

cotton industry was imported into Europe, and by the middle of the 13th century we find it flourishing in Spain. In the New World it would seem to have originated spontaneously, since on the discovery of America the wearing apparel in use included cotton fabrics. After the collapse of Spanish prosperity before the Moors in the 14th century the Netherlands assumed a leadership in this branch of the textile industries as they did also in other branches. It has been surmised that the cotton manufacture was carried from the Netherlands to England by refugees during the Spanish persecution of the second half of the 16th century; but no absolute proof of this statement has been forthcoming, and although workers in cotton may have been among the Flemish weavers who fled to England about that time, and some of whom are said to have settled in and about Manchester, it is quite conceivable that cotton fabrics were made on an insignificant scale in England years before, and there is some evidence to show that the industry was not noticeable till many years later. If England did derive her cotton manufacture from the Netherlands she was unwillingly compelled to repay the loan with interest more than two hundred years later when the machine industry was conveyed to the continent through the ingenuity of Liévin Bauwens, despite the precautions taken to preserve it for the British Isles. About the same time English colonists transported it to the United States. Since, as transformed in England, the cotton industry, particularly spinning, has spread throughout the civilized and semi-civilized world, though its most important seat still remains the land of its greatest development.

As early as the 13th century cotton-wool was used in England for candle-wicks.¹ The importation of the cotton from the Levant in the 16th century is mentioned by Hakluyt,² and according to Macpherson it was brought over from Antwerp in 1560. Reference to the manufacture of cottons in England long before the second half of the 16th century are numerous, but the "cottons" spoken of were not cottons proper as Defoe would seem to have mistakenly imagined. Thus, for example, there is a passage by William Camden (writing in 1590) quoted below, in which Manchester cottons are specifically described as woollens, and there is a notice in the act of 33 Henry VIII. (c. xv.) of the Manchester linen and woollen industries, and of cottons—which are clearly woollens since their "dressyng and frisyng" is noted, and the latter process, which consists in raising and curling the nap, was not applicable to cotton textiles. John Leland, after his visit to Manchester about 1538, used these words—"Bolton-upon-Moore market standeth most by cottons; divers villages in the Moores about Bolton do make cottons." Leland, it is true, might conceivably be referring to manufactures from the vegetable fibre, but it is exceedingly unlikely, since the term "cottons" would seem to have been current with a perfectly definite meaning. The goods were probably an English imitation in wool of continental cotton fustians—which would explain the name. Again we may quote from the act of 5 and 6 Edward VI., "all the cottons called *Manchester*, Lancashire and Cheshire *cottons*, full wrought to the sale, shall be in length twenty-two yards and contain in breadth three-quarters of a yard in the water and shall weigh thirty pounds in the piece at least"; and from the act 8 Elizabeth c. xi., "every of the said cottons being sufficiently milled or thicked, clean scoured, well-wrought and full-dried, shall weigh 21 lb at the least."³ These are evidently the weights of woollen goods: further, it may be observed that milling is not applicable to cotton goods. The earliest reference to a cotton manufacture in England which may reasonably be regarded as pointing to the fabrication of textiles from cotton proper, is in the will of James Billston (a not un-English name), who is described as a "cotton manufacturer," proved at Chester in 1578.⁴ It may plausibly be contended that James Billston was a worker in the

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COTTON MANUFACTURE. The antiquity of the cotton industry has hitherto proved unfathomable, as can readily be understood from the difficulty of proving a universal negative, especially from such scanty material as we possess of remote age. That in the 5th century B.C. cotton fabrics were unknown or quite uncommon in Europe may be inferred from Herodotus' mention of the cotton clothing of the Indians. Ultimately the

¹ See the extract from the books of Bolton Abbey, given by Baines (p. 96) and dated 1298.

² Vol. ii. p. 206; Baines, pp. 96-97.

³ Baines, pp. 93 and 94.

⁴ Lancashire and Cheshire Record Society, vol. ii.

vegetable fibre, since otherwise "manufacturer of cottons" would have been a more natural designation. But the proof of the will of one cotton manufacturer establishes very little.

The next earliest known reference to the cotton industry proper occurs in a petition to the earl of Salisbury, made presumably in 1610, asking for the continuance of a grant for reforming frauds committed in the manufacture of "bambazine cotton such as groweth in the land of Persia being no kind of wool."¹ But a far more valuable piece of evidence, discovered by W. H. Price, is a petition of "Merchants and citizens of London that use buying and selling of fustians made in England, as of the makers of the same fustians."² Its probable date is 1621, and it contains the following important passages:—

"About twenty years past, divers people in this kingdom, but chiefly in the county of Lancaster, have found out the trade of making of other fustians, made of a kind of bombast or down, being a fruit of the earth growing upon little shrubs or bushes, brought into this kingdom by the Turkey merchants, from Smyrna, Cyprus, Acra and Sydon, but commonly called cotton wool; and also of linen yarn most part brought out of Scotland, and othersome made in England, and no part of the same fustians of any wool at all, for which said bombast and yarn imported, his majesty has a great yearly sum of money for the custom and subsidy thereof.

"There is at the least 40 thousand pieces of fustian of this kind yearly made in England, the subsidy to his majesty of the materials for making of every piece coming to between 8d. and 10d. the piece; and thousands of poor people set on working of these fustians.

"The right honourable duke of Lennox in 11 of Jacobus 1613 procured a patent from his majesty, of alnager of new draperies for 60 years, upon pretence that wool was converted into other sorts of commodities to the loss of customs and subsidies for wool transported beyond seas; and therein is inserted into his patent, searching and sealing; and subsidy for 80 several stuffs; and among the rest these fustians or other stuffs of this kind of cotton wool, and subsidy and a fee for the same, and forfeiture of 20s. for putting any to sale unsealed, the moiety of the same forfeiture to the said duke, and power thereby given to the duke or his deputies, to enter any man's house to search for any such stuffs, and seize them till the forfeiture be paid; and if any resist such search, to forfeit £10 and power thereby given to the lord treasurer or chancellor of the exchequer, to make new ordinances or grant commissions for the aid of the duke and his officers in execution of their office."

Here the date of the appearance of the cotton industry on an appreciable scale—it is questionable whether any importance should be attached to the expression "found out"—is given by those who would be speaking of facts within the memory of themselves or their friends as "about twenty years past" from 1621, and the annual output of the industry in 1621 is mentioned. Moreover, it is established by this document that for a time at least the cotton manufacture was "regulated" like the other textile trades. The date assigned by the petitioners for the first attraction of attention by the English cotton industry may be supported on negative grounds.

Baines assures us that William Camden, who wrote in 1590, devoted not a sentence to the cotton industry, though Manchester figures among his descriptions: "This town," he says, "excels the towns immediately around it in handsomeness, populousness, woollen manufacture, market place, church and college; but did much more excel them in the last age, as well by the glory of its woollen cloths (*laneorum pannorum honore*), which they call Manchester cottons, as by the privilege of sanctuary, which the authority of parliament under Henry VIII. transferred to Chester."³ It is significant too that in the Elizabethan poorlaw of 1601 (43 Elizabeth), neither cotton-wool nor yarn is included among the fabrics to be provided by the overseers to set the poor to work upon; though, of course, it might be argued that so short-stapled a fibre needed for its working, when machinery was rough, a skill in the operative which would be above that of the average person unable to find employment. However, a proposal was made in 1626 to employ the poor in the spinning of cotton and weaving wool.⁴

¹ *State Papers, Domestic*, lix. 5. See W. H. Price, *Quar. Jour. Econ.*, vol. xx.

² London Guildhall Library, vol. Beta, *Petitions and Parliamentary Matters (1620-1621)*, No. 16 (old No. 25).

³ The act referred to is 33 Henry VIII. c. xv., already mentioned.

⁴ Cunningham, *Growth of English Industry and Commerce* (1903), vol. ii. p. 623.

Prior to Mr Price's discovery of the petition mentioned above, the earliest known notice of the existence in England of a cotton industry of any magnitude was the oft-quoted passage from Lewes Roberts's *Treasure of Traffic* (1641), which runs: "The town of Manchester, in Lancashire, must be also herein remembered, and worthily for their encouragement commended, who buy the yarne of the Irish in great quantity, and weaving it, return the same again into Ireland to sell: Neither doth their industry rest here, for they buy cotton-wool in London that comes first from Cyprus and Smyrna, and at home work the same, and perfect it into fustians, vermillions, dimities and other such stuffs, and then return it to London, where the same is vented and sold, and not seldom sent into foreign parts."⁵

Despite Lewes Roberts's flattering reference, the trade of Manchester about that time consisted chiefly in woollen frizes, fustians, sackcloths, mingled stuffs, caps, inkles, tapes, points, &c., according to "A Description of the Towns of Manchester and Salford," 1650,⁶ and woollens for a long time held the first place. But before another century had run its course cottons proper had pushed into the first rank, though the woollen industry continued to be of unquestionable importance. In 1727 Daniel Defoe could write, "the grand manufacture which has so much raised this town is that of cotton in all its varieties,"⁷ and he did not mean the woollen "cottons," as he made plain by other references to the industry in the same connexion; but it was not until some fifty years later that the ousting of the woollen industry from what is now peculiarly the cotton district became unmistakable.⁸ As a rule the woollen weavers were driven farther and farther east—Bury lay just outside the cotton area when Defoe wrote—and finally many of them settled in the West Riding. Edwin Butterworth even tells of woollen weavers who migrated from Oldham to the distant town of Bradford in Wiltshire because of the decline of their trade before the victorious cotton industry. Much the same fate was being shared by the linen industry in Lancashire, which was forced out of the county westwards and northwards. The explanation of the three centralizations, namely of the woollen industry, the cotton industry and the linen industry, is not far to seek. The popularity of the fabrics produced by the rising cotton industry enabled it to pay high wages, which, indeed, were essential to bring about its expansion. This a priori diagnosis is supported by contemporary analysis: thus "the rapid progress of that business (cotton spinning) and the higher wages which it afford, have so far distressed the makers of worsted goods in that county (Lancashire), that they have found themselves obliged to offer their few remaining spinners larger premiums than the state of their trade would allow."⁹ The best operatives of Lancashire were attracted sooner or later to assist the triumphs of art over the vegetable wool. At the same time the scattered woollen and linen workers of Lancashire were suffering from the competition of rivals enjoying elsewhere the economies of some centralization, and the demand for woollen and linen warps in the cotton industry ceased after the introduction of Arkwright's water-twist. When the factory became common the economies of centralization (which arise from the wide range of specialism laid open to a large local industry) increased; moreover they were reinforced by the diminution of social friction and the intensification of business sensitiveness which marked the development of the 19th century. Once begun, the centralizing movement proceeded naturally with accelerating speed. The contrast beneath is an instructive statistical comment:—

⁵ Original edition, pp. 32, 33.

⁶ Aikin's *Description of the Country from Thirty to Forty Miles round Manchester*, p. 154.

⁷ *Tour*, vol. iii. p. 219.

⁸ For instance Radcliffe p. 61. Ogden (author of *A Description of Manchester, &c.*, published in 1783), if Aikin's "accurate and well-informed enquirer" by Ogden, says that the period of rapid extension of the cotton industry began about 1770. See also Butterworth's *History of Oldham* and the passage quoted below in the text.

⁹ Account of Society for Promotion of Industry in Lindsey (1789), Brit. Mus. 103, L. 56. Quoted from Cunningham's *English Industry and Commerce*, vol. ii. p. 452, n. ed., 1892.

Distribution of Cotton Operatives in 1838 and 1898-1899 (from Returns of Factory Inspectors).

	1838.	1898-1899.
Cheshire	36,400	34,300
Cumberland	2,000	700
Derbyshire	10,500	10,500
Lancashire	152,200	398,100
Nottinghamshire	1,500	1,600
Staffordshire	2,000	2,300
Yorkshire	12,400	35,200
England and Wales ¹	219,100	496,200
Scotland	35,600	29,000
Ireland	4,600	800
United Kingdom	259,300	526,000

The distribution of the industry has varied greatly in the two periods. If it had remained constant Lancashire would only have contained 300,000 operatives in 1899, instead of the actual 400,000. Scotland, on the other hand, only contained 30,000 instead of 70,000, and in Ireland the numbers were one-tenth of what they should have been. The percentage of operatives in Lancashire in 1838 was 58.5, but this increased to 75.7 in 1898.

Why, we may naturally inquire, did not the cotton industry localize in the West Riding or Cheshire and the woollen industry maintain its position in Lancashire? Accident no doubt partly explains why the cotton industry is carried on where it is in the various parts of the globe, but apart from accident, as regards Lancashire, it is sufficient answer to point to the peculiarly suitable congeries of conditions to be found there. There is firstly the climate, which for the purpose of cotton spinning is unsurpassed elsewhere, and which became of the first order of importance when fine spinning was developed. In the Lancashire atmosphere in certain districts just about the right humidity is contained on a great number of days for spinning to be done with the least degree of difficulty. Some dampness is essential to make the fibres cling, but excessive moisture is a disadvantage. Over the county of Lancashire the prevailing west wind carries comparatively continuous currents of humidified air. These currents vary in temperature according to their elevation. Hot and cold layers mix when they reach the hills, and the mixture of the two is nearer to the saturation point than either of its components. The degree of moisture is measured by the ratio of the actual amount of moisture to the moisture of the saturation point for that particular temperature. Owing to the sudden elevation the air is rarefied, its temperature being thereby lowered, and in consequence condensation tends to be produced. In several places in England and abroad, where there is a scarcity of moisture, artificial humidifiers have been tried, but no cheap and satisfactory one has hitherto been discovered. To the advantages of the Lancashire climate for cotton spinning must be added—especially as regards the early days of the cotton industry—its disadvantages for other callings. The unpleasantness of the weather renders an indoor occupation desirable, and the scanty sunshine, combined with the unfruitful nature of much of the soil, prevents the absorption of the population in agricultural pursuits. In later years the port of Liverpool and the presence of coal supplemented the attractions which were holding the cotton industry in Lancashire. All the raw material must come from abroad, and an enormous proportion of English cotton products figures as exports. The proximity of Liverpool has aided materially in making the cotton industry a great exporting industry.

