hours during which the Mill worked in the Month ending May 4, 1833.	Counts spun.*	Average Counts spun.	Number of Persons engaged in preparing and spinning Cotton.	Number of Persons engaged in Weaving.	Number of Persons engaged as Engineers, Mechanics, Roller Coverers, &c.†	Total Number employed.	Total NET Earnings realized by the Total NUMBER of Persons given in the preceding Column during the Month ending 4th May 1833, and for working the Number of Hours given in the Third Column.			Average Weekly Net Earnings of each Individual, calculated for 69 hours.
										£.	s.	d.	*Pence.*
1a	Birley and Kirk . .	Manchester .	270	14 to 40	25	931	471	100	1,692	3,470	12	0½	127·26
1b	Ditto	Duckenfield .	276	22 to 40	30	176	..	14					111·79
2	Ormrod and Hardcastle . . .	Bolton . . .	274	30 to 200	100	1,255	295	26	1,576	2,877	5	6½	110·34
3	M'Connell and Co. .	Manchester. .	276	100 to 240	170	1,493	..	52	1,545	3,374	2	0	131·03
4a	E. and W. Bolling .	Bolton . . .	286	36 to 110	50	698	..	30	1,356	2,446	6	2	100·19
4b	Ditto	Ditto . . .	286	38 to 70	43·42	140	..	1					98·77
4c	Ditto	Ditto . . .	276	46 to 68	57	213	..	1					98·18
4d	Ditto	Ditto . . .	286	40 to 130	85	273	..	..					126·36
5	T.Houldsworth, M.P.	Manchester .	276	130 to 230	180	1,155	..	46	1,201	2,456	10	2	122·72
6	Joseph Horsefield .	Hyde . . .	276	38 to 40	39·02	475	705	3	1,183	2,520	16	3	127·85
7	Thomas Ashton . .	Ditto . . .	272	12 to 40	18·96	386	762	1	1,149	2,888	3	11	153·3
8	T. Marsland, M.P. .	Stockport . .	267	18 to 32	25	347	566	34	947	2,447	7	11¾	160·28

9	Taylor, Hindle, and Co. . . .	Bolton . . .	272	Mule Twist 80 / Water ditto 17	..	860	40	24	924	1,569	6	9	103·40
10	Collinge and Lancashire . . .	Oldham. . .	276	34 to 55	41·66	338	444	71	853	2,096	3	6	147·44
11	A. and G. Murray .	Manchester .	276	90 to 200	145	805	..	36	841	1,989	16	4	141·96
12	Stirling and Beckton	Ditto . . .	264	14 to 24	19	343	432	66	841	1,699	13	9½	126·77
13	Joseph Lane and Son	Stockport . .	280·5	34 to 38	36	305	542	26	873	1,995	9	4½	134·94
14	Jer. Lees and Sons .	Stayley Bridge .	276	28 to 38	34	308	485	3	796	1,774	17	4½	133·78
15	The Oxford Road Twist Company .	Manchester . .	276	17 to 36	23	306	427	41	774	1,717	19	4	133·17
16	William Smith .	Heaton Norris .	276	36 to 40	38	267	490	4	761	1,668	17	4½	131·57
17	Lambert, Hoole, and Co. . . .	Manchester. .	276	. .	..	725	..	27	752	1,422	14	8½	113·51
18a	Samuel Ashton . .	Apethorn Mill .	288	37	37	134	237	1	727	1,813	12	2½	143·80
18b	Ditto	Woodley Mill .	300	20 to 38	25·83	128	226	1					137·33
19	T. R. and T. Ogden .	Manchester .	276	150 to 220	176	709	..	3	712	1,483	9	11	125·01
20	James Guest . .	Ditto . . .	276	16 to 24	20	323	386	3	712	1,243	2	1	104·75
21	C. and T. Howard .	Hyde . . .	276	36 to 38	37	224	403	21	648	1,396	3	0	129·27

* N. B.—This column indicates the quality of work done in each mill during the month ending May 4, 1833. Mills are roughly classed in the district as "fine spinning" and "coarse spinning" mills, and each confines itself in general to its own class of work. Coarse spinning ranges from No. 1 to No. 90, at Manchester, and fine spinning from No. 90 to No. 340, which is the highest number that has ever been reached, as I have been informed, with the present machinery. These different qualities are technically called "the counts spun" or the "numbers spun."

A hank of cotton yarn or twist always measures 840 yards. Therefore,

No. 1 signifies that *one* hank of cotton yarn or twist weighs *one* pound.
No. 40 ,, ,, *forty* hanks taken collectively weigh *one* pound.
No. 340 ,, ,, *three hundred and forty* hanks taken collectively weigh *one* pound.

Consequently the length of 16 ounces of cotton yarn of the fineness of No. 340 is 840×340, or 285,600 yards, or rather more than 162 miles. Cotton yarn and cotton twist are general terms for all spun cotton.

† The hands in this column are all, strictly, "mill hands," and though some of them are not engaged in the actual manipulation of cotton, yet all are correctly entitled to be called "operatives." Jobbers are included in this column, but all the persons comprehended in the answers to the 1st and 2d primary queries of the first form, and likewise managers, are rigidly excluded from it, and, of course, from the two preceding columns.

TABLE OF COTTON MILLS (*continued*).

	Name of Firm.	Town or Place in or near which the Mills are situate.	Hours during which the Mill worked in the Month ending May 4, 1833.	Counts spun.	Average Counts spun.	Number of Persons engaged in preparing and spinning Cotton.	Number of Persons engaged in Weaving.	Number of Persons engaged as Engineers, Mechanics, Roller Coverers, &c.	Total Number employed.	Total NET Earnings realized by the Total NUMBER of Persons given in the preceding Column during the Month ending 4th May 1833, and for working the Number of Hours given in the Third Column.	Average Weekly Net Earnings of each Individual, calculated for 69 Hours.
										£. s. d.	*Pence.*
22a	Sampson, Lloyd, and Co.	Stockport	287	36 to 40	38	116	252	1	632	1,354 7 1	127·28
22b	Ditto	Ditto	276	36 to 40	38	57	54	..			149·09
22c	Ditto	Ditto	257	36 to 40	38	50	102	..			112·13
23	John Howard	Hyde	296	36 to 40	38	241	358	29	628	1,512 18 3½	134·77
24	James Kennedy	Manchester	272	70 & below and 170	90	594	..	5	599	957 12 10	97·33
25	Bayley and Brothers	Stayley Bridge	315	34 to 38	35·33	243	322	20	585	1,435 13 7½	129·01
26	Henry Sidebottom and Brothers	Houghton	270	12 to 40	36·78	245	331	1	577	1,310 11 8	136·28
27	Samuel Greg and Co.	Bury	273·5	12 to 36	24·14	217	326	14	557	1,009 1 7½	109·69
28	Hugh Beaver	Manchester	267	20 to 55	22·01	201	301	23	525	1,091 15 8½	128·98
29	H. and E. Ashworth	Bolton	271	50 to 100	..	515	..	2	517	986 10 9	116·60
30	Pooley and Son	Manchester	264	30 to 40	35	475	..	39	514	967 1 8	118·02
31	George Cheetham and Sons	Duckenfield	Above 18 300 Under 18 274	6 to 60	30	454	..	6	460	881 19 3	108·58
32	Jesse Howard	Stockport	252	20 to 40	33·64	292	153	5	450	949 3 11	138·61
33	New Bridge Mills Twist Company	Manchester	264	115 to 195	155	444	..	6	450	866 5 0	120·75
34	Apelles Howard	Brinnington	266	14 to 40	36·39	176	268	2	446	881 11 9½	123·05
35	Jas. and John Potter	Manchester	265·8	12 to 36	24	238	173	33	444	967 7 3	130·72