Before the localization of the separate parts of the industry can be treated the differentiation of the industry must be described. We pass then, at this stage, to consider the manufacture in its earliest form and the lines of its development. First, and somewhat incidentally, we notice the early connexion between the conduct of the cotton manufacture, when it was a domestic

¹In 1838 the only other county with more than 1000 was Gloucester with 1500. 217,000 of the 219,100 operatives in England and Wales were employed in the counties enumerated. Of the 2000 operatives whose location is not given, about 1000 worked in Flintshire.

industry in its primitive form, and the performance of agricultural operations. A few short extracts will place before us all the evidence that it is here needful to adduce. First Radcliffe, an eye-witness, writing of the period about 1770, says "the land in our township (Mellor) was occupied by between fifty and sixty farmers . . . and out of these fifty or sixty farmers there were only six or seven who raised their rents directly from the produce of their farms, all the rest got their rent partly in some branch of trade, such as spinning and weaving woollen, linen or cotton. The cottagers were employed entirely in this matter, except for a few weeks in the harvest."² Next we may cite Edwin Butterworth who, though not an eye-witness (he was not born till 1812), proved himself by his researches to be a careful and trustworthy investigator. In the parish of Oldham, he recorded, there were "a number of master (cotton-linen fustian)³ manufacturers, as well as many weavers who worked for manufacturers, and at the same time were holders of land or farmers. . . . The number of fustian farmers who were cottagers working for manufacturers, without holding land, were few; but there were a considerable number of weavers who worked on their own account, and held at the same time small pieces of land."⁴ Other passages might be quoted, but these two will suffice. Weaving was not exactly a by-employment of farm labourers, but many weavers made agriculture a by-employment to some extent, (a) by working small parcels of land, which varied from the size of allotments to farms of a very few acres, and (b) by lending aid in gathering in the harvest when their other work enabled them to do so. The association of manufacturing and weaving survived beyond the first quarter of the 19th century. Of the weavers in many districts and "more especially in Lancashire" we read in the report of the committee on emigration, "it appears that persons of this description for many years past, have been occupiers of small farms of a few acres, which they have held at high rents, and combining the business of the hand-loom weaver with that of a working farmer have assisted to raise the rent of their land from the profits of their loom."⁵ One of the first lines of specialism to appear was the severing of the connexion described above, and the concentration of the weavers in hamlets and towns. Finer fabrics and more complicated fabrics were introduced, and the weaver soon learnt that such rough work as farming unfitted his hands for the delicate tasks required of them. Again, really to prosper a weaver found it necessary to perfect himself by close application. The days of the rough fabrics that anybody could make with moderate success were closing in. As a consequence the dispersion of the weavers becomes less and less. They no longer wanted allotments or farms; and their looms having become more complicated, the mechanic proved himself a convenient neighbour. Finding spinners too was an easier task in the hamlet or town than in the remote country parts. But there is no reason to suppose that agriculture and the processes of the domestic cotton manufacturer had ever been universally twin callings. There never was a time, probably, when weavers who did nothing but weave were not a significant proportion, if not the major part, of the class of weavers. All again were not independent and all were not employees. Some were simply journeymen in small domestic workshops; others were engaged by fustian masters or Manchester merchants and paid by the piece for what they made out of material supplied them; others again bought their warps and cotton and sold to the merchants their fabrics, which were their own property. The last class was swept away soon after the industry became large, when by the organization of men of capital consumers and producers were more and

Early system of manufacture and organisation.

² W. Radcliffe's *Origin of the New System of Manufacturing*, p. 59.
³ The term "fustian" had originally been used to designate certain woollen or worsted goods made at Norwich and in Scotland. A reference to Norwich fustians of as early a date as the 14th century is quoted by Baines.
⁴ E. Butterworth's *History of Oldham*, p. 101.
⁵ *Parliamentary Reports, &c.* (1826-1827), v. p. 5. See for even later examples Gardner's evidence to the committee on hand-loom weavers in 1835.

more kept in touch. In early days most weavers owned their looms, the great part of which they had frequently constructed themselves: later, however, a large number hired looms, and it was as usual in certain quarters for lodgings to be let with a loom as it is to-day for them to be provided with a piano. When it became customary for weavers to undertake a variety of work, the masters usually provided reeds (which had to vary in fineness with the fineness of the warp), healds, and other changeable parts, and sometimes they employed the gaiters to fit the new work in the looms.

Until the success of the water-frame, cotton could not be spun economically of sufficient strength and fineness for warps, and the warps were therefore invariably made of either linen or wool. Some were manufactured locally, others were imported from Germany, Ireland and Scotland. The weaver prepared them for his loom by the system of peg-warping,¹ but after the introduction of the warping-mill he received them as a rule all ready for insertion into the loom from the Manchester merchant or local fustian master.

"It did not pay the individual weaver to keep a warping-mill for occasional use only, and frequently the contracted space of his work-room precluded even the possibility of his doing so. The invention of the warping-mill necessitated specialism in warping, and it was essential that warping should be done to order, since at that time, the state of the industrial world being what it was, no person could ordinarily have been found to adventure capital in producing warps ready made in anticipation of demand for the great variety of fabrics which was even then produced. Moreover, had the weaver himself placed the orders for his warps, any occasional delay in the execution of his commissions might have stopped his work entirely until the warps were ready; for warps cannot be delivered partially, like weft, in quantities sufficient for each day's work. To ensure continuous working in the industry, therefore, it was almost inevitable that the merchant should himself prepare the warps for such fabrics as he required, or possibly have them prepared. To the system of the merchant delegating the preparation of warps there was less objection than to the system of the weaver doing so, since the merchant, dealing in large quantities, was more likely to get pressing orders completed to time. Further, the merchant knew first what kind of warps would be needed. The first solution, however, that of the merchant undertaking the warping himself, was the surer, and there was no doubt as to its being the one destined for selection in a period when a tendency to centralize organization, responsibility and all that could be easily centralized, was steadily gaining in strength."²

Guest says the system by which the weaver was supplied with warps and other material was substituted for the purchase of warps and cotton-wool by the weaver about 1740. No doubt the change was very gradual, especially as Aikin mentions the use of warping-mills in the 17th century. The weaver as a rule received his weft material in the form of cotton-wool and was required to arrange himself for its cleaning and spinning. According to Aikin,³ dealers tried the experiment of giving out weft instead of cotton-wool, but "the custom grew into disuse as there was no detecting the knavery of the spinners till a piece came in woven." As it was impossible to unwrap the yarn and test it throughout its length, defects were hidden until it came to be used, and the complaints of weavers were not conclusive as to the inferiority of the yarn, since their own bad workmanship might have had something to do with its having proved unsatisfactory. It was therefore found best to saddle the weaver with full responsibility for both the spinning and weaving. Women and children cleaned, carded and spun the cotton-wool in their homes. The cotton had to be more thoroughly cleaned after its arrival in this country. The ordinary process of cleaning was known as "willowing," because the cotton was beaten with willow switches after it had been laid out on a tight hammock of cords. The cotton used for fine spinning was also carefully washed; and even when it was not washed it was soaked with water and partially dried so that the fibres might be made to cling together.⁴ Most of the weaving was done by men, and until

¹ This is illustrated in one of the plates to Guest's *History of the Cotton Manufacture*.

² Chapman's *Lancashire Cotton Industry*, pp. 15 and 16.

³ Page 167.

⁴ Mrs Crompton, wife of Samuel Crompton, we are told, used to

the invention of the fly-shuttle they cast the shuttle from hand to hand in the manner of their remotest ancestors. For the making of the broader fabrics two weavers were required when the width was greater than the easy stretch of a man's arms. Sometimes cloths were woven wide and then split into two or more: hence the term "splits." This became a common practice when the hand-loom workers were groaning under the pressure of competition from the power-loom.

We now reach the era of the great inventions. In order to ensure clearness it will be desirable to consider separately the branches of spinning and weaving: to pass from the one to the other, and follow the chronological order, might cause confusion. First emphasis must be laid upon the point that it was not mechanical change alone which constituted the industrial revolution. No doubt small hand-loom factories would have become the rule, and more and more control over production would have devolved upon the factory master, and the work to be done would have been increasingly assigned by merchants, had the steam-engine remained but the dream of Watt, and semi-automatic machinery not been invented. The spirit of the times was centralizing management before any mechanical changes of a revolutionizing character had been devised. Loom-shops, in which several journeymen were employed, were not uncommon: thus "in the latter part of the last (18th) and the beginning of the present (19th) century," says Butterworth, describing the state of affairs in Oldham and the neighbourhood, "a large number of weavers . . . possessed spacious loom-shops, where they not only employed many journeymen weavers, but a considerable proportion of apprentice children." It is true that both the fly-shuttle and drop-box had been invented by that time, but the loom was still worked by human power. Specialism, however, was on the increase, the capitalist was assuming more control, and the operative was being transformed more and more into the mere executive agent. Further, as creative of enterprise, an atmosphere of freedom and a general economic restlessness, consequent upon the reaction against mercantilism, were noticeable. Great changes, no doubt, would soon have swept over Lancashire had a new source of power and big factories not been rendered essential by inventions in spinning.

The chief inventors were Lewis Paul and John Wyatt, James Hargreaves and Samuel Crompton. The two first originated the principle of spinning by rollers. Their patent was taken out in 1738, but no good came of it immediately, though many trials were made and moderately large sums of money were lost. Ultimately Richard Arkwright brought forward the same plan improved:⁵ his first patent was dated 1769. Over the real authorship of the fundamental idea there has been much controversy, and it has not been absolutely proved that the second inventor, whether Thomas Highs, Arkwright or John Kay (a clockmaker of Warrington who assisted Arkwright to construct his machine and is said by some to have told him of an invention by Highs), did not hit upon the device afresh in ignorance of the work already done. Even as between Paul and Wyatt it is not easy to award due measure of praise. Probably the invention, as a working machine, resulted from real collaboration, each having an appreciable share in it. Robert Cole, in his paper to the British Association in 1858 (reprinted as an appendix to the 1st ed. of French's *Life of Crompton*), championed the claims of Paul, but Mantoux, in his *La Révolution industrielle au XVIII^e siècle*, after studying the Wyatt MSS., inclines to attribute to Wyatt a far more important position, though he dissents from the view of Baines, who ascribes little or nothing to Paul.

Arkwright's prospects of financial success were much greater than those of his predecessors, because, first, there was more employ her son George shortly after he could walk, as a "dolly-peg" to tread the cotton in the soapy water in which it was placed for washing. See French's *Life of Crompton*, pp. 58-59 (3rd ed.). Rowbotham in his diary gives two accounts of fires which were caused by carelessness in drying cotton.

⁵ On the difference between the two machines see Baines's *History*, p. 138 et seq.

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Spinning and preparatory machinery.

need in his time of mechanical aids, and secondly, he was highly talented as a business man. In 1775 he followed up his patent of 1769 with another relating to machinery for carding, drawing and roving. The latter patent was widely infringed, and Arkwright was compelled to institute nine actions in 1781 to defend his rights. An association of Lancashire spinners was formed to defend them, and by the one that came to trial the patent was set aside on the ground of obscurity in the specifications. Arkwright again attempted to recover his patent rights in 1785, after the first patent had been in abeyance for two years. Before making this further trial of the courts he had thought of proceeding by petition to parliament, and had actually drawn up his "case," which he was ultimately dissuaded from presenting. In it he prayed not only that the decision of 1781 should be set aside, but that both patents should be continued to him for the unexpired period of the second patent, *i.e.* until 1789. In his "case" (*i.e.* the petition mentioned above) Arkwright stated that he had sold to numbers of adventurers residing in the different counties of Derby, Leicester, Nottingham, Worcester, Stafford, York, Hertford and Lancaster, many of his patent machines, and continued: "Upon a moderate computation, the money expended in consequence of such grants (before 1782) amounted to at least £60,000. Mr Arkwright and his partners also expended in large buildings in Derbyshire and elsewhere upwards of £30,000, and Mr Arkwright also erected a very large and extensive building in Manchester at the expense of upwards of £4000. Thus a business had been formed which already (he calculated) employed upwards of five thousand persons, and a capital on the whole of not less than £200,000."¹ It is impossible to discover exactly the rights of the matter. Certainly Arkwright had been intentionally obscure in his specifications, as he admitted, and for his defence, namely that it was to preserve the secret for his countrymen, there was only his word. He may have hoped to keep the secret for himself; and as to the originality of both inventions there were grave doubts. But Arkwright has received little sympathy, because his claims were regarded as grasping in view of the large fortune which he had already won. He began work with his first partners at Nottingham (when power was derived from horses) and started at Cromford in 1771 (where the force of water was used). Soon he was involved in numerous undertakings, and he remained active till his death in 1792. He had met throughout with a good deal of opposition, which possibly to a man of his temperament was stimulating. Even in the matter of getting protective legislation reframed to give scope to the application of the water-frame, a powerful section of Lancashire employers worked against him. This protective legislation must here be shortly reviewed.

In 1700 an act had been passed (11 & 12 William III. c. 10) prohibiting the importation of the printed calicoes of India, Persia and China. In 1721 the act 7 George I. c. 7 prohibited the use of any "printed, painted, stained or dyed calico," excepting only calicoes dyed all blue and muslins, neckcloths and fustians. This act was modified by the act 9 George II. c. 4 (allowing British calicoes with linen warps). Thus the matter stood as regards prints when Arkwright had demonstrated that stout cotton warps could be spun in England, and at the same time the officers of excise insisted upon exacting a tax of 6d. from the plain all-cottons instead of the 3d. paid by the cotton-linens, on the ground that the former were calicoes. Arkwright's plea, however, was admitted, and by the act 14 George II. c. 72 the still operative part of the act of 1721 was set aside, and the manufacture, use, and wear of cottons printed and stained, &c., was permitted subject to the payment of a duty of 3d. per sq. yd. (the same as the excise on cotton-linens) provided they were stamped "British manufactory." The duty was varied from time to time until its repeal in 1832.

Some more powerful force than that of man or horse was soon needed to work the heavy water-frames. Hence Arkwright placed his second mill on a water-course, fitting it with a water-wheel, and until the steam-engine became economical most of the new twist mills were built on water-

¹ Baines p. 183.

courses. On rare occasions the old fire-engines seem to have been tried.

The following passage quoted from a note in Baines's *History* illustrates the pressing need of the early mills: "On the river Irwell, from the first mill near Bacup, to Prestolee, near Bolton, there is about 900 ft. of fall available from mills, 800 of which is occupied. On this river and its branches it is computed that there are no less than three hundred mills. A project is in course of execution to increase the water-power of the district, already so great and so much concentrated, and to equalize the force of the stream by forming eighteen reservoirs on the hills, to be filled in times of flood, and to yield their supplies in the drought of summer. These reservoirs, according to the plan, would cover 270 acres of ground, and contain 241,300,000 cub. ft. of water, which would give a power equal to 6600 horses. The cost is estimated at £59,000. One reservoir has been completed, another is in course of formation, and it is probable that the whole design will be carried into effect."²

As early as 1788 there were 143 water-mills in the cotton industry of the United Kingdom, which were distributed as follows among the counties which had more than one.³

Lancashire	41	Flintshire	3
Derbyshire	22	Berkshire	2
Nottinghamshire	17	Lanarkshire	4
Yorkshire	11	Renfrewshire	4
Cheshire	8	Perthshire	3
Staffordshire	7	Midlothian	2
Westmorland	5	Isle of Man	1

The need of water to drive Arkwright's machinery, and its value for working other machinery, caused a strong decentralizing tendency to show itself in the cotton industry at this time, but more particularly in the twist-spinning branch. Ultimately the steam-engine (first used in the cotton industry in 1785) drew all branches of the industry into the towns, where the advantages of their juxtaposition—*i.e.* the external economies of centralization—could be enjoyed. Out of the crowding of the mills in one locality sprang the business specialism which has continued up to the present day. Here it will not be out of place to notice the appearance of the new power, electricity, in the cotton industry, the extension of which may involve striking economic changes. The first electric-driven spinning-mill in Lancashire, that of the "Acme" Spinning Company at Pendlebury, the work of which is confined to the ring-frame, was opened in 1905. Power is obtained from the stations of the Lancashire Power Company at Utwood near Radcliffe, some 5 m. distant.

The chief principle of the water-frame was the drawing out of the yarn to the required degree of tenacity by sets of gripping rollers revolving at different speeds. This principle is still applied universally. Twist was given by a "flyer" revolving round the bobbin upon which the yarn was being wound; the spinning so effected was known as throstle-spinning. The plan is still common in the subsidiary processes of the cotton industry, but for spinning itself the ring-frame, which appears to have been invented simultaneously in England and the United States (the first American patent is dated 1828), is rapidly supplanting the throstle-frame,⁴ though the "ooziness" of mule yarn has not yet been successfully imitated by ring-frame yarn. The great invention relating to weft-spinning was the jenny, introduced by James Hargreaves probably about 1764, and first tried in a factory four years later.⁵ Hargreaves unfortunately was unable to maintain his patent, because he had sold jennies before applying for protection. Crompton's mule, which combined the principles of the rollers and the jenny, was perfected about 1779. Both jennies and mules were known as "wheels," because they were worked in part by the turning of a wheel. As they could be set in motion without using much power, being light when of moderate

² Baines's *History of the Cotton Manufacture*, p. 86 n.

³ These figures are quoted from a pamphlet published in 1788 entitled "An Important Crisis in the Calico and Muslin Manufactory in Great Britain explained." Many of the estimates given in this pamphlet are worthless, but there seems no reason why the figures quoted here should not be at least approximately correct.

⁴ See article on COTTON-SPINNING MACHINERY.

⁵ Hargreaves' claim to this invention has been disputed, but no satisfactory evidence has been brought forward to disprove his claim. Hargreaves was a carpenter and weaver of Stand-hill near Blackburn, and died in 1778.

size, for a long time they were worked entirely by hand or partially with the aid of horses or water. The first jenny- and mule-factories were small for this reason, and also because skill in the operative was a matter of fundamental importance,¹ as it was not in twist-spinning on the water-frame. The size of the typical weft-spinning mill suddenly increased after the scope for the application of power was enlarged by the use of the self-actor mule, invented in 1825 by Richard Roberts, of the firm of Sharp, Roberts & Co., machinists, of Manchester. In 1830 Roberts improved his invention and brought out the complete self-actor. Self-actors had been put forward by others besides Roberts—for instance by William Strutt, F.R.S. (son of Arkwright's partner), before 1790; William Kelly, formerly of Lanark mills, in 1792; William Eaton of Wiln in Derbyshire; Peter Ewart of Manchester; de Jongh of Warrington; Buchanan, of Catrine works, Scotland; Knowles of Manchester; and Dr Brewster of America²—but none had succeeded. And Roberts's machines did not immediately win popularity. For a long time the winding done by them was defective, and they suffered from other imperfections. Broadly speaking, until the American Civil War the number of hand-mules in use remained high. It was for the fine "counts" in particular that many employers preferred them.³ About the end of the 'sixties, however, and in the early 'seventies, great improvements were effected in machinery, partly under the stimulus of a desire to elevate its fitness for dealing with short-staple cotton, and it became evident that hand-mules were doomed. Here we may suitably refer to the scutching machine for opening and cleaning cotton, invented by Mr Snodgrass of Glasgow in 1797, and introduced by Kennedy⁴ to Manchester in 1808 or 1809; the cylinder carder invented by Lewis Paul and improved by Arkwright; and the lap-machine first constructed by Arkwright's son.

We now transfer our attention to that accumulation of improvements in manufacturing (as weaving is technically termed) which, taken in conjunction with the inventions already described, presaged the large factory system which covers Lancashire to-day. Gradually, for many years, the loom had been gathering complexities, though no fundamental alteration was introduced into its structure until 1738, when John Kay of Bury excited the wrath of his fellow-weavers by designing and employing the device of the fly-shuttle. For some unfathomable reason—for the opposition of the weavers hardly explains it, though they expressed their views forcibly and acted upon them violently—this invention was not much applied in the cotton industry until about a quarter of a century after its appearance. The plan was merely to substitute for human hands hammers at the ends of a lengthened lathe along which the shuttle ran, the hammers being set in motion by the jerking of a stick (the picking peg) to which they were attached by strings. The output of a weaver was enormously increased in consequence. In 1760 John Kay's son Robert added the drop-box, by the use of which many different kinds of weft could be worked into the same fabric without difficulty. It was in fact a partitioned lift, any partition of which could be brought to a level with the lathe and made for the time continuous with it. The drop-box usefully supplemented the "draw-boy," or "draught-boy," which provided for the raising of warps in groups, and thereby enabled figured goods to be produced. The "draw-boy" had been well known in the industry for a long time; in 1687 a Joseph Mason patented an invention for avoiding the expense of an assistant to work it,⁵ but there is no evidence to show that his invention was of

practical value. Looms with "draw-boys" affixed, which could sometimes be worked by the weavers themselves, later became common under the name of harness-looms, which have since been supplanted by Jacquard looms, wherein the pattern is picked out mechanically.

The principle of the fly-shuttle was a first step towards the complete mechanizing of the action required for working a loom. The second step was the power-loom, the initial effort to design which was created by the tardiness of weaving as contrasted with the rapidity of spinning by power. After the general adoption of the jenny, supplies of yarn outran the productive powers of the agencies that existed for converting them into fabrics, and as a consequence, it would seem, some yarn was directed into exports which might have been utilized for the manufacture of cloth for export had the loom been more productive. The agitation for the export tax on yarn at the end of the 18th, and in the first years of the 19th century, is therefore comprehensible, but there was no foundation for some of the allegations by which it was supported. For a large proportion of the exported yarn, fabrics could not have been substituted, since the former was required to feed the hand-looms in continental homes and domestic workshops, against much of the product of which there was no chance of competing. The hand-loom was securely linked to the home of the peasant, and though he would buy yarn to feed his loom he would not buy cloth and break it up.⁶

Cartwright's loom was not the first design adapted for weaving by power. A highly rudimentary and perfectly futile self-actor weaving machine, which would have been adapted for power-working had it been capable of working at all, had been invented by a M. de Gennes: a description of it, extracted from the *Journal de sçavans*, appeared in the *Philosophical Transactions* for July and August 1678, and again in the *Gentleman's Magazine* in 1751 (vol. xxi. pp. 391-392). It consisted of mechanical hands, as it were, that shot in and out of the warp and exchanged the shuttle.⁷ Another idea, which however proved fruitful, was that of grinding the shuttle through the warps by the agency of cog-wheels working at each end upon teeth affixed to the upper side of the shuttle. Though shuttles could not in this fashion be set in rapid movement, the machine turned out to be economical for the production of ribbons and tapes, because many pieces could be woven by it at once. These contrivances were known as swivel-looms, and in 1724 Stukeley in his *Itinerarium curiosum* wrote that the people of Manchester have "looms that work twenty-four laces at a time, which was stolen from the Dutch." Ogden says also that they were set up in imitation of Dutch machines by Dutch mechanics invited over for the purpose. Another interesting passage relating to the swivel-looms will be found in the rules of the Manchester small-ware weavers dated 1756, where the complaint is made that the masters have acquired by the employment of "engine or Dutch looms such large and opulent fortunes as hath enabled them to vie with some of the best gentlemen of the country," and it is alleged that these machines, which wove twelve or fourteen pieces at once, "were in use in Manchester thirty years ago."⁸ One power-factory at least was devoted to them as early as 1760, namely that of a Mr Gartside at Manchester, where water-power was applied, but the enterprise failed.⁹ Cartwright's invention was probably perfected in its

⁶ For further analysis of the arguments current see Chapman's *Lancashire Cotton Industry*, pp. 66 et seq.

⁷ Also in the 17th century a John Barkstead was granted a patent for a method of manufacturing cotton goods, but the method is not described. 1691, Specification 276.

⁸ In the parliamentary reports (1840), xxiv. p. 611, the invention of the swivel-loom is claimed for a "Van Anson." It is a plausible supposition that by "Van Anson" is meant Vaucanson, as he appears to have improved the swivel-loom. But he could not have been the original inventor, since in 1724 (that is, when Vaucanson was at the most fifteen years of age) they were being employed in Manchester.

⁹ Aikin, pp. 175-176, and Guest, p. 44. An explanation of the mechanism of the swivel-loom will be found in the *Encyclopédie méthodique, manufactures, arts et métiers*, pt. i. vol. ii. pp. 202, 208, and *Recueil de planches*, vol. vi. (1786), pp. 72-78.

¹ See Chapman's *Lancashire Cotton Industry*, pp. 59 et seq.

² See Baines p. 207.

³ "Counts" are determined by the number of hanks to the lb. A hank is 840 yds. The origin of the hank of 840 yds. is probably that spinners used a winding-reel of $1\frac{1}{2}$ yds. in circumference, so that 80 threads (one "lea" or "rap" according to old phraseology) would contain 120 yds., and seven leas (i.e. a hank) would contain 840 yds. A hank of seven leas was the common measure in the woollen industry, in which the reels were 1 yd. or 2 yds. in circumference. For details see an article on the subject in the *Textile World Record*, vol. xxxi. No. 1.

⁴ The author of the memoir of Crompton (see bibliography).

⁵ Specification 257.

first form about 1787, but many corrections, improvements and additions had to be effected before it became an unqualified success. Cartwright's original idea was elaborated by numerous followers, and supplementary ideas were needed to make the system complete. Of the latter the most important were those due to William Radcliffe, and an ingenious mechanic who worked with him, Thomas Johnson, which were patented in 1803 and 1804. They related to the dressing of the warp before it was placed in the loom, and for the mechanical taking up of the

cloth and drawing forward of the warp, so that the loom had not to be stopped for the cloth to be moved on and the warp brought within play of the shuttle to be sized. Looms fitted with the latter of these devices were known as "dandy" looms. The looms that followed need not be described here, nor need we concern ourselves with the degree in which some were imitations of others. It is of interest to note, however, in view of recent developments, that one of Cartwright's patents included a warp-stop motion, though it was never tried practically so far as the writer is aware. Looms with warp-stop motions are now common in the United States, as are also automatic looms, but both are still the exception in Lancashire for reasons that will be sketched later.

Power-looms won their way only very gradually. Cartwright and others lost fortunes in trying to make them pay, but the former was compensated by a grant of £10,000 from government. In 1813 there were 2400 only in the whole of the United Kingdom; in 1820 there were 14,000, beside some 240,000 hand-looms; in 1829, 55,500; in 1833, 100,000; and in 1870, 440,700.¹ To-day there are about 700,000 in the cotton industry. The beginning, and the final consequences, of the competitive pressure of the power-looms may be read in the reports of official inquiries and in Rowbotham's diary.² It was upon the fine work that the hand-loom weavers retained their last hold. In 1829 John Kennedy wrote in his paper to the Manchester Literary and Philosophical Society on "The Rise and Progress of the Cotton Trade," "It is found . . . that one person cannot attend upon more than two power-looms, and it is still problematical [even in 1829, observe] whether the saving of labour counterbalances the expense of power and machinery and the disadvantage of being obliged to keep an establishment of power-looms constantly at work." It was not easy to obtain a sufficiency of good hands for the power-looms, because the operatives, who had acquired their habits under the domestic system, hated factory life. This, in conjunction with the ease with which the art of coarse weaving could be acquired and the cheapness of rough looms, helps to explain the wretched straits into which the hand-loom weavers were driven.

Improvements in machinery, which ultimately affected every process from cleaning the cotton to finishing the fabric, and the application of water and steam-power, so lowered the cost of production as to render Lancashire the cotton factory of the world. Figures are quoted in the table to show the rate of growth in different periods of England's imports and exports as regards the raw material and products of this industry. It is important to remember when reading the last 6 columns that the value of money was the same in 1831-1835, 1851-1855

and 1876-1880: the sums of Sauerbeck's index numbers for these periods were 454, 451 and 444 respectively. In the last two periods there were considerable depressions in prices. If prices had remained constant, in the periods 1891-1895 and 1896-1900 the figures of exports would have been £90 millions and £91 millions respectively. The growth in trade has been partly occasioned by the enormous increase in the volume of cotton goods consumed all over the world, which in turn has been due to (1) the growth of population, (2) the increase in productive

Year.	Imports of Raw Cotton, Million lb.	Raw Cotton re-exported, Million lb.	Exports of Cotton Yarns and Manufactures, Million £.			Imports of Cotton Yarns and Manufactures, Million £.		
			Yarns.	Manu- factures.	Total.	Yarns.	Manu- factures (excluding Lace).	Total.
1700-1705	1.17	..	..	..	..	..	..	..
1771-1775	4.76	..	..	..	..	..	..	..
1785-1789	..	..	..	..	1.07 ³	..	..	..
1791-1795	26.00	..	..	..	2.09 ³	..	..	..
1816-1820	139.00	10.6	2.5	13.8	16.30	..	..	..
1831-1835	313.00	23.0	4.8	14.2	19.00	..	..	..
1851-1855	872.00	124.0	6.8	24.9	31.70	..	..	..
1876-1880	1456.00	180.0	12.4	56.1	68.30	..	2.29	2.29
1891-1895	1746.00	217.0	9.7	56.6	66.30	.42	2.78	3.20
1896-1900	1798.00	223.0	8.9	58.2	67.10	.26	4.27	4.53
1901-1905	1920.00	265.0	8.4	70.7	79.10	.22	5.10	5.32

efficiency and well-being, and (3) the substitution of cotton fabrics for woollen and linen fabrics. The rate of growth between the periods 1771-1781 and 1781-1791 (which is not shown in the above table) was particularly remarkable, and reached as high a figure (when measured by importations of weight of cotton) as 320%.

Nothing is more interesting in the cotton industry than the processes of differentiation and integration that have taken place from time to time. Weaving and spinning had been to a large extent united in the industry in its earliest form, in that both were frequently conducted beneath the same roof. With mechanical improvements in spinning, that branch of the industry became a separate business, and a substantial section of it was brought under the factory régime. Weaving continued to be performed in cottages or in hand-loom sheds where no spinning at all was attempted. Cartwright's invention carried weaving back to spinning, because both operations then needed power, and the trouble of marketing yarn was largely spared by the reunion. Mr W. R. Grey stated in 1833 to the committee of the House of Commons on manufactures, commerce and shipping, that he knew of no single person then building a spinning mill who was not attaching to it a power-loom factory. Some years later the weaving-shed split away from spinning, partly no doubt because of the economies of industrial specialism, partly because of commercial developments, to be described later, which rendered dissociation less hazardous than it had been, and partly because, in consequence of these developments, much manufacturing (as weaving is termed) was constituted a business strikingly dissimilar from spinning. The manufacturer runs more risks in laying by stocks than the spinner, because of the greater variety of his product and the more frequent changes that it undergoes. The former, therefore, must devote more time than the latter to keeping his order book and the productive power of his shed in close correspondence. The minute care of this kind that must be exercised in some classes of businesses explains why the small manufacturer still holds his own while the small spinner has been crushed out. It also explains to some extent the prevalence of joint-stock companies in spinning, and their comparative rarity in manufacturing. Here we should notice, perhaps, that the only combination of importance in the cotton industry proper (apart from calico-printing, bleaching, &c., and the manufacture of sewing-cotton) is the Fine Cotton Spinners and Doublers Association, founded in 1898, which is practically coextensive with fine spinning and doubling.

³ Official values.

¹ Figures for the years above up to 1838 will be found in parliamentary reports (1840), xxiv. p. 611.

² This is the manuscript diary of a weaver of Oldham roughly covering the period 1787 to 1830. It is now in the Oldham public library. Mr S. Andrew edited extracts from it in a series of articles in the *Standard* (an Oldham paper), under the title *Annals of Oldham*, beginning January 1, 1887.