36	Samuel Stocks	Heaton Mersey	276	20 to 40	36·25	177	259	2	438	816	4	8	111·81
37	T. and R. Barnes	New Mills	240	..	..	437	..	..	437	756	8	1	119·43
38	James and R. Gee	Cheadle Bulkeley	299·83	36 to 40	38	211	208	14	433	952	11	7	121·50
39	Charles Axon	Stockport	253	36 to 38	36·8	189	213	17	419	818	4	10½	127·82
40	Thomas Harbottle	Manchester	276	18 to 65	27·81	126	267	8	401	739	18	9	110·71
41	Thomas Fernley	Stockport	Above 18 288 / Under 18 276	36 to 40	38	116	279	5	400	949	16	9	138·58
42	J. and R. Ashton	Hyde	270·5	18 to 40	31·81	155	240	2	397	907	13	3½	139·96
43	Benjamin Gray	Manchester	276	100 to 200	130	388	..	3	391	739	13	1	113·50
44	Ralph Orrell	Brinnington	273	19 to 38	26·5	194	190	4	388	842	7	6	131·69
45	G. T. Knowles	Stockport	276	12 to 36	19·33	143	243	1	387	782	1	2	121·24
46	Benjamin Sandford	Manchester	276	140 to 210	175	365	..	17	382	719	1	1	112·94
47a	Hadfield and Frost	Warrington	276	31 to 42	36·5	143	..	4	350	716	0	0½	112·63
47b	Ditto	Ditto	276	..	..	..	192	11					130·06
48	Thomas Robinson	Stockport	264	40	40	123	219	7	349	850	1	5½	152·78
49	Dacca Twist Company	Manchester	282	16 to 38	24	180	155	13	348	730	19	11	123·35
50	Thos. Ogden and Sons	Ditto	276	30 to 170	43·29	344	..	2	346	726	13	7	126·01
51	Thomas Plant	Ditto	276	140 to 210	175	342	..	1	343	642	5	1	112·34
52	Samuel Ratcliffe	Oldham	207	12 to 50	1	186	153	3	342	553	7	5	129·44
53	Hardy and Andrew	Stockport	Above 18 296 / Under 18 276	7 to 30	18·50	310	6	3	319	516	14	5	93·57
54	Mosley and Howard	Disley	276	38 to 46	42	233	76	10	319	636	17	6	119·78
55	John Brown	Stockport	294·5	14 to 38	30·78	156	154	2	312	694	12	0	125·18
56	John Tattersall	Oldham	276	..	50	116	188	..	304	594	8	0	117·31
57	Roger Holland & Co.	Bolton	274·5	24 to 130	72·85	277	3	18	298	669	16	0	135·59

TABLE OF COTTON MILLS (*continued*).

	Name of Firm.	Town or Place in or near which the Mills are situate.	Hours during which the Mill worked in the Month ending May 4, 1833.	Counts spun.	Average Counts spun.	Number of Persons engaged in preparing and spinning Cotton.	Number of Persons engaged in Weaving.	Number of Persons engaged as Engineers, Mechanics, Roller Coverers, &c.	Total Number employed.	Total NET Earnings realized by the Total NUMBER of Persons given in the preceding Column during the Month ending 4th May 1833, and for working the Number of Hours given in the Third Column.	Average Weekly Net Earnings of each Individual, calculated for 69 Hours.
										£. s. d.	*Pence.*
58	Rooth and Mayer	Stockport	270	40	40	112	176	1	289	536 4 7	113·80
59	T. Steel and Son.	Ditto	Above 18 296 Under 18 276	36 to 38	37	140	122	22	284	659 5 8	133·82
60	Trustees of Josiah Cheetham	Tintwistle	273	20 to 36	28	7	184	7	278	730 17 5	159·47
61	John Sidebottom	Hyde.	Spinning rooms 276 Other rooms 300	36	36	107	169	..	276	656 7 11½	133·72
62	James Lord	Manchester.	210	..	..	..	253	20	273	429 5 9½	124·00
63	D. Dronsfield.	Oldham.	276	28 to 40	34	177	92	..	269	576 4 5	128·52
64	W. Higson	Stockport	291	14 to 20	17	99	166	..	265	541 0 1	117·17
65	C. Ainsworth and Co.	Bolton	276	20 to 140	100	235	13	3	251	488 16 7⅓	116·85
66	Peter Ewart	Manchester.	273	6 to 26	16·75	250	..	1	251	424 8 6	102·57
67	John Garside	Brinnington	266	18 to 24	21	112	132	1	245	581 17 1½	147·85
68	Richard Thompson	Oldham	252	24 to 60	49·48	211	23	7	241	480 4 6	130·94
69	T. Barton and Co.	Manchester.	272·5	14 to 24	20	105	135	..	240	505 7 2	127·96
70	J. and W. Bellhouse.	Ditto	276	130 to 210	170	208	..	3	211	522 2 2	148·46
71	Abraham Haigh.	Bolton	276	60 to 150	110	209	..	1	210	425 9 6	121·56

72	Adshead & Brothers.	Duckenfield .	Above 18 296 Under 18 276	36 to 54	45	204	..	5	209	504	18	3	137·92
73	Blackstock and Bowers . . .	Levenshulme .	276	18 to 24	21	68	136	..	204	570	3	11½	167·70
74	E. and T. Dodgshon.	Manchester. .	270	17 to 20	18·5	79	119	5	203	434	7	4	131·23
75	J. and J. Hague . .	Oldham . . .	274	30, 40 & 55	41·66	149	51	3	203	399	7	3	118·89
76	Wagstaff and Side-bottom . . .	Duckenfield. .	296	40 to 140	90·20	196	..	6	202	468	17	9	129·86
77	Taylor, Weston, and Co.. . . .	Manchester .	Above 18 288 Under 18 276	18 to 40	32·16	180	10	8	198	317	14	0	93·84
78	William Higgins .	Ditto . . .	270·5	13 to 40	22	180	..	16	196	382	5	5	119·40
79	Henry Lees . . .	Glossop . . .	272	34 to 40	38	64	126	1	191	424	10	1½	133·35
80	S. M. Moore . . .	Manchester . .	276	150 to 210	180	186	..	3	189	407	19	3	129·49
81	James Hall and Son	Stayley Bridge	Above 21 299 Under 21 276	8 to 40	30·75	185	..	2	187	381	0	8	..
82	Alexander M'Cool .	Bolton . . .	276	60 to 100	80	185	..	1	186	419	16	8½	135·43
83	Ogden and Walmsley	Oldham. . .	252	38	38	82	104	..	186	333	15	9	117·92
84	Hugh Shaw and Co..	Manchester . .	276	150 to 210	180	181	..	1	182	339	3	1	111·80
85	A. W. Thorniley and Brothers. . .	Duckenfield .	280	35 to 40	39	121	60	1	182	403	0	1½	130·96
86	The Pin Mill Twist Company. . .	Manchester . .	272·8	14 to 22	18	76	105	..	181	406	9	4½	136·32
87	Robinson and Armitage . . .	Duckenfield .	276	36 to 40	38	76	94	3	173	417	9	1	144·78
88	Seville and Wright .	Oldham . . .	252	24 to 30	27	166	2	4	172	290	10	0	110·98

TABLE OF COTTON MILLS (*continued*).