The specialism of the two main branches of the industry has been followed by the specialism of sub-branches and by the localization of specialized parts. Of the localization of certain sections of the cotton industry the late Mr Elijah Helm, who spoke with the authority of great local knowledge, has written as follows:—

“ Spinning is largely concentrated in south Lancashire and in the adjoining borderland of north Cheshire. But even within this area there is further allocation. The finer and the very finest yarns are spun in the neighbourhood of Bolton, and in or near Manchester, much of this being used for the manufacture of sewing-thread; whilst other descriptions, employed almost entirely for weaving, are produced in Oldham and other towns. The weaving branches of the industry are chiefly conducted in the northern half of Lancashire—most of it in very large boroughs, as Blackburn, Burnley and Preston. Here, again, there is a differentiation. Preston and Chorley produce the finer and lighter fabrics; Blackburn, Darwen and Accrington, shirtings, dhooties and other goods extensively shipped to India; whilst Nelson and Colne make cloths woven from dyed yarn, and Bolton is distinguished for fine quiltings and fancy cotton dress goods. These demarcations are not absolutely observed, but they are sufficiently clear to give to each town in the area covered by the cotton industry a distinctive place in its general organization.”¹

The present local distribution of the cotton industry, as far as it is displayed statistically, is revealed in the table beneath, based upon the figures of spindles and looms given by Worrall and those of operatives in the census returns of 1901.

Distribution of Cotton Operatives in Lancashire and the Vicinity according to the Census Returns of 1901, together with the Number of Spindles and Looms according to Worrall.

	No. of Operatives.	No. of Spindles (in Thousands).	No. of Looms.
Blackburn	41,400	1,325	75,300
Bolton	29,800	5,035	20,100
Oldham	29,500	11,603	18,500
Burnley	27,900	687	79,300
Manchester and Salford	27,200	2,666	24,200 ²
Preston	25,000	2,036	57,900
Rochdale	14,800	2,168	25,100
Darwen	12,500	336	28,700
Nelson	12,400	23	39,000
Glossop ³ . . . . .	..	968	15,400
Bury	10,700	818	22,200
Stockport	9,700	1,803	8,700
Ashton-under-Lyne	8,600	1,839	11,500
Accrington	8,300	417	36,400
Colne	7,300	140 ⁴	20,500
Heywood	7,300	869	6,400
Stalybridge	7,100	1,106	7,100
Todmorden	6,900	261	15,800
Rawtenstall	6,600	356	8,800
Hyde	6,500	553	7,900
Chadderton	6,400	..	..
Haslingden	6,100	148	12,000
Bacup	5,900	315	9,300
Chorley	5,900	547	17,900
Farnworth, near Bolton	5,700	738	10,600
Leigh	5,000	1,667	5,900
Great Harwood	4,900	72	12,400
Middleton	4,900	511	2,500
Radcliffe	4,800	157	8,900

Local markets have steadily lost in importance, partly owing to railway development, and it is now almost entirely in Manchester, on the Exchange, that dealing in yarns and fabrics takes place, and arrangements are made for export. The old Manchester Exchange, built in 1729, was taken down in 1792. A new Exchange, reared on a contiguous site, was opened in 1809, the first stone having been laid in 1806. The present building was erected in 1869. The great bulk of the exports of cotton goods proceeds from Liverpool, though London used to be the leading port, and Liverpool is still the chief English market for raw cotton, though now from one-sixth to one-eighth of English cotton supplies come up the Manchester Ship Canal.

¹ Printed in *British Industries*. Edited by W. J. Ashley.

² Manchester only.

³ The number of operatives in places in Derbyshire is not separately specified.

⁴ Includes Foulridge with Colne.

To understand the present organization of the cotton industry the reader must begin by mentally separating the commercial from the industrial functions. By the industrial functions are meant the arrangements of factors in production—choosing the most suitable machinery and hands, combining them in the most economical system, adapting the material used to this system, and keeping it working at the highest attainable level. The commercial functions consist in business which is not industrial. Analysis will show that there are, broadly speaking, two classes of commercial functions, namely (1) arranging for purchases and sales, and (2) the bearing of risks. The character of the former is apparent: it consists, as regards yarn, in discovering for each manufacturer which spinner makes the yarn which is best adapted to his requirements at the lowest cost, and in finding the most suitable customers for spinners. Risk-bearing is a commercial function of another kind. Every business that involves anticipation involves commercial risks. Thus the spinner who sells “forward” yarn, trusting that the price of cotton will not rise, is taking commercial risks, and so is the spinner who produces for stock, trusting that the class of yarn that he is making will continue in demand. These two instances will suffice to indicate what is meant by the carrying of commercial risks. To make the rest of our argument clear it will be well to write down formulae. Let A and B represent respectively the industrial operations of spinning and manufacturing. Let a and a represent respectively the commercial operations implied by the separate existence of A, that is, the buying of cotton and the selling of yarn; and let b and β stand for the commercial operations associated with manufacturing, that is, the buying of yarn on the one hand, and the finding of customers and arranging for their purchases on the other hand. Then, A and B being distinct businesses, it is obvious that a range of schemes is possible of which the extremes may be roughly represented as follows:—

1. (aAa), (bB β)
2. (a), (A), (ab), (B), (β),

where the brackets signify independent businesses. In case 1 each spinning business would be engaged with three problems, namely, (i.) buying material at the most favourable time, (ii.) producing at the lowest cost, and (iii.) finding buyers and selling at the highest price, including the arranging for the performance of the most remunerative work. But in case 2 the spinner would confine his attention to purely industrial matters, while the problem of finding cotton and arranging for the bearing of the risks as to future prices would rest with other persons, and the business of bringing spinner and manufacturer together and taking such risks as may be involved in ordering or disposing of yarn would be the function of yet others. In case 2 the commercial functions may be said to have differentiated completely from the main body of the industry. We need hardly give illustrations of the intermediate arrangements that formally lie between cases 1 and 2. A may retain commercial risks but find customers through intermediaries; in such an event there would be only partial differentiation of the commercial functions. The reader must be reminded also that for the sake of simplicity in the formulae we have overlooked different classes of A and of B, omitted bleaching, dyeing, printing and finishing, and drawn no distinction between the various classes of commercial work covered by one letter, for instance, selling in the home market and selling abroad.

It may help the reader to appreciate the organic growth of the cotton industry if we now run over the main lines of its evolution. Originally the industrial units were held together in one homogeneous commercial setting. The Manchester merchants bought cotton and warps, put them out to the weavers, and arranged for the finishing of the cloth and then for its sale, so far as they had not been acting on orders already received. There were variations of this system—for instance, in early years weavers sometimes bought their own yarns and cotton and sold their cloth—but just before the industrial revolution the arrangement sketched above was the most usual. Adverting to our formula, the Manchester merchants, we observe, performed functions

*Modern
organiza-
tion.*

a (in conjunction with importers), b (as regarded warps), and β. Weft the weaver had to get spun by his family or outsiders. So, broadly speaking, there was one single commercial setting. After the appearance of the factory, the commercial work as between the water-twist mills, the mule-spinning businesses and the manufacturers, so far as the businesses were distinct, appears to have been done by the several producing firms concerned. It was not at once that (ab) began to differentiate. β was already a separate business in the hands of Manchester merchants and the foreign houses who had established themselves in Manchester to direct the export trade. At the present time an advanced stage of commercial specialism has been reached. From the risks connected with the buying of cotton the spinner may if he please escape entirely.¹ Selling work is now done usually through intermediaries, but there is no one uniform rule as to the carrying of the commercial risks involved. This appears to be now to some extent a matter of arrangement between the persons concerned, but ultimately no doubt the risks will have to be borne by those most qualified by experience to bear them, namely, the commercial specialists. In no other trade in England, and in no other cotton industry abroad, has commercial specialism been carried so far as in the cotton trade of Lancashire. It is partly in consequence of the difference in this respect between the cotton industry in Lancashire and abroad that the separation of spinning from weaving is far more common in England than elsewhere. Elsewhere producers are deterred from specializing processes further in distinct businesses by the fear of the worries of buying and selling as between them.

The explanation of differences in respect of the degree of commercial specialism in different places and industries can be formulated only very generally. Time is required for the differentiation and localization to take place. The English cotton trade had not advanced very far in the "thirties," if we are to judge from the evidence given to commissions and parliamentary committees. The general conditions under which commercial specialism evolves may be taken to be a moderately limited range of products which do not present many varieties, and the qualities of which can be judged generally on inspection. In such circumstances private markets need not be built up, as they must be, for instance, for a new brand of soap which claims some subtle superiority to all others. Soaps under present conditions must be marketed by their producers. Broadly stated, if there be little competition as to substitutes, though there may be much as to price in relation to quality, commercial functions may specialize. On the whole this is the case in the cotton industry; in so far as it is not and firms

produce specialities, they undertake much of the marketing work themselves.

The advantages of commercial specialism are numerous. Firstly it allows of differentiation of industrial processes, and this, of necessity, is accompanied by increasing returns. When weaving dissociates from spinning, both the number of looms in each business and the number of spindles in each business tend to increase; more division of labour is therefore secured, and lower costs of production are reached, and there is a further gain because producers concentrate their attention upon a smaller range of work. Again when producers are freed entirely, or to some extent, from commercial worries, they can attain a higher level of efficiency at the industrial task of mill organization, and a more perfect accommodation of capacity to function will be brought about. If the business unit is (aAα), a particular person may retain his place in the market by reason of his excellence at the work a or α, though as works organizer (*i.e.* at the performances of function A) he may be incompetent. The heads of businesses will succeed according to their average capacities at the three tasks a, A and α, and there is no guarantee, therefore, that any one of these tasks will be performed with the highest attainable efficiency in our present somewhat immobile economic system. But if the three functions are separated there is more certainty of a person's success in the performance of each determining his continued discharge of it. The problems that arise when specialized markets become very highly developed are dealt with in the article COTTON: *Marketing and Supply*.

The distribution of cotton operatives among the chief centres has already been shown, but their distribution between processes has yet to be considered, and the proportions of different ages and sexes from time to time, together with the total. With such statistical material as is available relating to supplies of labour we may set forth also the official returns made of the quantity of machinery at work from time to time. It hardly need be pointed out that the ratio of machinery to operatives roughly measures the efficiency of labour, other things being equal.

Operatives in various processes.

Machinery in the United Kingdom (in Thousands).

Years.	Spinning Spindles.	Doubling Spindles.	Power-Looms.
1874	37,516	4366	463
1878	39,528	4679	515
1885	40,120	4228	561
1890	40,512	3993	616
1903	43,905	3952	684

Operatives employed in the Cotton Industry (in Thousands). (From the Census Returns.²)
(The figures in italics relate to Married and Widowed Women.)

	1901.				1891.				1881.			
	Lancashire.		England and Wales.		Lancashire.		England and Wales.		Lancashire.		England and Wales.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Cotton, card and blowing-room processes	11.4	28.7	13.8	34.0	..	..	..	..	..	..	..	..
Cotton spinning processes	49.5	19.6	64.1	28.6	..	..	..	..	..	..	..	..
Cotton winding, warping, &c.	14.8	38.6	18.3	48.9	..	..	..	..	..	..	..	..
Cotton weaving, warping, &c.	57.6	113.5	66.1	130.8	..	..	..	..	..	..	..	..
Total	133.3	265.9	162.3	320.7	178.2	281.8	213.2	332.8	150.7	249.8	185.4	302.4
Cotton workers in other processes or undefined	29.0	6.7	34.5	9.4	..	..	..	..	..	..	..	..
Tape, manufacturer dealer	..	1.8	..	2.3	..	..	..	..	..	..	..	..
Thread, manufacturer dealer	..	..	..	..	..47	..25	..9	..1.5	..4	..24	..7	..1.2
Fustian, manufacturer dealer	..6	1.2	2.1	2.6	1.1	2.9	3.2	5.0	1.7	3.5	3.0	5.2
Cotton, calico, warehouseman, dealer	..	..55	..	1.0	..	..	..	..	2.5	3	3.2	3.8

¹ This is explained in the article COTTON: *Marketing and Supply*.

² Census classifications have been altered twice in the period covered by this table.

COTTON MANUFACTURE

In Scotland there are less than 15,000 cotton operatives distributed as follows:—

	In Thousands.
Card and blowing-room processes	4
Spinning-room processes	2.1
Winding, warping, &c.	2.7
Weaving, warping, &c.	6.8
Workers in other processes or undefined	2.8
Total	14.8

the proportion of children employed and the steady increase in the number of operatives as a whole until recent years. The contraction of the body of operatives of late years seems to have occurred primarily among children and young persons (where the first check would naturally be looked for), and secondarily among adult males. If allowance be made for the smaller value of children as compared with adults, and the census results be taken, it is not evident that there has been any diminution in the amount of labour-power; and if the factory inspectors' returns be accepted, the falling off in the number of operatives cannot be proved to have taken place

Operatives employed in Cotton Factories in the United Kingdom and Percentages of each Class. (From Returns of Factory Inspectors.)

	1835.	1838.	1847.	1850.	1856.	1862.	1867.
Male and Female under 13, or half-timers	13.2	45.7	5.8	4.6	6.5	8.8	10.4
Male, 13 to 18	12.5	16.6	11.8	11.2	10.3	9.1	8.6
Male, over 18	26.4	24.9	27.1	28.7	27.4	26.4	26.0
Female, over 13	47.9	53.8	55.3	55.5	55.8	55.7	55.0
Total number of Cotton Operatives	218,000	259,500	316,400	331,000	379,300	451,600	401,100

	1870.	1874.	1878.	1885.	1890.	1895.	1901.
Male and Female under 13, or half-timers	9.6	14.0	12.8	9.9	9.1	5.8	4.1
Male, 13 to 18	8.5	8.0	7.2	7.9	8.2	7.9	7.0
Male, over 18	26.0	24.1	25.3	26.4	26.9	27.6	27.8
Female, over 13	55.9	53.9	54.7	55.8	55.8	58.7	61.1
Total number of Cotton Operatives	450,100	479,600	483,000	504,100	528,800	538,900	513,000

Number of Operatives (in Thousands) engaged in Spinning, Manufacturing and Subsidiary Processes (excluding Lace-making, but including the Fustian Manufacture). (From Census Returns.)

	Males.				Females.				Males and Females.			
	Under 15.	15-20.	Over 20.	All Ages.	Under 15.	15-20.	Over 20.	All Ages.	Under 15.	15-20.	Over 20.	All Ages.
1881	29	39	121	189	40	81	189	310	69	120	310	500
1891	36	45	137	218	50	94	197	341	86	139	334	560
1901	24	36	139	199	36	92	207	335	60	128	346	535

The fact that the branches of work covered by the figures are not identical explains discrepancies between this and the previous table.

are given below, together with averages for cotton and wool workers, the building trades, mining, workers in iron, sailors, com-

Number of Operatives engaged in the Cotton Industry (Processes being distinguished and Ages and Sex). (From Special Returns made by Factory Inspectors.)

	Males in Thousands.			Females in Thousands.			Total in Thousands.
	Half-timers.	Under 18.	18 and over.	Half-timers.	Under 18.	18 and over.	
Spinning and Preparatory Processes							
1896	5.58	22.24	71.44	4.40	30.12	78.69	212
1898-1899 ¹	5.42	21.57	71.37	3.86	30.44	77.64	210
1901	4.98	21.10	68.98	3.10	30.98	81.68	211
Weaving and Preparatory Processes							
1896	7.54	18.79	75.81	11.87	49.19	151.34	315
1898-1899 ¹	6.21	17.29	72.74	10.38	48.38	150.99	306
1901	4.72	14.86	73.81	8.0	45.66	155.03	302

The figures in this table are not quite complete except for 1901; the relations between the changes shown for each class should nevertheless be accurately represented.

have probably been approximately those stated in the second table beneath, but as these figures are culled from various sources they must not be taken to indicate fluctuations.²

The most noticeable features of these tables are the decrease in

The wage of fine spinners exceeds the average wage of spinners

Index Numbers of Money, Wages and Prices.