	Name of Firm.	Town or Place in or near which the Mills are situate.	Hours during which the Mill worked in the Month ending May 4, 1833.	Counts spun.	Average Counts spun.	Number of Persons engaged in preparing and spinning Cotton.	Number of Persons engaged in Weaving.	Number of Persons engaged as Engineers, Mechanics, Roller Coverers, &c.	Total Number employed.	Total NET Earnings realized by the Total NUMBER of Persons given in the preceding Column during the Month ending 4th May 1833, and for working the Number of Hours given in the Third Column.	Average Weekly Net Earnings of each Individual, calculated for 69 Hours.
										£. s. d.	*Pence.*
89	F. S. Clayton . .	Stockport .	Above 18 288·5 Under 18 270·5	..	.	..	155	..	155	348 13 1	131·71
90	J. Rothwell . . .	Bolton . . .	276	90 to 120	105	150	..	1	151	291 0 0	115·62
91	Barker & Ainsworth.	Warrington. .	276	50 to 80	65	144	..	5	149	230 4 0	92·69
92	H. Marsland & Co. .	Stockport .	Spinners 267 Weavers 264	36 to 60	43	43	102	1	146	359 16 7	154·06
93	Assignees of James Gleadhill. . .	Oldham. . .	255	12 to 40	27·5	142	..	4	146	260 18 11	116·06
94	Joseph Walsh . .	Warrington. .	299	30	30	61	81	3	145	287 13 1	109·87
95	Samuel Shepley . .	Glossop . . .	288	40	40	144	..	..	144	232 13 8	92·91
96	Nathan Gough . .	Manchester. .	276	28 to 36	30·75	139	..	5	144	193 18 9	80·80
97	William Carruthers .	Ditto . . .	276	150 to 210	180	143	..	..	143	348 11 0	146·24
98	John Winterbottom .	Tintwistle . .	308	38 to 46	42	126	..	8	134	303 11 5	121·80
99	Smith and Rawson .	Manchester. .	276	22 to 30	26	128	..	5	133	211 12 4½	95·46
100	Welsh and Sells. .	Ditto . . .	276	40	40	46	86	..	132	292 18 7	133·14
101	Gould and Cooper .	Oldham. . .	248	20 to 50	35	82	48	..	130	240 16 4	123·69
102	France & Boardman.	Manchester. .	277	..	..	..	122	2	124	224 0 2½	108·39
103	S. Forster and Co. .	Ditto. . . .	276	30	30	42	75	4	121	252 6 11	125·13
104	J. and R. Howard .	Stayley Bridge .	276	40	40	114	..	1	115	263 7 6½	137·41
105	Wimpenny and Swindells. . .	Duckenfield. .	286	40	40	110	..	3	113	236 18 4	121·39
106	Haywood and Sons	Manchester. .	279	155 to 175	165	109	..	3	112	231 18 10	122·91

107	Broadbent & Sons	Oldham	Carding room 252 Spinning room 246	20 to 40	30	104	..	2	106	241	2	4	151·90
108	W. Sidebottom	Werneth	262	36	36	31	74	..	105	251	4	11½	151·24
109	Johnson & Brooks	Manchester	276	17 to 20	18·5	42	60	3	105	186	5	8	106·44
110	James Wilkinson	Stayley Bridge	296	40	40	104	..	..	104	244	6	8	131·43
111	John Clegg	Oldham	276	14 to 32	26	49	48	2	99	180	18	3	109·64
112	Robert Shepley	Glossop	282	34 to 38	36	98	..	..	98	196	14	9	117·88
113	Edward Brideoak	Oldham	276	20 to 50	36	95	2	..	97	167	14	1½	103·73
114	C. Bradbury	Ditto	276	20 to 80	50	94	..	1	95	201	14	2	127·39
115	Ogden and Walmsley	Ditto	252	38	38	10	80	..	90	170	8	6½	124·43
116	Edmund Wilde	Ditto	276	20 to 26	23	90	..	..	90	128	16	9	85·89
117	Abraham Clegg	Ditto	252	7 to 30	16	88	..	..	88	146	12	9½	109·50
118	James Wardlow	Glossop	288	38, 40, & 42	40	87	..	..	87	187	9	8	123·91
119	John Lees	Ditto	296	38 to 42	40	86	..	1	87	168	17	9½	108·60
120	Robert Schofield	Manchester	276	124 to 150	137	87	..	..	87	134	3	0½	92·51
121	John Barker	Glossop	276	32, 40, & 50	40·66	84	..	2	86	175	10	8½	122·46
122	Ralph Sidebottom	Tintwistle	295·58	46	46	84	..	2	86	173	4	5	112·84
123	Buckley and Howard	Stayley Bridge	288	40	40	82	..	..	82	180	19	1½	126·89
124	The Islington Twist Company	Manchester	276	28 to 34	30·25	76	..	1	77	121	2	9½	94·39
125	J. Stanney	Mellor	276	36, 38, & 60	44·66	39	37	..	76	100	16	11	79·61
126	S. Thornley and Co.	Levenshulme	276	20	20	22	50	3	75	166	14	7½	133·38
127	Daniel Nield, jun.	Oldham	276	20 to 30	23·33	48	26	..	74	139	1	5½	112·76
128	Hugh Shaw	Duckenfield	276	..	..	23	50	..	73	172	8	0	141.69
129	T. and R. Hope	Manchester	279·75	..	..	..	73	..	73	141	17	1	115·02
130	Clare, Crosfield, and Sowden	Warrington	276	34 to 36	35	72	..	..	72	86	6	6	71·93
131	Samuel Armstrong	Disley	214·5	24 to 36	32	68	..	..	68	92	9	2	104·97
132	Sibson Rigg	Manchester	264	20 to 26	23	66	..	..	66	105	12	11	100·40
133	John Duncuft	Oldham	238	40 to 60	50	60	..	..	60	121	3	1½	140·50

TABLE OF COTTON MILLS (*continued*).

	Name of Firm.	Town or Place in or near which the Mills are situate.	Hours during which the Mill worked in the Month ending May 4, 1833.	Counts spun.	Average Counts spun.	Number of Persons engaged in preparing and spinning Cotton.	Number of Persons engaged in Weaving.	Number of Persons engaged as Engineers, Mechanics, Roller Coverers, &c.	Total Number employed.	Total NET Earnings realized by the Total NUMBER of Persons given in the preceding Column during the Month ending 4th May 1833, and for working the Number of Hours given in the Third Column.	Average Weekly Net Earnings of each Individual, calculated for 69 Hours.
										£. s. d.	*Pence.*
134	Joseph Cooper . .	Glossop . .	Under 18 276 Adults 300	60	60	52	..	1	53	99 15 7	108·50
135	James Nield, jun.	Oldham. . .	276	20 to 26	23	53	..	..	53	84 17 2½	96·06
136	Joseph Howard .	Glossop . . .	296	50	50	52	..	..	52	113 17 0	122·48
137	J. and J. Bennett	Ditto . . .	294	40	40	49	..	3	52	94 12 9	102·51
138	Waring and Sons	Oldham. . .	276	2 to 40	26	49	..	..	49	84 1 2	103·47
139	Parrott and Weston	Brinnington .	267	36	36	47	..	..	47	113 6 0	149·54
140	C. Bullock . . .	Manchester .	270	18 to 42	25·02	47	..	..	47	85 19 5	112·18
141	Cheetham and Hill	Duckenfield. .	296	50 to 60	55	44	..	1	45	102 6 5	127·20
142	James Kershaw .	Charlestown .	308	33, 35, & 36	34·66	44	..	..	44	97 14 5	119·41
143	M. Hadfield . .	Glossop . . .	286	40	40	43	..	..	43	95 15 8	128·97
144	John Cheetham .	Stockport . .	282	20 to 26	23	36	2	1	39	66 17 5	100·68
145	Aaron Rangeley .	Hayfield . .	276	40	40	38	..	..	38	69 18 0	110·36
146	Rusby and Linney	Glossop . .	Under 18 264 Above 300	20 to 24	22	37	..	..	37	62 7 10	100·58
147	Moss and Howard	Oldham. . .	276	36	36	28	..	..	28	84 8 3	180·88
148	George Platt . .	Glossop . . .	286	40	40	27	..	..	27	45 16 4	98·25
149	J. Greaves . . .	Mottram . .	240	38 to 42	40	26	..	..	26	60 0 0	159·23
150	Joseph Lamb. . .	Stockport . .	282	20 to 24	22	25	1	..	26	44 9 1	100·40
151	George Froggatt .	Mellor . . .	267	8	8	19	..	..	19	31 4 9½	101·97
						31,444	16,040	1,161	48,645	100,971 18 11¼	125·13

SAMUEL STANWAY.

SUPPLEMENT (A.) (GENERAL).—Showing the Distribution of the 48,645 Hands (employed in the 151 Mills given in the preceding List) in the different Places mentioned, their Ages, Sex, &c., the Aggregate Net Earnings of the whole Number, and the Average Net Earnings of an Individual, in each Place, for 69 Hours' Work.