	1840.	1855.	1860.	1866.	1870.	1874.	1877.	1880.	1883.	1886.	1891.	1902.
Cotton operatives	50	54	64	74	74	90	90	85	90	93	100	105
Average wages for eight trades	61	61	73	81	83	97	94	89	92	90	100	108.7 ³
Sauerbeck's index number	103	73	99	102	96	102	94	88	82	69	72	69
Average price of wheat per quarter	66/4	40/3	53/3	49/11	46/11	55/9	56/9	44/4	41/7	31/-	37/-	28/1

Weekly Wages in the Manchester and District Cotton Trade.

	1834.	1836.	1839.	1841.	1849.	1850.	1859.	1860.	1870.	1877.	1882.	1883.	1886.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Spinners' average	23 4	23 11	22 11	22 0	21 7	20 5	24 1	23 2	27 8	34 4	31 6	32 4	35 7
Big piecers' average	11 0	9 3	8 0	8 8	8 6	13 0	10 0	10 0	11 0	12 4	16 0	16 0	13 7
Weavers' average	11 0	10 2	9 6	9 6	10 6	10 3	11 2	10 8	12 2	15 1	15 6	15 0	13 3

¹ Average for 1898 and 1899.

² See chapter on cotton in Bowley's *Wages in the United Kingdom* and table there given.

³ Average for a slightly different group.

in either of the chief branches of the industry at so rapid a rate as to have occasioned the enforced dismissal of any hands. An industry which was not recruited at all would have dwindled at a greater rate. At least it may be inferred from these figures, when taken in conjunction with the large increase in spindles and looms, that the output per head has considerably advanced in spite of the rise in the average quality of both yarns and fabrics produced. This rise in the value per unit of the output accounts to some extent for the fact that wages have not been adversely affected of late.

Mr A. L. Bowley has calculated index numbers of wages for the leading *Wages and piece-rate lists.* trades, including the manu-

facture of cotton. Those for the cotton industry are given below, together with averages for cotton and wool workers, the building trades, mining, workers in iron, sailors, compositors and agriculturists (England), the numbers in each class being allowed for in the average. Side by side with these figures, Sauerbeck's index numbers of general wholesale prices are given, together with the average prices of wheat per quarter.

It must be remembered that the figures given above for cotton workers and average wages for eight trades do not measure the differences between each, but only the differences between the movements of each. Actual average money wages in the cotton industry

by percentages varying from about 25 to 35. In the above figures the earnings of three classes of spinners are averaged.

The highest wages are earned by mule-spinners (who are all males); their assistants, known as piecers, are badly paid. Persons can easily be found, however, to work as piecers, because they hope ultimately to become "minders," *i.e.* mule-spinners in charge of mules. The division of the total wage paid on a pair of mules between the minder and the piecers is largely the result of the policy of the spinners' trade union. Almost without exception in Lancashire one minder takes charge of a pair of mules with two or three assistants according to the amount of work to be done. Among the weavers there is no rule as to the number of assistants to full weavers (who are both male and female), or as to the number of looms managed by a weaver, but the proportion of assistants is much less than in the spinning branches, perhaps because of the inferior strength of the weavers' unions. For the calculation of wages piece-rate lists are universally employed as regards the payment of full weavers and spinners; some piecers get a definite share of the total wage thus assigned to a pair of mules, while others are paid a fixed weekly amount. Many ring-spinners are now paid also by piece-rate lists, and all other operatives are almost universally so paid, except, as a rule, the hands in the blowing-room and on the carding-machines. Spinning and weaving lists are most complicated; allowances are made in them for most incidents beyond the operatives' control, by which the amount of the wage might be affected. Still, however, they could not cover all circumstances, and much is left to the manner of their application and private arrangement. They should be regarded as giving the basis, rather than as actually settling, the wage in all cases. The history of lists stretches back to the first quarter of the 19th century as regards spinners, and to about the middle of the century generally as regards weavers, though a weaving list agreed to by eleven masters was drawn up as early as 1834. There are still many different district lists in use, but the favourite spinning lists are those of Oldham and Bolton, and the weaving list most generally employed is that known as the "Uniform List," which is a compromise between the lists of Blackburn, Preston and Burnley. Under the "Particulars Clause," first included in a Factory Act in 1891 and given extended application in 1895, the particulars required for the calculation of wages must be rendered by the employer. As in spinning there used to be doubts about the quantity of work done, the "indicator," which measures the length of yarn spun, is coming into general use under pressure from the operatives. We ought to observe here that the Oldham spinning list differs from all others in that its basis is an agreed normal time-wage for different kinds of work on which piece-rates are reckoned. But in effect understandings as to the level of normal time-wages are the real basis everywhere. If the average wages in a particular mill are lower than elsewhere for reasons not connected with the quality of labour (*e.g.* because of antiquated machinery or the low quality of the cotton used), the men demand "allowances" to raise their wages to the normal level. Advances and reductions are made on the lists, and under the Brooklands Agreement, entered into by masters and men in the cotton spinning industry in 1893, advances and reductions in future must not exceed 5% or succeed one another by a shorter period than twelve months. The changes as a rule now are 5% or 2½%. In all branches of the cotton industry it is usual for a conference to take place between the interested parties before a strike breaks out, on the demand of one or other for an advance or reduction.

Organization among the workers in the cotton industry is remarkably thorough. Almost all spinners are members of trade unions, and though the weavers are not so strongly united, the bulk of them are organized. The piecers are admitted as members of piecers' associations, connected with the spinners' associations and controlled by them. Attempts to form independent piecers' unions have failed. Weavers' assistants are included in the weavers' unions, which may be joined in different classes, the benefits connected with which vary with the amounts paid. One subscription only, however, is imposed by each branch spinners' association, but in all branches it is not the same, though every branch pays the same per member to the amalgamation. All the trade unions of the chief workers in the cotton industry are federated in the four societies: (1) the Amalgamated Association of Operative Cotton Spinners (created in 1853 and reformed in 1870), (2) the Northern Counties Amalgamated Association of Weavers (founded 1884), (3) the Amalgamated Association of Card and Blowing-room Operatives (established 1886), and (4) the Amalgamated Association of Power-loom Overlookers (founded 1884). These were not, however, the first attempts at federation, and the term "federation" must not be taken in any strict sense. The distribution of power between the central authority and the local societies varies, but in some cases, for instance among the spinners, the local societies approximate as closely to the status of mere branches, as to that of independent units federated for limited objects. We ought also to mention the societies of warp-dressers and warpers, tape-sizers and cloth-workers and warehousemen. There is no one federation of all cotton-workers, but the United Textile Factory Workers has been periodically called into being to press the matter of factory legislation, and international textile congresses are occasionally held by the operatives of different countries.

As to employers, four extensive associations include almost all the organization among them, two concerned chiefly with spinning and two with weaving. The former two are the Federation of Master Cotton Spinners' Associations with local associations and including 21,000,000 spindles, and the Bolton Master Cotton Spinners' Association with 7,000,000 spindles; the latter two are the North and North-East Lancashire Spinners' and Manufacturers' Association, covering about 3,000,000 spindles in addition to a large section of the looms of Lancashire, and the United Cotton Manufacturers' Association.¹

Factory legislation began in the cotton industry, and in no industry is it now more developed. The first acts were those of 1802 and 1819, both of which applied only to cotton-mills, and the former of which related only to parish apprentices. The first really important measure was that of 1833, which curtailed the abuse of child-labour, enforced some education and provided for factory inspectors, of whom there were at first only four. The next act of importance, that of 1844, was chiefly remarkable for its inclusion of all women among young persons. The proportion of women, young persons and children engaged in the cotton industry is so high, that most regulations affecting them, *e.g.* those relating to the hours of labour, must practically be extended to all cotton operatives. This act killed night work for "young persons," and children were not allowed to work at night. The year 1847 saw the introduction of what was known as the Ten Hours Act —after the 1st of May 1848 the hours of young persons (women included) and children were not to exceed ten a day and fifty-eight a week. A further limitation of hours to 56½ a week was secured in 1874, and this was cut down by another hour (the concession of the 12 o'clock Saturday) in 1901. "Young persons" now includes all who are not half-timers and have not attained the age of eighteen, and all women. The rules as regards the employment of children, which have steadily improved, are at present as follows. No child under twelve may be employed. On attaining the age of thirteen the child may become a full-timer if he has obtained the prescribed educational certificate (*i.e.* fifth standard attainment or three hundred attendances each year for five consecutive years). Failing this he must wait till he is fourteen before he can be employed full time. Half-timers may be employed either (a) on alternate days, which must not be the same days in two successive weeks, or (b) in morning and afternoon sets. In the case of arrangement (a), the child when at work may be employed during the same period as a young person or woman, which in Lancashire is almost universally from 6 to 6 with two hours for meals.² In the case of arrangement (b), which is the system generally adopted in Lancashire, a half-timer in the morning set works from 6 to 12.30, with half an hour for breakfast, and in the afternoon from 1.30 to 6, except on Saturdays, when the hours are from 6 till 11.30 for a manufacturing operative, or till 12 for other work, for instance, cleaning. The child must not work two consecutive weeks in the same set (that is, in mornings or afternoons), nor on two successive Saturdays, nor on Saturday at all if during any other day of the same week the period of employment has exceeded 5½ hours (*i.e.* a child in the morning set does not work on the Saturday). Other important features of factory legislation relate to the fencing of dangerous machinery and its cleaning when in motion (the regulations being strictest in the case of children and most lax in the case of male adults), and conditions of health, including the amount of steaming allowed, which was first regulated by the Cotton Cloth Factories Act of 1889.

The Cotton Industry outside England.

A brief survey will now be made of the cotton industry in parts of the globe other than the British Isles, and as a prelude the following broad estimates of the numbers of spindles and looms in the chief national seats of the cotton industry may be put forward.³ The table is further supplemented by other figures⁴ for the number of spindles at different times in the United Kingdom, the United States and the continent; and finally we may add the figures of cotton consumed.

The different average fineness of counts spun in different places must be borne in mind when the consumption of each district at the same time is being considered, but the relations between the amounts consumed in the contrasted districts in the two periods would not be affected much by this difference.

¹ A detailed analysis of the whole labour question in the cotton industry will be found in Chapman's *Lancashire Cotton Industry*.

² There are other permissible arrangements, namely from 7 to 7 and from 8 to 8, but they are not used in the textile trades of Lancashire.

³ The figures for looms are based upon a number of returns and estimates. Those for spindles are taken from the highly authoritative estimates of the International Federation of Master Cotton Spinners.

⁴ *Journal of Board of Trade*, April 28th, 1904.

COTTON MANUFACTURE

	Estimated Population in 1902. In Millions.	Million Spinning Spindles in 1909.	Thousand Power-Looms about 1906.
United Kingdom	42	53.5	700
United States	79	27.8	550
Germany	58	9.8	215
France	39	6.8	110
Russia	139	7.8	150
India	294 (1901)	5.8	45
Austria	26.7	4.2	80
Spain	18.6 (1900)	1.9	69
Italy	33	4.0	100
Switzerland	3.4	1.5	30
Japan	46	1.7	..
Belgium . . . . .	..	1.2	..

Cotton Spindles (including Doubling Spindles) in Millions.

	United Kingdom.	Europe.	United States.	Other Countries.	Total.
1870	37.7	13	7.1	..	57.8
1880	44.5	21	10.6	2	78.1
1890	44.5	26	14.2	4	88.7
1900	46.2	32	19	7	104.2
1903	47.9	33	22.2	7.5	110.6

Average Annual Consumption of Cotton in the Period 1831-1835. Millions of lb.

United Kingdom	295
Continent of Europe	143
United States	79

Average Annual Consumption of Cotton in the Period 1900-1905. Millions of lb.

United Kingdom	1634
Continent of Europe	2486
United States	1995

Roughly the consumption of cotton per spindle in the three areas to-day is, in lb, 35 for the United Kingdom, 70 for the continent, and 95 for the United States.

Before the cotton industry in other countries is described it will be necessary to explain how it could have developed there on a large scale at all. Of course this growth is to be accounted for very largely by the natural protection of cost of transport aided by tariffs. But it would be a mistake for Englishmen to imagine that all foreign cotton mills are the product of a forcing culture, and that if the favourable conditions created by import duties were removed they would totally disappear. No doubt some of the growth is artificial, but much is natural and would have taken place under universal free trade conditions. Much of it, indeed, would have appeared in these circumstances even were cost of production a negligible quantity, difficult though it may be at first to reconcile this statement with certain ordinary conceptions of the operations of the law of increasing returns. Lancashire secured an immense lead at the beginning of the 19th century, and if the cost of production may be represented as varying inversely as the magnitude of the industry, every addition to her success increased her advantages. How could the small industry, with a high cost of production because it was small, compete with Lancashire? The answer is to be found in the peculiar conditions governing international trade and a closer analysis of "increasing returns." "Increasing returns" in any place are a function of two variables, (1) the magnitude of the world market under conditions of world commerce, and (2) the magnitude of the industry in the spot in question. The economies connected with the first variable, which in such an industry as the cotton industry are enormous, and govern ultimately the limits of business specialism, are shared by every national section of the industry whether it be great or small. If Haiti started a cotton factory she might import all her specialized machinery—the specialism involved in producing which is dependent upon the exportation of some of it—and restrict narrowly the work undertaken by her one factory. The cotton goods outside this range she would still import, and if her specialized product were in excess of local demand she could export some of it, if she were favourably placed in respect of cost of carriage, for cost of production in

Haiti would not be impossibly high, since machinery and the general system of production would be quite up to date though labour might be highly inefficient. Of course, the country with a large industry enjoys high local economies, and it might be thought that these alone would be a menace to the stability of the small industry, because if the industry in the favoured locality increased these would increase also and the small industry would be undersold. The answer to this difficulty is that foreign trade depends upon ratios between ratios, that is, upon the ratios between the costs of production of all the products of each country in relation to similar ratios for other countries. Relatively, therefore, diminishing returns operate in every country. In every country there must come a time, the utility of commodities being taken into account, when a unit of labour and capital provides less utility when applied to the creation of cotton goods, say, than when applied to producing something else for home consumption or for export in exchange for commodities wanted at home. It becomes apparent, therefore, that cotton industries of widely varying sizes dispersed throughout the world can settle into relations of perfectly stable equilibrium, as that term is understood by the economist. Slow changes, of course, in their relative volumes might be looked for with changes in a mutable world, but very sudden collapses would be impossible unless the general course of human affairs were revolutionized.

The United States.—The machine-cotton industry was carried to North America almost as soon as it evolved in England. Models of Arkwright's machines were smuggled across the Atlantic in 1786—Arkwright's first mill had not been started in England until 1769—and these with a jenny and stock-card were publicly exhibited. From these models a great mass of machinery was soon constructed. The first mill was erected in 1788 (that of the Beverly Association), the second appeared in 1790, the third five years later, and in 1798 Samuel Slater started with some of his wife's relatives the first mill in which the principle of the water-frame was carried throughout. It is said that it was not until 1814 that power-loom manufacturing was commenced, but in England success with the power-loom was long delayed. As early as 1831, however, there were in the United States—mainly in the New England states—800 factories, a million and a quarter spindles, 33,500 looms and 62,200 operatives. At this time the annual consumption of cotton was about 77,000,000 lb as compared with some 300,000,000 lb in England at the same date, and 2,000,000,000 approximately in the United States at the present time.¹ Writing in 1840, James Montgomery said that, in respect of cost of production, the American industry was 19% behind that of England apart from the cost of raw material, which was then a good deal less to the Americans. In 1878, when there was much interest in the question of British efficiency in the cotton industry because the passage of the Factory Act of 1874 had cut down the working hours, the *Economist* contrasted the result of twenty-five years' growth in England and America:—

"In 1853 the average English production per weaver of 8½ lb shirting was 825 yds. per week of sixty hours. In 1878 the working hours had fallen to fifty-seven, and the production had risen to 975 yds. An increased production of 23% is thus due to improvement in the processes of manufacture. In 1865 there were 24,151 persons employed in Massachusetts in the production of cotton goods, and they produced 175,000,000 yds. In 1875 the operatives numbered 60,176, and their product was 874,000,000 yds. The operatives had increased 150% and their products had increased 500%. The increase of production due to improved methods was thus in England 23%, and in Massachusetts 100%. I do not, of course, suppose that the American manufacturer is in advance of his English rival to the extent of this difference, for I presume that he started upon the career of improvement from a lower platform. But a progress so greatly more rapid than ours will be admitted to cast much light on the change which has occurred in our relative positions."

The contrast no doubt was not perfect, as indeed it could not be

¹The early history of the industry in the United States is summarized in one of the official bulletins of the state of Massachusetts, dated 1798. See W. R. Bagnall, *Textile Industries of the U. S.* (1893).

in view of the varieties of product and their changes, but it proves at any rate that Americans were making vast strides in industrial efficiency even before the period when American methods and American enterprise were monopolizing in a wonderful degree the attention of the business world.¹ About a dozen years later the low real cost of production of simple fabrics in the United States was universally admitted, and also that American manufacturers were making more use of machinery than their European rivals. In a typical weaving shed in Massachusetts, for instance, of which particulars were published, twenty women "tended" as many as eight looms apiece, forty-three managed seven, two hundred and thirty-two managed six, and only eleven had five only.² Since then, moreover, advance has been rapid, and the sudden development of the South has astonished the business community of other centres of the cotton industry.

Before the lines of development in America are specifically dealt with, and particularly the industrial phenomena in the South, a few words must be said of the general extension of the industry. The consumption of cotton in the United States in million lb was about 75 in 1830, 390 in 1860, 1100 in 1890 and nearly 2000 on an average of the five crop years from 1900-1901 to 1904-1905: active spindles advanced from 1,250,000 in 1830 to 10,653,000 in 1880 and about 21,250,000 in 1905. Looms which numbered 33,500 in 1830 had reached 226,000 in 1880 and nearly 550,000 in 1905. At the same time population, it must be remembered, was growing at a phenomenal rate: from 31.4 millions in 1860 it had passed to 38.6, 50.2, 62.6 and 76.3 at the succeeding decennial censuses, the decennial rates of increase being in order 22.5, 30, 25 and 20.5 as compared with 8.5, 10.5, 8 and 9 as shown by the corresponding censuses in the United Kingdom. Protection was of course contributory to the growth of the American cotton industry. It may be remarked incidentally that the New World, including the West Indies and the Chinese empire, take the bulk of American exports, which for so large an industry are inconsiderable. The imports have always been well in excess of the exports. The encouragement of home industries by tariffs was definitely aimed at after the war with England during the Napoleonic struggles, and although a sensible reduction of duties was experienced after 1845 the reaction to protection that followed the Civil War was never significantly departed from except by the single act of 1883. In 1790 the duties on cotton goods were 7½% *ad valorem*, and they rose gradually until they reached 25% in 1816. Slight reductions some seventeen years later were followed in the early 'forties by a tariff of 30%. Diminutions were succeeded by oscillations, though at no point was a low level touched. Severe charges were imposed in 1890, and after some relaxation in 1894 the policy of restrictiveness was restored in 1897. According to the calculations made by the English Board of Trade in 1903³ no fabrics were admitted at a charge equivalent to less than 68% *ad valorem*, and no yarns were admitted at a charge lower than 45% *ad valorem*. Cotton thread is subjected to a rate equivalent to 375%.⁴

The character of the growth of the cotton industry in the United States, as revealed by recent census returns, is peculiarly interesting:—

Cotton small wares are included in the totals for 1880 and 1890, but excluded from those for 1900 and 1905. We must observe further that "capital" is a vague term. Recent events in the United States afford a valuable empirical indication of the effect that improved machinery actually has upon wages. The new automatic looms caused a saving of labour per unit of product which recalled the complete subversion at the industrial revolution of the proportions in which the several factors in production were organized. Displacement of labour and falling wages might not unreasonably have been looked for temporarily, but wages stuck at their old level or rose. The rise was caused by numerous converging forces which brought their united weight to bear. First, prices so fell as the result of the new machinery that the increased volume of commodities which the market could absorb more than counterbalanced, it would seem, the labour-saving of the new machinery, the cotton industry being taken as a whole. It must be remembered that to increase the output from the subsidiary processes where labour had not been saved more hands had to be drafted in. Thus, a contraction of the body of weavers was accompanied by an expansion of the body of cotton operatives. Again weavers' wages were naturally raised in a special degree because automatic machinery called for quick, trustworthy and intelligent hands, endowed with versatility, especially in the days when the machinery was still in the semi-experimental stage. The American employer tries to save in labour but not to save in wages, if a generalization may be ventured. The good workman gets high pay, but he is kept at tasks requiring his powers and is not suffered to waste his time doing the work of unskilled and boy labour. There is, certainly, in the American labour problem no serious grievance on the question of wages. If there is any abuse it consists in excessively fierce work. Mr. T. M. Young, who visited the American cotton districts in 1904 with an informal commission of Lancashire spinners and manufacturers, did not think that the cause of the high wages—allowance being made for the purchasing power of money, they are above those of England, though cotton operatives in England are well paid relatively—was the superiority of the American cotton worker; neither did the representatives of the English cotton operatives who accompanied the Moseley Commission. As often as not "the cotton operative in the United States is a French Canadian, a German, an Italian, a Hungarian, an Albanian, a Portuguese, a Russian, a Greek, or an Armenian." It is the extensive "exploitation" of machinery seemingly, together with the speed of work, which keep wages high, combined with the horizontal and vertical mobility of American labour, which prevents it from accumulating in pools, and causes streams of the best hands to be flowing continuously to other callings and places, and no insignificant proportion to climb the social ladder. The remainder naturally profit, for a local or trade congestion of labour is avoided, and the voluminous recruiting of enterprise by the intensified competition among employers keeps the demand for labour high.

One noticeable point in the table quoted above is that until recently cotton consumed increased much faster than the number of spindles. This might be explained in a variety of ways. Average counts remaining constant, the average speed of the

	Thousands.				Percentage Increases.		
	1880.	1890.	1900.	1905.	1880-1890.	1890-1900.	1900-1905.
Active Spindles	10,653	14,188	19,008	23,156	33.8	34	21.8
Looms	226	325	451	541	43.90	38.7	20
lb cotton consumed	750,344	1,117,946	1,814,003	1,873,075	48.99	62.3	3.3
Wages	\$42,041	\$66,025	\$85,126	\$94,378	57	28.9	10.9
Capital	\$208,280	\$354,021	\$460,843	\$605,100	70	30.2	31.3
Employees not officers and clerks	174.7	218.9	297.9	310.5	25.3	36.1	4.2

¹ See also the official report of J. P. Harris-Gastrell in 1873.

² Quoted by Schulze-Gaevernitz.

³ *Memorandum* on British and foreign trade and industrial conditions.

⁴ The method of calculating these percentages is discussed in the blue-book mentioned.

spindle might have risen; or the latter remaining constant, counts might have been getting finer. Speeds have certainly gone up a good deal of late on some counts. And it is quite likely, too, that concentration on the manufacture of coarse goods for export, with stout warps to keep down the

breakages and raise the output per loom, may be reckoned as one cause.

Despite the recent sensational growth in the South, the New England States still remain the most prominent seat of the American cotton industry. They contained in 1905 about 14 million spindles as compared with 7.7 millions in the South and West, and their relative possession of looms approaches, though it does not quite reach, the same proportion. The leading States in the South in order of importance are South Carolina, North Carolina, Georgia and Alabama, and in the North, first Massachusetts with an enormous lead, then, in order, Rhode Island, New Hampshire, Connecticut, Maine, New York, Pennsylvania, New Jersey. The bulk of the cotton industry in the North is contained within a small area. A circle around Providence, Rhode Island, of 30 m. radius includes, according to the twelfth census, nearly $7\frac{1}{4}$ million spindles,—there were only 58,500 spindles in this area in 1809. Of the chief towns Fall River stood first in 1900 in value output, and was followed in order by Philadelphia, New Bedford, Lowell, Manchester and Pawtucket. The climate of Fall River is very similar to that of English spinning districts. Its population in 1900 was 105,000, and of these only 14,600 were of American parentage. Of the remainder, 16,700 were English, 17,800 Irish, 29,600 French Canadians and about 5000 Portuguese. Among the rest of foreign parentage, Armenians, Russians and Italians are numerous. But Massachusetts is famous for the number of immigrants it attracts. It is almost incredible, but nevertheless a fact according to a recent statistical report, that in 1903 as many as 91% of the cotton operatives of the State were of foreign descent—chiefly French Canadian and Irish. In 1902 there were nearly 90 mills at Fall River with 3,000,000 spindles and 16,000 looms. The spindles amount to about one-third of all in Massachusetts, but Fall River's share of the looms of the State is not large. The spindles exceed in number those possessed by any State except of course the one in which it is placed. In comparison with a great spinning town in England, nevertheless, Fall River does not appeal strongly to the English imagination. It has little over a quarter of the spindles of Oldham, or three-fifths of those of Bolton,—among English towns it would stand third, *i.e.* between Bolton and Manchester and Salford, which, in spite of the movement of spinning to the hills, still holds in England a leading place. The whole of Massachusetts, it is of interest to observe, has fewer spindles than Oldham, and only about half those of Oldham and Bolton together. Originally it was the river which attracted the mills to Fall River, and as the water-power available was almost inexhaustible, it was possible for the mills to congregate together and for a town to grow up. In England, when much of the industry was dependent for power upon water, decentralization was entailed, for the thin streams of Lancashire could not support more than two or three mills at most in proximity. Hence in England, after Watt's steam-engine had succeeded, the economies of centralization led eventually to the desertion of the mills on the water-courses. But at Fall River the perfecting of the application of steam-power merely involved its use to supplement the water-power on the old site. The presence of water-power explains half the success of New England. In the six States 35% of all the power used is derived from water, and in the cotton-manufacturing of these States water provides 32.6% of the power. For industrial purposes generally the river most exploited is the Merrimac, upon which stand the leading cotton towns of Lowell, Lawrence and Manchester. Hitherto little has been done in the way of using water to generate electric power.¹

The two most striking features of the American industry to-day are the introduction of the automatic looms, already briefly referred to, and the development of the South. The Northrop Loom Company has spent a fortune in pushing its loom on to the market. It has not hesitated to share risks, and it has run one "advertisement" mill at least, namely that at Burlington, Vermont, with 55,000 spindles and nearly 1300 looms. In this mill the labour-saving is shown by the following

¹ Upon the above see Uttley's report.

figures, the looms being of two sizes, 32 in. and 44 in. Of the former, 3 weavers run 18 each, 39 tend 16 each, only a few odd weavers tend less than 16, and learners even are at work on 8 to 11 each; on the latter, of 29 weavers 17 mind 16 looms each and 12 mind 12 (on stripped fabrics).² Of course a high level of efficiency would be expected in this show mill. That American employers have readily been converted to a belief in the economy of the new machinery we are not astonished to learn in view of the American temperament, the intensity of competition among business leaders, and the prevailing spirit of adventure. Thousands of workable old looms have been scrapped, and probably at the present time there are 100,000 automatic looms running in the United States. No other country can point to a rate of substitution which approaches that in the United States. The causes, apart from the temperamental and social to which reference has already been made, are probably (1) that there is disagreement as to the present economy of automatic looms on many fabrics,³ (2) that Americans aim at frequency of renewal of plant, and avoid making their machinery so durable as to prove ultimately, perhaps, a handicapping inheritance, and (3) that a greater bulk of American work is appropriate for the new looms than of English or continental work. But automatic machinery is being used increasingly in Lancashire.⁴ And the operatives ultimately benefit. It is the half-developed machine, to which labour must actually be linked as an essential part, which is responsible for monotonous work and creates the dislike of mechanical aids.

Now we turn to the recent development of the Southern States. Never has an industry grown faster than that of the two Carolinas, Georgia and Alabama. Some of the earliest experiments with the machine industry were conducted in South Carolina, but from that time till the end of the 19th century nobody imagined the possibility of a great Southern expansion. In 1880 the South contained less than half a million spindles—*i.e.* about as many as Hyde, Middleton or Chorley, and one-twenty-third of the numbers in Oldham. Twenty years later they had increased twelvefold and the Southern States, in respect of the number of spindles, had taken precedence of Bolton. To-day probably about eight and a half millions might be counted. In addition there are some two hundred thousand looms, or nearly as many as in the three leading cotton-weaving towns of England—Burnley, Blackburn and Preston. The rapid oncoming of the South may also be traced by its consumption of cotton—which as an index, however, is not perfect. This on an annual average was, in thousand bales, 164, 269, 453, 717 and 1233 in each of the periods 1876-1880, 1881-1885, 1886-1889, 1891-1895 and 1895-1900 successively. The consumption since then, as compared with that of the Northern States, Great Britain and the European continent, has been as follows. It must be remembered that the consumption per spindle varies greatly from place to place.

Consumption of Cotton in Thousand Bales of about 500 lb each.

	Southern States.	Northern States.	Total United States.	Great Britain.	Europe.
1900-1901	1583	1963	3546	3269	4576
1901-1902	2017	2066	4083	3253	4836
1902-1903	1958	1866	3824	3185	5148
1903-1904	1889	2046	3935	3017	5148
1904-1905	2270	2292	4562	3620	5148

The densest distribution of mills in the South is along the line of the Southern railroad, in the district known as the Piedmont. Of this group Charlotte in North Carolina is the natural centre: roughly, half the spindles and half the looms in the Southern States would be included within a circle around Charlotte of a

² The figures are those quoted by Mr T. M. Young and relate to the year 1902.

³ See *e.g.* some passages upon this point in Uttley's report.

⁴ For an account of the numerous types of automatic looms see the article on WEAVING: § *Machinery*.

radius of about 100 m. Of the remainder a large proportion is scattered over a wide area.

Much interest has been excited by this newly created Lancashire of a new type, and much speculation as to the causes that account for it has been elicited. An informal commission of Lancashire spinners and manufacturers crossed the Atlantic to make inquiries in 1902 and investigations have been undertaken by other persons,¹ and much has been written on the subject. A general explanation can now be framed without much difficulty, as in all probability most of the relevant facts have been brought to light. First and foremost the general development of the cotton industry in the United States must be emphasized. The industry was unquestionably foredoomed to expansion at this time, and the only question was where the expansion should take place. It was plain that the growth might be so great as to prevent the appearance of a new industry created with new labour rather than an extension of an old industry. It was not altogether surprising, therefore, that the exploitation of a new field of labour was thought of. The labour market of the North was comparatively exhausted; in less developed parts of the country larger supplies of intrinsically good labour might be looked for at lower wages. Skill was not a matter of much moment, because in the North it would have been necessary to incorporate much labour without previous experience in the industry, the work was intended to be of the rough kind upon which manual skill is least important, and it was intended to repose reliance for economy upon machinery in the main. The choice of new fields meant at the outset the sacrifice of some of the economies of localization, but so large an expansion was looked for that projectors did not despair of creating fresh industrial localization of sufficient magnitude to produce such economies as are derived from it, which, it must be observed, are inconsiderable in America, and have declined relatively with falling cost of transport and the adoption, as regards machinery, of the principle of interchangeable parts. And at any rate a new local industry would have a slight advantage in supplying markets in proximity to it.