Place of Employment.	Adults.*		Children under Eighteen Years.						Average Number employed.	Aggregate Number of Hours worked by the whole during the Month ending 4th of May, 1833.	Total Number of Hours worked by each.	Aggregate Amount of their Net Earnings for the Month ending 4th May, 1833.			Average Weekly Net Earnings of each Individual, calculated for 69 Hours.
			Males.			Females.									
	Males.	Females.	In the direct Employ of Masters.	In the direct Employ of Operatives.	Employers uncertain.	In the direct Employ of Masters.	In the direct Employ of Operatives.	Employers uncertain.				£.	s.	d.	Pence.
Manchester and immediate neighbourhood . . .	4,421	5,731	1,423	2,349	29	1,957	1,451	29	17,390	4,737,977·1	272·4	35,089	2	3½	122·64
Stockport and Heaton Norris . .	2,314	2,175	609	917	30	883	525	38	7,491	2,057,002·0	274·5	16,399	7	6¾	132·02
Duckenfield & Stayley Bridge . .	1,251	1,256	87	458	7	240	192	25	3,516	1,016,789·0	289·1	7,822	2	6	127·39
Hyde, Brinnington, &c.	1,936	2,451	698	598	27	1,402	127	10	7,249	2,020,639·5	278·7	16,629	6	0½	136·28
Tintwistle, Glossop, &c.	728	675	108	445	19	262	227	18	2,482	678,228·7	273·2	4,951	4	0	120·89
Oldham	1,318	824	198	575	40	506	276	38	3,775	987,294·0	261·5	7,577	3	3	127·09
Bolton	1,443	1,279	356	1,069	..	657	665	..	5,469	1,510,984·0	276·2	10,174	8	0½	111·50
Warrington. . .	207	235	38	105	..	63	68	..	716	200,951·0	280·6	1,320	3	7½	108·79
One Mill at Bury .	122	195	68	41	..	121	10	..	557	152,339·5	273·5	1,009	1	7½	109·69
	13,740	14,821	3,585	6,557	152	6,091	3,541	158	48,645	13,362,204·8	274.6	100,971	18	11¼	125.13

* The word "Adult" is used throughout these Tables to signify a Person who has completed the Eighteenth year of age.

SUPPLEMENT (B.) (GENERAL).—Distributing the 48,645 Hands into Eight different Branches or Departments of Cotton Working, and showing the Aggregate Net Earnings of the whole Number of the Operatives in each Branch, and the Average Net Earnings of an Operative in each, for 69 Hours' Work.

Employed in	Adults.		Children under Eighteen Years.						Total Number employed.	Aggregate Number of Hours worked by the whole, during the Month ending the 4th May, 1833.	Average Number of Hours worked by each.	Aggregate Amount of their Net Earnings for the Month ending 4th May, 1833.			Average Weekly Net Earnings of each Individual, in each Branch, calculated for 69 Hours.
			Males.			Females.									
	Males.	Females.	In the direct Employ of Masters.	In the direct Employ of Operatives.	Employers uncertain.	In the direct Employ of Masters.	In the direct Employ of Operatives.	Employers uncertain.				£.	s.	d.	
Cleaning & spreading cotton	272	689	212	1	9	94	2	3	1,282	353,660.5	275.8	2,111	1	5	98.85
Carding	2,350	3,501	1,229	81	18	2,061	117	40	9,397	2,591,188.7	275.7	17,252	16	8½	110.26
Mule-spinning	5,163	1,189	697	5,852	50	346	2,284	24	15,605	4,291,208.6	274.9	33,057	12	2¾	127.57
Throstle-spinning	194	688	373	4	32	500	4	51	1,846	501,621.5	271.7	2,819	1	6½	93.06
Reeling	146	2,552	40	5	..	542	23	8	3,316	906,261.8	273.2	5,213	14	3¾	95.26
Weaving	4,627	6,108	986	610	35	2,538	1,104	32	16,040	4,400,274.7	274.3	36,080	19	11	135.78
Roller covering	61	87	5	1	..	9	7	..	170	47,268.3	278.0	414	15	7	145.31
As engineers, firemen, mechanics, &c.	927	7	43	3	8	1	..	..	989	270,720.7	273.7	4,021	17	2¾	246.01
	13,740	14,821	3,585	6,557	152	6,091	3,541	158	48,645	13,362,204.8	274.6	100,971	18	11¼	125.13

SUPPLEMENT (C.) (GENERAL).—Showing the Number of Children under Fourteen years of Age comprehended in the Total Number of 48,645 Hands, the Aggregate Net Earnings of the whole Number of Children under Fourteen, and the Average Net Earnings of a Child under Fourteen, for 69 Hours' Work.*

Place of Employment.	Persons Eighteen Years of Age and upwards.			Persons above Fourteen and under Eighteen.			Children under Fourteen.				Average Net Earnings per Week of each Child under 14.
	Males.	Females.	Total Number.	Males.	Females.	Total Number.	Males.	Females.	Total Number.	Aggregate Net Earnings of the whole Number of Children for the Month ending 4th May, 1833.	
										£. s. d.	
Manchester and immediate Neighbourhood	4,421	5,731	10,152	1,514	1,887	3,401	2,287	1,550	3,837	2,861 3 9¼	44.74
Stockport and Heaton Norris	2,314	2,175	4,489	583	777	1,360	973	669	1,642	1,370 15 8	50.08
Duckenfield and Stayley Bridge	1,251	1,256	2,507	232	163	395	320	294	614	480 2 5¼	46.91
Hyde, Brinnington, &c.	1,936	2,451	4,387	666	924	1,590	657	615	1,272	1,256 1 5¼	59.24
Tintwistle, Glossop, &c.	728	675	1,403	324	252	576	248	255	503	422 4 4¼	50.36
Oldham	1,318	824	2,142	371	422	793	442	398	840	603 9 0	43.10
Bolton	1,443	1,279	2,722	570	637	1,207	855	685	1,540	956 14 3¼	37.27
Warrington	207	235	442	53	55	108	90	76	166	109 5 8	39.50
One Mill at Bury	122	195	317	40	73	113	69	58	127	83 17 8¼	39.63
	13,740	14,821	28,561	4,353	5,190	9,543	5,941	4,600	10,541	8,143 14 5¼	46.35

Of which total number of 10,541 Children under the age of 14,—There are in the direct employ of the mill owners . 3,931
Ditto ditto of operatives . . . 5,898
And of those whose direct employer is unknown . . 712
10,541

* The statement of time worked by Children under 14, and also of Engineers, is to be taken with the modification specified in the Preface, page 5. This remark is to apply throughout.

SUPPLEMENT (D.) (GENERAL).—The 48,645 Hands exhibit the following Proportions in 100, of Persons above Eighteen years of Age, of Persons above Fourteen and under Eighteen, and of Children under Fourteen. The Proportions of the Sexes of each Age are likewise exhibited.

Place of Employment.	Adults.		Persons above Fourteen and under Eighteen.		Children under Fourteen.		Total Adults.	Total Non-Adults.	Total Males.	Total Females.
	Males.	Females.	Males.	Females.	Males.	Females.				
Manchester and immediate Neighbourhood . . .	25.42	32.96	8.71	10.85	13.15	8.91	58.35	41.62	47.28	52.72
Stockport and Heaton Norris .	30.87	29.06	7.78	10.37	12.99	8.93	59.93	40.07	51.64	48.36
Duckenfield and Stayley Bridge	35.58	35.72	6.60	4.64	9.10	8.36	71.30	28.70	51.28	48.72
Hyde, Brinnington, &c. . .	26.71	33.81	9.19	12.75	9.06	8.48	60.52	39.48	44.96	55.04
Tintwistle, Glossop, &c. . .	29.33	27.20	13.06	10.15	9.99	10.27	56.53	43.47	52.38	47.62
Oldham.	34.91	21.83	9.83	11.18	11.71	10.54	56.74	43.26	56.45	43.55
Bolton	26.38	23.39	10.42	11.65	15.63	12.53	49.77	50.23	52.43	47.57
Warrington	28.91	32.82	7.40	7.68	12.57	10.62	61.73	38.27	48.88	51.12
One Mill at Bury	21.90	35.01	7.18	13.11	12.39	10.41	56.91	43.09	41.77	58.53
Total Average . .	28.24	30.47	8.95	10.67	12.21	9.46	58.71	41.29	49.40	50.60

SUPPLEMENT (E.) (GENERAL.)—Showing the Average Net Earnings of certain Classes of Operatives employed in the Four Processes of Carding, Mule-spinning, Throstle-spinning, and Weaving, in all the Districts, as specified in Supplement (C.)