These were the main general considerations, and the scale was turned in favour of the new locality (*a*) by the advantage of nearer supplies of cotton, and (*b*) by the known presence of much half-occupied white labour in the vicinity of otherwise suitable sites close to the cotton-fields. It must be borne in mind that the whole calculation had not to be reared merely upon an intangible theoretical basis. Cotton mills already existed in the South, and comparisons of costs of production, as things were then, afforded some groundwork for judgment.

As regards the first of the two special advantages mentioned above, the saving in the cost of carriage of the raw material is not commonly held to be high. Transport to the cotton ports is so well organized and sea-carriage is so cheap that Lancashire's distance from the source of her raw material is not a very appreciable handicap. A good deal of the cotton that must be used in some of the Southern mills cannot be supplied locally because it is not grown in the neighbourhood, and the requirements of these mills are met by transport arrangements which at present cost a sum not altogether out of relation to similar costs in the New England States and Lancashire. The percentages of freight charges on raw material in 1900 were \$2.18 in Georgia, \$1.59 in North Carolina, \$1.17 in South Carolina, and the amazingly low figure of \$1.20 in Massachusetts, but of course some part of the explanation is the somewhat higher quality of cotton on an average that is worked up in Massachusetts. For some years, however, the saving in labour has been a most important economy. Large supplies of half-occupied white labour existed in the Southern States among the families of small farmers who flocked South after the Civil War, and in the districts of the decayed hand industry in the mountains of Kentucky and North Carolina. For small money wages much of this labour could be attracted to the mills. Negroes do not work in the mills; the reason is said to

¹ Of which special mention may be made of Uttley's report as a Gartside scholar of the university of Manchester, already referred to, and Pidgin's report for the Massachusetts Bureau of Labour Statistics.

be partly their own disinclination and partly that they are not very efficient at factory work. As outside labourers, however, they have afforded important aid at a very trifling cost, but the expense of outside labour to a mill is never an item of much weight. The halcyon days to employers, when keen workers could be had for low wages, are now said to be past. The demand for labour was considerable, and as time went on additional supplies could be enticed only with the offer of better pay. In 1904 it was reported that some mills were unable to get fully to work for want of hands even at the improved rates. Again the Southern operatives have been visited by emissaries from the operatives of the New England States, which explains partly the present aspect of the wages question. Mr Pidgin, in his official report to the Massachusetts Bureau of Labour Statistics, questions whether a saving in wages can be expected to continue, and points out that though wages have been low the average efficiency of the operatives has not been high. Some, indeed, were sent to gain experience in Northern mills in the hopes that on their return they would spread the tradition of working at high pressure. Mr Pidgin is at some pains to measure labour efficiency in the South and North as far as it is possible to do so, but no simple sets of figures will prove very much. The value of the product per operative in 1900 was \$1200 in Massachusetts, \$1010 in Georgia, \$937 in North Carolina and \$984 in South Carolina, but the value of the product per operative depends as much upon the fixed capital charge per operative as upon the latter's efficiency. And the amount of machinery used per head is higher in the South than in the North. The percentage of operatives to machinery in Massachusetts being expressed as 100, that of Georgia was 53, that of North Carolina 43 and that of South Carolina 55 in 1900. These figures must be borne in mind when the average numbers employed in a mill in different States are being considered: in 1900 the averages were 565 for Massachusetts, 273 for Georgia, 171 for North Carolina and 378 for South Carolina. Measured by quantity of machinery the sizes of mills would stand in quite different relations. Hours of work in the South are bound to fall and the abuse of child labour, which had unquestionably crept in, may be expected to discontinue entirely. The factory conditions of children are better now than they were, but in some places they are still very bad. In Georgia no children under twelve are employed, but infants without fathers may begin work at ten years of age, and according to Mr Pidgin's report, "it certainly seemed as though the intention was honoured more in the breach than in the observance, or that there must be many widows in the neighbourhood of the cotton mills." In North and South Carolina the employment of children under twelve is illegal, but in these States also conditions are recognized under which it is possible to employ them earlier. According to figures relating to 1900 the dependence on child labour in the Southern States is very striking. The proportions engaged at different ages in the three chief cotton-manufacturing Southern States and Massachusetts are as follows:

	Men, 16 Years and over.	Women, 16 Years and over.	Children under 16.
Massachusetts	48.98	44.59	6.43
Georgia	39.98	35.52	24.50
North Carolina	42.22	34.23	23.55
South Carolina	44.43	28.72	26.85

It might be said that children are more useful when the work is rough, but this argument can hardly be regarded as accounting altogether for the great discrepancy as between Massachusetts and the South. The work is much rougher in the South: in 1900 the counts spun respectively in Massachusetts, Georgia, North Carolina and South Carolina were 25.10, 14.37, 18.83, and 19.04, and on the showing of the American census of 1900 spinning was getting finer over the last decade of the 19th century.

As contributory to the influences already recorded as accounting for Southern success it has been hinted that in the North employers have been less ready to welcome the new machinery, though in comparison with European rivals they would seem at

first to have acted rashly. However this may be, the South enjoyed the important advantage that its industry began just after a great technical advance had been made. When Northern mill-owners were anxiously deliberating about the destruction of good machinery merely because it was antiquated in design, the fortunate Southern mill-proprietor was getting to work with appliances up to date in every particular. It will be easier to balance comparative advantages as between North and South when undertakers in the newer district are confronted by problems concerning replacements and alterations. The rapidity of Southern growth need not astonish those who have watched the operations by which new mills are frequently set up in Lancashire and remember that the American business man is more daring than his British cousin. Company promotion in the great financial centres, payment for machinery and other plant in shares, or partially in shares, a general diffusion of risks and pledging of credit, would explain even more rapid growth of industries of even greater magnitude.

Broad generalizations are difficult to frame, hard to establish and liable to be misleading; some generalizations relating to the features of the American cotton industry taken as a whole the author is tempted to venture nevertheless. The characteristics of labour have already been incidentally commented upon. We have also noticed that the bulk of the work done is of a rough and simple character. In spite of American nationalism and the prevalence of protective sentiments it is said that there is still a prejudice in the United States against home-made fine cotton goods.¹ "The product of the American system is a cloth which is, on the whole, distinctly inferior in appearance, 'feel' and finish to that produced by the Lancashire system. To equal a Lancashire cloth in these respects an American cloth must not only be made of better cotton, but must contain more of it—perhaps 5% more. To this rule of inferiority there are, it is needless to say, exceptions, notably some of the American drills made for the China market. But the American home market, which absorbs nearly the whole of the product of American looms, is less exacting in these matters than the markets in which Lancashire cloths are sold."² It follows that the average counts spun in the United States are lower than in England, though they have been rising somewhat. Another feature of American spinning as compared with English is the high proportion of ring-frames to mules. In New England between 1890 and 1900 mule-spindles advanced by 100,000 and ring-spindles by nearly 2,000,000; in the South mule-spindles increased only from 108,500 to 180,500, while to the ring-frames 2,700,000 were added. To the general rule Rhode Island is the sole exception; here mule-spindles have increased and ring-spindles decreased; but in Rhode Island much of the fine spinning—for instance that for hosiery—is congregated.³ One explanation of the preponderance of ring-spinning is to be found in the character of American fabrics. Again most of the operatives are not of a kind likely to acquire great excellence at mule-spinning. To the Americans we largely owe the ring-frame, because their encouragement helped it through the difficult period when its defects were serious, though it appears to have been discovered independently in both countries.

American organization displays intense specialism, but of a type different from that in England, where businesses are specialized by processes; in America they are specialized by products but hardly at all by processes. Independent spinning, independent manufacturing, independent bleaching, dyeing and finishing are the significant features of English industry to the bird's-eye view; in the United States the typical firm will spin, make up its own yarn, and perhaps complete its fabrics for the market; but the mills, it must be remembered, are intensely specialized as to the range of their product, so that the statement that American mills are less specialized than English mills must be received with caution. For some reasons we should expect to

find the American method applied even in England for fabrics of the highest qualities, because in their case the adaptation of the yarn to the fabric, and finishing to the fabric, are of great importance, and actually where the American plan is followed in England the explanation is frequently the speciality of the product which is associated with the particular firm producing it. When a firm manufactures a speciality of this kind it cannot always trust bought yarn, or the finishing applied to fabrics in the ton. But for other reasons specialized processes might be looked for where qualities were highest, as by specialism alone can the greatest excellence be attained. The final selection of method depends upon the relative importance for high qualities in the finished product of the connectedness of processes and the perfection of parts; and to these considerations must be added cost of transport between the works devoted to distinct processes, and the development of the commercial functions by which specialized process businesses are kept functioning as a whole. Probably it is the high development of British industry on the commercial side which chiefly explains the arrangements found in England. Attention should also be directed to the huge magnitude of American businesses. This is partly a consequence of American ambition in business, and partly a consequence of the undeveloped commercial ligaments by which producing businesses are brought into union. American producers in both North and South are too widely scattered for one town, like Manchester in the English cotton district, to be visited frequently by them for the purpose of making purchases and effecting sales. Even if the Americans did possess a convenient commercial centre, the high cost of transport between works distributed over a very wide area would prevent much specialism of businesses by processes from appearing. Writing capital letters for industrial processes and small letters and Greek letters for commercial functions, the possible arrangements in the cotton industry may be represented broadly as follows, brackets indicating the scope of businesses:⁴

- I. (a,A,B,C,d)
- II. (a)(A,B,C)(d).
- III. (aAa)(bBβ)(cCγ).
- IV. (a)(A)(a,b)(B)(β,c)(C)(γ).

The American industry approximates to the first type, while the English approximates rather to the last. Differences in respect of specialism by range of product are not shown in the formulæ.

Other Parts of America.—Little need be said of the cotton industry in other parts of the New World. In Canada in 1909 there were, approximately, 855,000 spindles, and in Mexico in 1906, where the first factory was established in 1834, 450,000 spindles. In Brazil also there is an appreciable number of spindles, distributed (in 1895) among 134 factories, which are located chiefly in Rio de Janeiro and Minas Geraes, and are run for the most part by turbines and water-wheels.

Germany.—In Germany the cotton industry is by no means so intensely localized as in England, but three large districts may be distinguished:—

1. The north-west district, which consists of the Rhine Province and Westphalia and contained 1½ million spindles in 1901.
2. The country north of the mountain ranges of northern Bohemia comprises the middle district, which contained 2½ million spindles in 1901. In Saxony the industry has been carried on for four centuries.
3. Alsace, Baden, Württemberg and Bavarian Swabia make up the south-west district, to which some 3½ million spindles were assigned. It is in close proximity to the cotton districts of east France, Switzerland and Vorarlberg.

According to Oppel (1902) the German spinning industry is chiefly localized in—

Prussia with 2020 thousand spindles			
Saxony	1870	"	"
Alsace	1600	"	"
Bavaria	1390	"	"

The spindles of Württemberg, which stands next, do not much exceed half a million. Only sixteen places in Germany (shown in tabular form on p. 169) contained as many as 100,000 spindles in 1901.

The history of the hand industry in Germany runs back some centuries. At the time when it flourished in the Netherlands we may be sure that it was prosecuted to some extent farther north and east. The start with the machine industry was not long

⁴ Similar formulæ have been used above, where a fuller explanation is given.

¹ *Textile Recorder*, August 15th, 1905.

² *Young's American Cotton Industry*, p. 13.

³ *Utley's report*, p. 4.

delayed after its economies had been learnt in England. It was fostered by protection against the cheap products of Lancashire, and in the course of time stimulated by every step taken towards the economic unity of the German states which broke down local barriers

	Spindles in Thousands.		Spindles in Thousands.
Mülhausen	471	Chemnitz	195
Augsburg	373	Gebweiler	187
Gronau	274	Leipzig	182
Werdau	249	Crimmitschau	168
Rheydt	248	Logelbach	141
München-Gladbach	216	Bocholt	128
Rheine	198	Bamberg	125
Hof	196	Bayreuth	100

and therefore enlarged the German market. Duties upon cotton goods, however, were not immoderately high until the measure of 1879, the policy of which was carried to a further stage in 1885. Slight reactions were brought about in 1888 and 1891, largely by the complaints, not only of the consumers of finished goods, but also of manufacturers whose costs of production were kept up by the high prices of home-spun yarns and the tax on imported substitutes. According to the investigations made by the Board of Trade, the general *ad valorem* impact of German duties on British goods stood somewhat as follows in 1902:—

Statement showing the Average Incidence (ad valorem) of the Import Duties levied by Germany on British Cotton Goods.

	Average Value of Exports from the United Kingdom to all Countries in 1902.	Rate of Duty estimated Equivalent.	Approximate Equivalent Rate of Duty <i>ad valorem</i> .
Cotton manufactures—			Per Cent.
Piece goods, unbleached	2.01d. per yd.	0.87d. per yd.	43
" " bleached	2.46d. " "	1.09d. " "	44
" " printed	2.68d. " "	1.31d. " "	49
" " dyed, &c.	3.46d. " "	1.31d. " "	38
Cotton thread for sewing	26.89d. per lb	3.81d. per lb	14
Cotton yarn—			
Grey	10.49d. " "	0.98d. " "	9
Bleached or dyed	11.23d. " "	1.63d. " "	15

The duties are not prohibitive—they are much less than those of the United States at the same time—but they are heavy on the classes of goods which come into competition with home-made goods. The general principle of the tariff is to treat easiest commodities which are made with least success at home, or are in the highest degree raw material for a home manufacture. Therefore yarns are not taxed very heavily, and of these the finest counts escape with slight discouragement.

In the cotton industry, as well as in numerous other industries of Germany, almost feverish activity was shown after the Franco-German War. Previously great advance had been made, but it was not until the last quarter of the 19th century that Germany forced herself into the first rank. As measured by the annual consumption of cotton the German industry increased as follows:—

<i>Metric Tons of Cotton per Annum.</i>	(In Thousands.)
1836-1840	9
1856-1860	46
1876-1880	124
1886-1890	201
1899-1903	324

It must be remembered that the spindles and looms of Alsace and Lorraine were reckoned as German after the war: they amounted in 1895 to one and a half million spindles and nearly forty thousand looms.