Denomination of Process in which employed.	Class of Operatives.	Classification as respects Sex and Age.	Total Number of Persons employed.	Total Number of Hours worked by them, during the Month ending 4th May, 1833.	Average Number of Hours worked by each.	Aggregate Net Earnings for the Month ending 4th May, 1833.			Average Weekly Net Earnings of each Individual in each Process, calculated for 69 Hours.
						£.	s.	d.	*Pence.*
Carding	Carders or overlookers.	Male adults	376	103,495·9	275·2	1,762	17	3½	282·06
	Jack-frame tenters	Principally female adults	696	190,385·0	273·5	1,103	10	3½	95·98
	Bobbin-frame tenters	Ditto ditto	945	261,650·1	276·8	1,414	3	5	89·50
	Drawing tenters	Ditto ditto	1,931	532,287·3	275·6	2,885	3	8½	89·76
Mule-spinning	Overlookers	Male adults	145	40,018·6	275·9	848	2	2	350·95
	Spinners	Male and female adults, but principally the former	3,797	1,046,252·0	275·5	19,454	3	5	307·91
	Piecers	Male and female adults and non-adults, but principally the latter	7,157	1,966,804·8	274·8	7,688	14	8½	64·73
	Scavengers	Male and female non-adults	1,247	340,019·1	272·6	712	2	11½	34·68
Throstle-spinning	Overlookers	Male adults	82	22,371·9	272·8	362	14	11½	268·51
	Spinners	Female adults and non-adults	1,123	305,712·4	272·2	1,716	17	6½	93·00
Weaving	Overlookers	Male adults	400	109,577·0	273·9	2,088	1	4	315·56
	Warpers	Male and female adults	332	90,660·2	273·0	805	5	0	147·08
	Weavers	Male and female adults, male and female non-adults, but chiefly females	10,171	2,784,258·7	273·7	21,835	9	6½	129·87
	Dressers	Male adults	836	230,771·0	276·0	4,650	4	11	333·69

Supplement (F.) (General).—Showing the Average Net Earnings per Week of Sixty-nine Hours of each Class of Operatives employed in the Eight different Branches of Cotton Working in the under-mentioned Districts.

Employed in	Manchester and its immediate Neighbourhood.	Stockport and Heaton Norris.	Duckenfield and Stayley Bridge.	Hyde, Brinnington, &c.	Tintwistle, Glossop, &c.*	Oldham.	Bolton.	Warrington.	Average Weekly Net Earnings of each Individual in each Branch, calculated for 69 Hours.
	Pence.	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*
Cleaning and spreading cotton	84·68	174·14	80·52	162·70	267·69	103·13	91·35	67·27	98·85
Carding	118·59	107·31	120·37	113·28	110·79	107·02	92·22	90·31	110·26
Mule-spinning	126·96	135·99	125·47	132·78	123·71	138·06	122·14	107·11	127·57
Throstle-spinning . . .	93·67	99·29	108·07	90·60	96·00	82·11	95·24	58·02	93·06
Reeling	97·65	96·70	94·34	88·20	90·00	100·85	86·14	77·24	95·26
Weaving	127·41	136·80	142·20	144·63	141·36	131·10	123·74	122·06	135·78
Roller covering	145·87	155·32	136·01	160·30	86·18	176·50	152·45	103·45	145·31
As engineers, mechanics, firemen, &c.	255·36	265·66	206·36	217·13	229·40	252·08	211·45	231·76	246·01
Total Average . .	122·64	132·02	127·39	136·28	120·89	127·09	111·50	108·79	125·13

* None but adults are returned as employed in this department in Tintwistle, &c.

SUPPLEMENT (G.) (GENERAL).—Showing the Average Net Earnings per Week of Sixty-nine Hours of certain Classes of Operatives employed in the Four Processes of Carding, Mule-spinning, Throstle-spinning, and Weaving, in the under-mentioned Districts.

Denomination of Process in which employed.	Class of Operatives.	Manchester and its immediate Neighbourhood.	Stockport and Heaton Norris.	Duckenfield and Stayley Bridge.	Hyde, Brinnington, &c.	Tintwistle, Glossop, &c.	Oldham.	Bolton.	Warrington.	Average Weekly Net Earnings of each Individual in each Process, calculated for 69 Hours.
		Pence.	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*
Carding	Carders or overlookers	314·46	283·65	249·60	245·73	258·11	304·19	256·94	209·87	282·06
	Jack-frame tenters	103·26	111·64	102·01	100·92	95·21	91·01	62·54	69·52	95·98
	Bobbin-frame tenters	103·92	95·76	95·52	101·96	92·78	76·26	67·94	73·79	89·50
	Drawing tenters	101·73	92·38	92·57	76·48	87·78	95·31	70·82	72·91	89·76
Mule-spinning	Overlookers	392·55	314·69	311·25	363·54	364·90	277·30	303·43	345·60	350·95
	Spinners	325·64	291·46	247·96	284·78	274·80	312·68	341·71	287·75	307·91
	Piecers	70·37	70·41	66·34	55·28	58·96	74·03	56·10	59·82	64·73
	Scavengers	33·15	39·87	43·05	42·65	41·49	30·92	33·38	29·86	34·68
Throstle-spinning	Overlookers	281·10	284·40	237·50	226·64	296·28	270·68	217·41	..	268·51
	Spinners	91·85	100·03	102·40	102·88	104·23	79·37	90·21	56·01	93·00
Weaving	Overlookers	293·86	354·81	271·81	308·14	373·44	295·81	282·56	270·72	315·56
	Warpers	142·35	147·86	121·76	150·52	215·55	150·50	152·87	131·05	147·08
	Weavers	129·93	128·25	135·47	132·50	137·60	128·51	111·19	141·65	129·87
	Dressers	323·70	349·36	290·78	344·89	345·63	353·48	236·03	369·04	333·69

SUPPLEMENT (H.) (LOCAL).—Distributing the 17,390 Operatives employed in Manchester and in the immediate Neighbourhood, and concerning whom complete Returns were obtained, into the Eight different Branches of Cotton-working specified in General Supplement (B.), and exhibiting similar Results.

Employed in	Adults.		Children under Eighteen Years.						Total Number employed.	Total Number of Hours worked by them during the Month ending 4th May, 1833.	Average Number of Hours worked by each.	Aggregate Net Earnings for the Month ending 4th May, 1833.	Average Weekly Net Earnings of each Individual in each Branch, calculated for 69 Hours.
			Males.			Females.							
	Males.	Females.	In the Employ of Masters.	In the Employ of Operatives.	Employers uncertain.	In the Employ of Masters.	In the Employ of Operatives.	Employers uncertain.				£. s. d.	*Pence.*
Cleaning and spreading cotton	92	493	152	..	..	68	..	1	806	220,674·9	273·7	1,128 9 0½	84·68
Carding	783	1,352	404	3	5	579	41	..	3,167	866,545·1	273·6	6,205 17 4	118·59
Mule-spinning	1,745	606	364	2,147	12	233	1,058	7	6,172	1,690,261·1	273·8	12,959 3 10½	126·96
Throstle-spinning	90	388	181	..	9	286	..	18	972	265,255·6	272·8	1,500 8 4	93·67
Reeling	67	1,446	36	1	..	277	..	3	1,830	502,030·9	274·3	2,960 12 6	97·65
Weaving	1,127	1,407	251	197	..	507	347	..	3,836	1,029,429·1	268·3	7,920 14 10½	127·41
Roller covering	16	34	..	1	..	6	5	..	62	16,901·6	272·6	148 17 7½	145·87
And as engineers, mechanics, firemen, &c.	501	5	35	..	3	1	..	..	545	146,878·8	269·5	2,264 18 8½	255·36
	4,421	5,731	1,423	2,349	29	1,957	1,451	29	17,390	4,737,977·1	272·4	35,089 2 3½	122·64

SUPPLEMENT (H.)—*continued.*

In addition to the number of 17,390 Operatives, concerning whom complete Returns were obtained from Manchester and the immediate Neighbourhood, incomplete Returns were obtained regarding 5,052 others who were either employed in Mills working both night and day, or the duration of whose work was not stated by the hour. The Distribution of the total Number of 22,442, and the Aggregate of their Net Earnings, is as under. See List II., incomplete Returns.

Employed in	Total Number employed.	Aggregate Net Earnings for the Month ending 4th May, 1833.		
		£.	s.	d.
Cleaning and spreading cotton	912	1,275	6	8½
Carding	3,986	7,713	10	5½
Mule-spinning	7,458	15,767	8	1
Throstle-spinning	1,190	1,814	11	2½
Reeling	2,526	4,024	1	11½
Weaving	5,672	11,815	8	10½
Roller covering	82	202	18	8
And as engineers, mechanics, firemen, &c. .	616	2,551	3	5½
	22,442	45,164	9	5

SUPPLEMENT (I.) (LOCAL.)—Showing the Average Net Earnings of certain Classes of Operatives employed in the Four Processes of Carding, Mule-spinning, Throstle-spinning, and Weaving, in Manchester and immediate Neighbourhood.

Denomination of Process in which employed.	Class of Operatives.	Classification as respects Sex and Age.	Number of Persons employed.	Total Number of Hours worked by them during the Month ending 4th May, 1833.	Average Number of Hours worked by each.	Aggregate Net Earnings for the Month ending 4th May, 1833.	Average Weekly Net Earnings of each Individual in each Process, calculated for 69 Hours.
						£. s. d.	*Pence.*
Carding	Carders or overlookers.	Male adults	121	33,084·5	273·4	628 5 1¼	314·46
	Jack-frame tenters.	Principally female adults	192	52,600·7	273·9	330 2 0¼	103·26
	Bobbin-frame tenters.	Ditto ditto	182	49,841·0	273·8	310 15 11¼	103·92
	Drawing tenters	Ditto ditto	638	174,129·7	272·9	1,069 15 8¼	101·73
Mule-spinning	Overlookers	Male adults	57	15,565·3	273·0	368 19 7	392·55
	Spinners	Male and female adults, but principally the former	1,435	392,409·9	273·4	7,716 12 11¼	325·64
	Piecers	Male and female adults and non-adults, but principally the latter	2,697	738,404·9	273·7	3,137 16 11¼	70·37
	Scavengers	Male and female non-adults	884	241,598·1	273·3	483 14 2	33·15
Throstle-spinning	Overlookers.	Male adults	39	10,699·6	274·3	181 12 6	281·10
	Spinners	Female adults and non-adults	596	162,720·5	273·0	902 12 8	91·85
Weaving	Overlookers	Male adults	95	25,144·1	264·6	446 3 9	293·86
	Warpers	Male and female adults	86	23,428·8	272·4	201 8 1	142·35
	Weavers	Male and female adults, Male and female non-adults, but chiefly females	2,021	536,923·4	265·6	4,212 17 6	129·93
	Dressers	Male adults	133	36,415·7	273·8	711 16 6	323·70

TABLE I.—Total of Cotton Factories worked by Mechanical Power, in the United Kingdom, according to the Inspectors' Returns of 1835.

Countries.	Number of Factories.		Number and Ages of Persons employed.														
			Between 8 and 12 Yrs.			Between 12 and 13 Yrs.			Between 13 and 18 Yrs.			Above 18 Yrs.			Total Persons.		
	At work.	Empty.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.
England ..	1,070	42	4,030	3,073	7,103	9,196	7,865	17,061	23,974	29,869	53,843	50,675	53,410	104,085	87,875	94,217	182,092
Wales.....	5	...	...	...	...	56	33	89	146	208	354	250	458	708	452	699	1,151
Scotland...	159	...	454	538	992	1,258	1,832	3,090	2,845	7,597	10,442	6,168	12,403	18,571	10,529	22,051	32,580
Ireland ...	28	...	44	58	102	153	181	334	286	561	847	960	1,553	2,513	1,639	2,672	4,311
Total.....	1,262	42	4,528	3,669	8,197	10,663	9,911	20,574	27,251	38,235	65,486	58,053	67,824	125,877	100,495	119,639	220,134

TABLE II.—Total of Children, Young Persons, and Adults in all the Factories of the United Kingdom.

Totals.	Number of Factories at Work.	Number and Ages of Persons employed.														
		Between 8 and 12 Yrs.			Between 12 and 18 Yrs.			Totals.			Above 18 Years.			Total Persons.		
		Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females	Total.	Males.	Females.	Total.
England....	2,555	9,292	9,536	18,828	53,114	65,218	118,332	62,406	74,754	137,160	75,848	80,685	156,533	138,254	155,439	293,693
Wales.....	90	47	29	76	485	403	888	532	432	964	448	524	972	980	956	1,936
Scotland....	425	690	842	1,532	6,420	14,722	21,142	7,110	15,564	22,674	8,904	19,117	28,021	15,818	34,362	50,180
Ireland	90	58	94	152	1,150	2,563	3,713	1,208	2,657	3,865	2,099	3,085	5,184	3,503	6,061	9,564
Total.....	3,160	10,087	10,501	20,588	61,169	82,906	144,075	71,256	93,407	164,663	87,299	103,411	190,710	158,555	196,818	355,373

TABLE of the Working Power employed in the Cotton Factories of England.*

Counties.	Number of Factories.		Motive Force.						Power actually employed.	Number and Age of Persons Employed.		
			Number of			Amount estimated according to the Power of same in Horses.				Between Eight and Twelve Years.		
	At Work.	Empty.	Steam-Engines.	Water Wheels.	Total.	Steam.	Water.	Total.		Males.	Females.	Total.
Chester . . .	109	7	170	53	223	5,055	1,266	6,321	5,598	425	406	831
Cumberland . .	13	..	..	..	..	..	..	..	..	8	4	12
Derby	32	..	..	..	..	..	..	..	..	87	97	184
	60	3	33	58	91	553	853	1,406	1,270	95	95	190
Durham . . .	1	..	..	..	..	..	..	..	..	..	..	..
Lancaster . . .	683	32	714	233	947	20,302½	2,851	23,153½	21,207½	2,806	1,983	4,789
Leicester . . .	6	..	..	..	..	..	..	..	..	9	..	9
Middlesex . . .	7	..	..	..	..	..	..	..	..	22	..	22
Nottingham . .	20	..	..	..	..	..	..	..	..	17	23	40
Stafford . . .	9	..	..	..	..	..	..	..	..	35	49	80
	4	..	3	2	5	50	60	150	134	37	33	70
York, West Riding	126	..	75	129	204	1,317	1,403	2,720	2,231½	489	387	876
Total . .	1,070	42	..	..	..	..	..	..	..	4,030	3,073	7,10

* Excepting the Northern District under Mr. Horner's inspection. See his Table, pp. 356, 357.

TABLE of the Numbers and Ages of Persons in the Cotton Factories of the different Counties of England.

Counties.	Number and Age of Persons Employed—*(continued.)*											
	Between Twelve and Thirteen Years.			Between Thirteen & Eighteen Years.			Above Eighteen Years.			Total Persons.		
	Males.	Females	Total.	Males.	Females	Total.	Males.	Females	Total.	Males.	Females.	Total.
Chester . . .	1,448	1,206	2,654	3,672	4,315	7,987	9,971	10,069	20,040	15,516	15,996	31,512
Cumberland . .	57	38	95	169	332	501	392	658	1,050	626	1,032	1,658
Derby	261	289	550	550	998	1,548	940	2,003	2,943	1,838	3,387	5,225
	243	275	518	523	926	1,449	1,915	1,553	3,468	2,276	2,849	5,625
Durham . . .	..	2	2	1	11	12	8	11	19	9	24	33
Lancaster . . .	6,419	5,261	11,680	16,855	20,365	37,220	34,071	94,655	68,726	60,151	62,264	122,415
Leicester . . .	66	17	83	130	92	222	120	158	278	325	267	592
Middlesex . . .	24	..	24	109	14	123	62	119	181	217	133	350
Nottingham . .	82	131	213	132	382	514	250	706	956	481	1,242	1,723
Stafford . . .	33	68	101	95	237	332	152	392	544	315	742	1,057
	34	45	79	106	166	272	257	313	570	434	557	991
York, West Riding	529	533	1,062	1,632	2,031	3,663	2,537	2,773	5,310	5,187	5,724	10,911
Total . .	9,196	7,865	17,061	23,974	29,869	53,843	50,675	53,410	104,085	87,875	94,217	182,092

Mills and Factories in which the Machinery is worked by Mechanical
in the Northern half of Ireland (North of the county of Dublin), in the
moreland, and the North-east angle of Yorkshire, being the district assigned

Counties.	Manufacture.				
	Cotton.	Wool.	Flax.	Silk.	Total.
Lanark	74	2	..	2	78
Renfrew	41	2	2	4	49
Ayr	1	21	..	..	22
Bute	2	..	..	..	2
Dumbarton	4	1	..	..	5
Stirling	4	6	..	..	10
Clackmannan	..	17	..	..	17
Linlithgow	1	2	1	..	4
Edinburgh	..	..	3	..	3
Fife	..	1	46	..	47
Forfar	..	..	80	..	80
Perth	1	4	14	..	18
Kincardine	..	1	9	..	10
Aberdeen	4	6	4	..	14
Selkirk	..	11	..	..	11
Roxburgh	..	12	..	..	12
Dumfries	1	2	..	..	3
Kirkcudbright	1	..	..	..	1
Wigton	..	1	..	..	1
	134	86	159	6	388
Antrim	10	..	11	..	21
Derry	1	..	..	..	1
Down	3	..	1	..	4
Armagh	1	..	5	..	6
Meath	..	..	1	..	1
Mayo	1	..	..	..	1
	16	..	18	..	34
Cumberland	12	12	7	..	31
Northumberland	..	3	3	..	6
Durham	..	5	6	1	11
Westmoreland	..	1	..	..	1
Yorkshire*	..	..	3	..	3
	12	21	19	..	52

* No Return from a Mill near Gisborough.

Power, engaged in the Manufacture of Cotton, &c. in the whole of Scotland, counties of Cumberland, Northumberland, and Durham, a part of West- to Leonard Horner, Esq., Inspector of Factories, as reported in July, 1834.

Moving Power.			Total of Persons employed in the Factories.	Of whom, of Thirteen and under Eighteen Years.			Of whom under Thirteen Years.		
Steam.	Water.	Together.							
Total of Horses.	Total of Horses.			Male.	Female.	Total.	Male.	Female.	Total.
2,394	520	2,914	17,949	1,345	3,702	5,047	756	895	1,651
550	650	1,200	7,615	722	1,759	2,481	304	706	1,010
146	365	511	1,271	91	147	238	111	150	261
10	60	70	499	65	110	175	30	57	87
90	244	334	1,339	163	227	390	89	116	205
48	479	527	1,615	151	306	457	148	206	354
..	154	154	540	100	51	151	28	49	77
32	45	77	153	17	28	45	19	23	42
48	36	84	360	15	90	105	7	32	39
355	389	744	2,669	126	610	736	79	220	299
1,166	315	1,481	5,701	405	1,174	1,579	471	470	941
..	432	432	1,457	136	281	417	137	114	251
..	67	67	174	11	34	45	3	9	12
473	598	1,071	4,363	315	1,216	1,531	263	523	786
..	161	161	258	56	8	64	38	26	64
..	189	189	545	58	131	189	49	65	114
18	86	104	199	18	32	50	15	15	30
..	20	20	92	..	15	15	3	..	3
..	12	12	26	5	1	6	2	..	2
5,330	4,822	10,152	46,825	3,799	9,922	13,721	2,552	3,676	6,228
642	275	917	3,887	358	1,075	1,433	114	181	291
..	15	15	82	11	29	40	2	2	4
91	86	177	710	115	134	249	36	33	69
..	126	126	574	39	165	204	17	37	54
..	36	36	107	2	33	35	1	4	5
..	9	9	35	..	4	4	..	..	..
733	547	1,280	5,395	525	1,440	1,965	170	257	427
136	270	406	2,147	227	479	704	97	83	180
76	54	130	387	26	67	93	7	43	50
214	102	316	1,277	55	220	275	79	72	151
..	7	7	17	..	1	1	6	..	6
36	..	36	132	11	35	46	18	13	31
462	438	895	3,960	319	800	1,119	207	211	418

REPORT OF DR. KAY OF MANCHESTER TO THE COMMISSIONERS UNDER THE POOR LAW AMENDMENT ACT, 22d JULY 1835.

Quantity of Steam Power recently erected, but not supplied with Hands, or which is ordered and will be in Operation in a Year and a Half or Two Years, in the Cotton District of Lancashire and its immediate Vicinity.

Miles Distant from Manchester to Town, &c.	Name of Town, Township, or Parish, which form the Centre of the District so called.	Number of Firms to which the Power is to be supplied.	Number of Horse Power.
6	Township of Hyde . . .	9	486
8	Ashton and Dukinfield . .	8	640
7	Stayley Bridge	9	606
20	Saddleworth (Greenfield) .	1	60
5	Stockport	17	936
11	Rochdale (district) . . .	16	660
8	Heywood	3	78
12	Spotland	1	50
14	Bagslate	1	60
6	Birch	1	10
18	Accrington	1	50
10	Bolton (district)	19	755
12	Leigh	2	50
13	Horwich	2	175
20	Wigan	6	325
9	Bury	4	120
17	Haslingden	2	70
25	Burnley	7	241
26	Bacup (district)	8	196
20	Todmorden	7	285
30	Colne	3	100
30	Preston	10	422
12	Longdendale, near Mottram	4	70
20	Blackburn	4	280
20	Chorley	1	60
20	Bollington, near Macclesfield	1	80
17	Glossop-dale	7	187
	Manchester	12	395
	Oldham	3	60
	Total Horse Power .	..	7,507

From the preceding Table it appears that 7,507 horses' power will be erected, and, if possible, brought into opera-

tion in the cotton district of Lancashire in the course of the next two years. One only doubt affects the limit of the period when this power will be in full operation, and this arises from the difficulty of supplying, in that time, even with the utmost exertion of every mechanist in the trade, the machinery which this prodigious force is intended to move. The impossibility of accomplishing this will, in the opinion of some of the most experienced manufacturers, delay the period when this vast accession to the trade will be in full employ.

Within whatever period this power is brought into complete activity, (calculating on an extensive average of mills in different departments of the trade,) six "mill hands" at least will be required for every horse-power, or the introduction of this power presupposes the employment of 45,042 "mill hands;" and if we take into account the unemployed members of the families of "mill hands," as well as mechanics, labourers, handicraftsmen, warehousemen, dyers, calenderers, finishers, shopkeepers, &c. &c. &c., in fact the whole population necessary to complete the social fabric of which these 45,042 "mill hands" will form a part, we must add an equal number.

This steam power will, therefore, place in immediate relation with itself a population of 90,084.

The outlay in buildings and machinery necessary to bring this horse-power into operation may be safely estimated at £500 per horse-power, without taking into account the capital necessarily employed in trading transactions in connexion with the power; or, in other words, the erection of this power presupposes an outlay of £3,753,500 in buildings and machinery, and which outlay we have shown will occur in the cotton district of Lancashire within two years.

END OF VOL. I.

his plans, and communicating them to his piratical competitors, who, if left to their own resources, would never have made a single hank of good yarn. It was in this way that many of his most valuable contrivances, the fruits of much thought and exertion, were snatched up and spread abroad before he had time to mature them to his mind, and embody them in his second patent—so that he found his own ideas stolen and fraudulently turned against him by his adversaries in a court of justice.

The difficulties which Arkwright encountered in organizing his factory system, were much greater than is commonly imagined. In the first place, he had to train his work-people to a precision in assiduity altogether unknown before, against which their listless and restive habits rose in continual rebellion; in the second place, he had to form a body of accurate mechanics, very different from the rude hands which then satisfied the manufacturer; in the third, he had to seek a market for his yarns; and in the fourth, he had to resist competition in its most odious forms. From the concurrence of these circumstances, 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. One event has been adduced in evidence of the uncertainty of his condition, which ought to excite interest in his behalf. He parted from his wife in 1779, because she would not agree to join him in converting some landed property into money, for the sale of which her consent was required by law. The property was worth, it is said, little more than four hundred pounds. Mrs. Arkwright entertained a high esteem for her husband, and always

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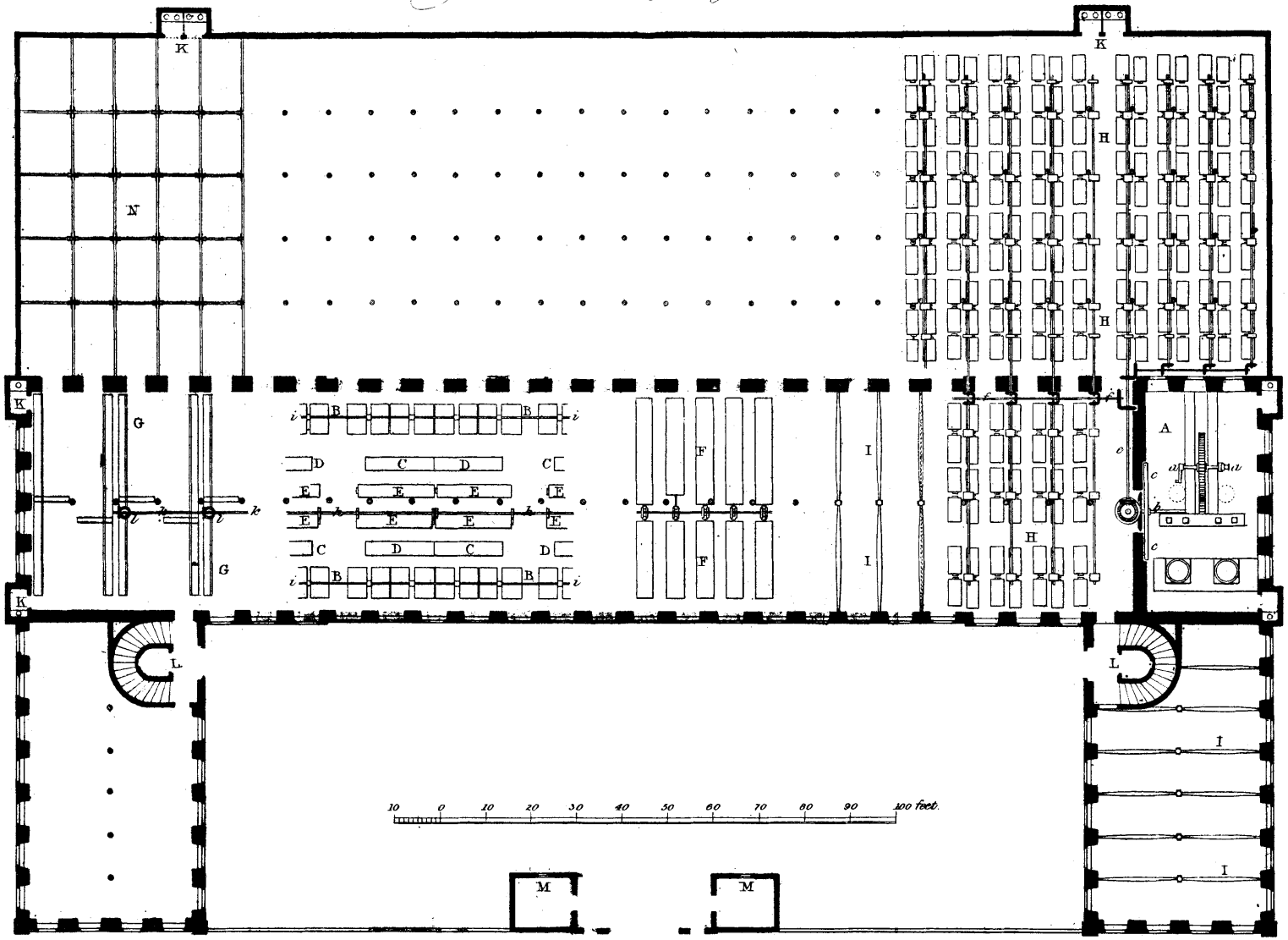
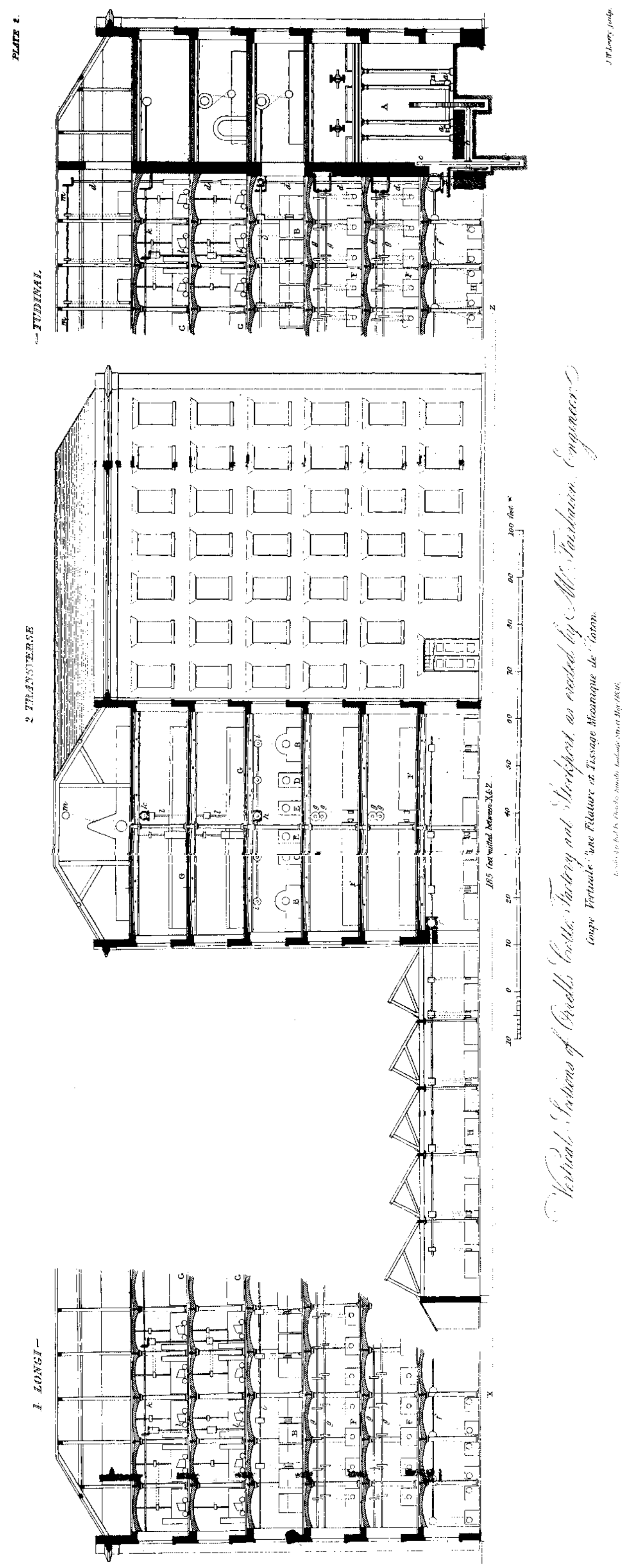
PLATE 1.

Plan of Orrell's Cotton Factory erected after designs by W. Fairburn Esq.r Manchester.



J.W.Lowry sculp.

Published May 1.1836 by Charles Knight Ludgate Street.



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