In the 'seventies there was no dispute as to England's substantial lead in respect of efficiency. Alexander Redgrave, the chief factory inspector, made inquiries on the continent both in 1873, when Lancashire was anxious as to the comparative cost of production abroad because of the short-time bill then before parliament, and previously, and reported most unfavourably upon the state of the industry in Germany. Hours were long, the skill of the hands was inferior, speeds were low and time was wasted. In several important respects his views were corroborated by M. Taine in his *Notes on England*, and by the evidence adduced before the German commission upon the cotton and linen industries in 1878. A marked contrast is noticeable between the sketches drawn of this period and the careful picture presented by Professor Schulze-Gaevernitz of the early 'nineties," but even in the latter the advantage of England is represented as substantial in every essential respect. The gap

which existed has narrowed, but it is still unmistakable. To give one example, according to Dr Huber's figures there were in Saxony at the end of the 19th century 106 spindles to an operative and about as many weavers as looms, whereas in England there were about twice as many spindles to an operative and twice as many looms as persons engaged in weaving sheds.¹ As regards manufacturing, the character of the product may partly explain the difference, but it will not entirely. The reader need hardly be warned that the comparison drawn is exceedingly rough. German cotton operatives taken all round are certainly less efficient than English labour of the same kind. The reason is partly that the proportion of the German workpeople who have been for long specialized to the industry, and look forward to continuing in it all their lives, is not high. Complaint is constantly made of the number of vacancies created in the mills each year by operatives leaving, and of the impossibility of filling them with experienced hands. Many of the vacancies are caused by the return of workpeople to the country parts. Sometimes the mills are in the country, or within easy reach of it, and labour is obtained from the unoccupied members of peasants' families. In these cases the factories do not always succeed in attracting the most capable people, and work in the factory is not infrequently looked upon as a makeshift to supplement a family's earnings. Among Lancashire operatives far more pride of occupation may be met with. In many of the industrial parts of Germany English conditions are evolving, but they are not generally the rule. An American consul may be taken to report to his own country without prejudice as to the rival merits of German and English conditions: one such wrote in 1901:—"The task of educating labour

up to a high degree of efficiency is difficult, and many generations are necessary to achieve that result. The English cotton spinners have attained such a degree of skill and intelligence that, for the most part, no supervision is necessary. In Germany the presence of a technical overseer is indispensable. Another advantage which England enjoys is the cheap price of machinery. Germany imports the major part of her machinery from England, and German wholesale dealers in these machines have not been able, by placing large orders, to overcome the difference caused by freight and tariff." Wages reflect the efficiencies of countries, not of course perfectly, but in some degree. They are much higher in Lancashire than in Germany, as is made evident by an article from the pen of Professor Hasbach in *Schmollers Jahrbuch* (vol. ii., 1903). The author tries to show that Germany is not so far behind England industrially as is generally believed, and the contrast drawn by him, greatly to the advantage of Lancashire, is not likely to exaggerate the superiority of English conditions. It is calculated by Professor Hasbach that the daily wages of spinners are about 5/10 to 6/ at Oldham, 6/6 at Bolton and 5/6 in Stalybridge and neighbouring places. With these he compares the 3.70 to 3.80 marks paid in the Rhine Province and Leipzig, and the 3 to 3.15 marks paid in the Vogtland, Bavaria and Alsace, and mentions an exceptionally high wage of 4½ marks, which was earned by an operative who worked a new and long doubling mule. The wage paid to the big piecer in England, Dr Hasbach goes on to show, is not much greater than that received by a good assistant in Germany. This comparison as it stands will probably give some readers an idea that English advantages are greater than they actually are, because it may be overlooked that the great difference between wages in the case of English and German spinners is not repeated among the piecers. Taking a spinner and his first assistant as the unit, we should have a joint average daily wage of about 8/6 in England and 6/ in Germany. In the case of weavers, comparison of wages is more difficult to draw, but the advantage of England would seem to be but little less. However, in instituting a comparison between two countries, as regards the relative efficiency of labour in some industries, we should do well to remind ourselves that efficiency is a somewhat transitory thing, dependent upon education and experience as much as upon aptitude. In respect of the capacity of labour for the task required in the cotton industry, we could not (writing in 1907) make the statement that England leads significantly with the assurance with which we can assert her superiority in respect of present attainments. The cotton industry has not been prosecuted on a large scale in Germany so long as in England, and the Germans have not, therefore, had the same opportunity for developing their latent powers. But the thoughtfulness and carefulness of the German workman are beyond dispute, and these qualities will procure for him a leading place where work is not mechanical. Already in the cotton industry it is said that the operatives are displaying quite striking powers of undertaking a wide range of work and changing easily from one pattern to another. Hence German firms feel little hesitation in taking small orders on special designs; they do not experience any great difficulty in getting their factors accommodated to produce the required articles. Apart from the efficiency of labour, reasons exist for the lower

¹ *Deutschland als Industriestaat.*

real cost of production in England in the organization of the industry. The German industry is not only less localized, but, as we might perhaps infer from that circumstance, less specialized. A German factory will turn out scores of patterns where an English firm will confine itself to a few specialities. Time is wasted in accommodating machinery to changes and in accustoming the hands to new work. The German producer suffers from the undeveloped state of the market. In England specialized markets with specialized dealers have greatly assisted producers both in their buying and selling. A German manufacturer may have to find his customers as the English manufacturer need not; at least, so Professor Schulze-Gaevernitz has assured us, and conditions have not been wholly transformed since he made his careful analysis. He wrote:—"But especially disadvantageous is the decentralization in respect to the sale. Here also the German manufacturer stands under the same disadvantages with which the English had to struggle in the 'thirties. The German manufacturer still seeks his customers through travellers and agents, and in many instances through retail sellers, whose financial standing is often questionable, whose necessity for credit is always certain. Hence the complaints about the bad conditions of payment in Germany which crop up continually in the *enquête*. The manufacturers had to wait three, four or six months, and even twelve months and longer for payment. In reality there existed 'termless terms,' a 'complete anarchy in the method of payment.' . . . The manufacturer cannot be at the same time commission agent, banker, merchant and retail dealer; he needs sound customers capable of paying. He fares best if the sale is concentrated in one market, and 'change' prices simplify the struggle between buyer and seller. The search for customers, foreign as well as home, and the bearing of all possible risks of disposal, are in any case difficult enough to necessitate the whole strength of a man. The wholesale merchant alone is in a position to pay the manufacturer in cash or on sure, short terms. But especially where export is in question is the dispersal of sales an extreme impediment. The manufacturer cannot follow the fashions in Australia and South America; the foreign buyer cannot travel from mill to mill."

It is the want of commercial development in Germany which accounts for the more frequent combination of weaving and spinning there than in England. But in Germany to-day economic enterprise is flourishing, and commercial development may confidently be looked for together with advance in other directions. It is not many years since the typical German cotton factory was comparatively primitive; now mills can be exhibited which might have been erected recently in Oldham. Between the early 'eighties and the 'nineties the expansion of the German industry was enormous—the imports of cotton-wool rose by nearly 70%—yet the number of spinning-mills was actually reduced from 6750 to 2450, while the number of weaving-sheds fell from 56,200 to 32,750. At the same time the factories devoted to mixed goods declined from 25,200 to less than 16,350. From these figures we may gather how rapidly the average size of mills and weaving-sheds enlarged in the period. One cause, no doubt, was that improved economies in the new businesses forced antiquated factories to shut down and make way for still newer erections. There were recently about twice as many persons engaged in weaving as in spinning, but the largest numbers of all—slightly in excess of those in weaving-sheds—were the persons occupied in the manufacture of cotton-lace, trimmings, &c. As we might imagine, Germany's exports of cotton goods are not high. Including yarns they amounted to £13.7 million per annum in 1899-1903. In order of value their largest exports are (1) coloured goods, (2) hosiery, (3) lace and embroidery, (4) yarns, and (5) trimmings, &c.

France.—Into the industrial conditions of the two leading rivals of England we have entered in some detail; the state of affairs in the rest of the world must be dealt with more briefly. Of France more ought to be said than we can find place for, though in respect of the magnitude of her cotton industry, as measured by the quantity of spindles, she stands now not fourth, but fifth, Russia taking precedence. But the work of the French is incomparably superior to anything that is turned out from Russia. France suffered a severe blow when the industry of Alsace and Lorraine was lost to Germany, but the inexhaustible originality of French *design* will always secure for her goods a place in the first rank. As regards *artistic* results France leads, but the real cost of her spinning and weaving cannot approach in lowness that of Lancashire. After costly strikes the French workmen have succeeded in shortening their hours to ten and a half a day; and here it may be remarked that the International Association of Textile Operatives tends to equate continental industrial conditions to those of England. The French industry has been fostered by tariffs. When the Board of Trade calculation was made, French tariffs were found to bear upon British cotton goods with about the same severity as those of Germany, except that the former treated more hardly yarns and cotton thread for sewing. French protectionism has kept down her exports; such as they are the majority proceed now to her colonies. Normandy, the north and east, in order, are the chief seats of the industry. In Normandy the leading city is Rouen, and Darnétal, Maromme, Sotteville, Havre, Yvetot, Dieppe, Evreux, Gisors, Falaise and Flers are important places. The north contains the

important towns of Lille, Tourcoing, Roubaix, St Quentin, Amiens and Hellemmes. The Vosges is the chief district of the east, and the leading towns are Epinal, St Dié, Remiremont, Senones, Val d'Ajol, Cornimont and La Bresse. The following towns which are not included in any of the districts mentioned above are also noteworthy:—Troyes, Nantes, Cholet, Laval, Tarare, Roanne, Thizy and Villefranche upon the Saône. Cotton arrives at Havre and Marseilles; at the latter chiefly the product of Egypt and the East. Havre used to be the most important cotton port in continental Europe, but to-day more spindles are fed from Bremen than from Havre. France's consumption of cotton annually in the period 1899-1903 was 215,000 metric tons.

Russia.—Power-spinning was carried into Russia by Ludwig Knoop, who had learnt the trade in Manchester, and to his efforts its early success was due. The growth, largely the result of very heavy protectionism—according to the Board of Trade report, from 50 to more than 100% more severe than that of Germany,—has been rapid, as the following table bears witness:—

Average yearly Importation of Cotton wool and Yarn into Russia.

	Raw Cotton in thousand tons.	Cotton Yarn in thousand tons.
1824-1826	·9	5.4
1836-1838	4.6	10.1
1842-1844	8.4	9.5
1848-1850	21.4	4.5
1889-1891	117.4	3.4
1899-1903	180.0	2.9

Table showing approximately the Growth of Spindles and Looms in Russia.

	Spindles.	Looms.
1857	1,000,000	..
1877	..	55,000
1887	4,000,000	85,000
1900	6,000,000	146,000
1909	7,800,000	..

The chief districts were the following in 1900:—

Government.	Factories.	Spindles (in thousands).	Looms (in thousands).
Moscow	56	1295	33
Vladimir	67	1224	42
Piotrkov	25	745	20
St Petersburg	24	1074	11
Jaroslav	4	347	2
Kostroma	25	274	20
Tver	6	348	9
Esthonia	1	440	2
Ryazan	4	146	3
Elsewhere	15	198	4
Total	227	6091	146

Fine spinning has been attempted only recently. Generally speaking 70's used to be the upper limit, but now counts up to 140's are tried, though the bulk of the output is coarse yarn. The inefficiency of the labour was made abundantly plain by Dr Schulze-Gaevernitz in his economic study of Russia, and conditions have not greatly altered for the better since. Roughly, 170,000 operatives worked 6,000,000 spindles in 1900, which means 35 spindles per head as compared with more than 100 in Saxony and more than 200 in England. In weaving the ratio of operatives to machinery worked out at about one loom to each weaver, which is comparatively much less unfavourable to Russia. The proportion in Saxony is about the same, but in England the average approaches two looms to a weaver. The speed of machinery cannot be compared, and we must remember that the above contrasts are rough only, and made without regard to differences of product. Russia is encouraging the growth of cotton at home. It is of very inferior quality, but 100,000 tons from the provinces of central Asia and Trans-Caucasia were used in 1900: her imports in the same year were about 170,000 tons.

Switzerland.—Swiss spindles advanced until the early "seventies," but a decline followed. Details are:—

1830	400,000
1850	950,000
1876	1,854,000
1883	1,809,000
1898	1,704,000
1909 (estimated)	1,500,000

The falling off is occasioned mainly by (a) the developing industrialism of the rest of Europe, notably Germany, and (b) the diminishing importance of the natural advantage of water-power with the

improvement of steam-engines. Swiss yarns have been kept out of continental markets in the interests of home spinning. Now fancy cotton goods, laces and trimmings are the leading specialities of the Swiss textile workers. About half the Swiss spindles are in the canton of Zürich, between a quarter and a third in Glarus, about the same in St Gall and 9% in Aargau. Figures show that the average size of the Swiss mill is small. The average spindles to a mill were 22,000, and very few mills held more than 50,000 spindles. Some 9000 of the power-looms are in Zürich, some 4500 in Glarus and 4000 in St Gall. Wald in the south-east of the canton of Zürich is an important centre of the muslin manufacture.

Austria.—Austria contains about 4,200,000 spindles and more yarn is consumed than it produces, as on balance there is an excess of imports of yarn. Bohemia, lower Austria, Tirol and Vorarlberg account for the mass of Austrian spinning. The following details relating to these districts recently are of interest:—

	Mills.	Spindles.	Average spindles to a mill.
Bohemia	82	1,870,000	22,800
Lower Austria	23	460,000	20,000
Tirol and Vorarlberg	20	435,000	21,700

Reichenberg and the surrounding district is the chief manufacturing place: here are more than 80,000 looms, nearly a half of which are hand-looms.

Italy.—Recent industrial growth in Italy is remarkable: statistics of spindles since 1870 are as follows, but the percentage of error is probably high:—

1870	500,000
1888	900,000
1898	2,100,000
1909	4,000,000

The distribution of spindles is roughly as follows:—

Lombardy	1,850,000
Piedmont	1,000,000
Venetia	550,000
Campania	250,000
Liguria	250,000
Tuscany	100,000

The distribution of spindles and power-looms in the chief manufacturing towns in Italy is shown in the following table:—

	Spindles.		Spindles.
Turin	470,000	Genoa	210,000
Bergamo	450,000	Salerno	150,000
Como	250,000	Brescia	310,000
Milan	660,000	Naples	100,000
Novara	410,000	Udine	240,000
	Power-Looms.		Power-Looms.
Milan	40,000	Pisa	2,500
Turin	22,000	Como	6,000
Novara	13,000	Bergamo	13,000
Genoa	6,000	Udine	3,500

The district between Milan and Lago Maggiore contains numerous villages devoted to the cotton industry. Many of the factories in the province of Bergamo are situated in the Valle Seriana, which is endowed with abundant water-power. In this district coarse and medium yarns and grey cloth are the chief products. In the province of Milan there are several small towns, notably Gallarate, Busto Arsizio and Monza, in which the manufacture of coloured and fancy goods is extensively carried on. The finest spinning in Italy is done in Turin. The coarsest spinning is done in Venetia.

The Netherlands.—In 1805 the cotton industry was reintroduced into the Netherlands from England in its factory form. Seventeen mules bearing 16,000 spindles are said to have been smuggled across the channel, while forty Englishmen were enticed over to work them, in spite of English legal prohibitions. Liévin Bauwens was the prime mover of the achievement. Expansion rapidly followed, and in 1892 Belgian spindles numbered nearly a million. Since then a decline has set in. Ghent, with about 600,000 spindles, is the only really important place: no other place has as many as 50,000. Holland possesses about 417,000 spindles: the leading district is Twente and the leading town Enschede; Twente contains also about 20,000 power-looms. Rotterdam is the chief cotton port; Amsterdam, always a far-away second, has lost place still further of late.

Spain and Portugal.—The greatness of Spain in the cotton industry lies buried in the remote past, but of late she has awakened somewhat, with the result that her spindles now number about 1,853,000. Catalonia is the chief province where the industry is carried on, and Barcelona surpasses all other centres. Portugal possesses nearly half a million spindles (the bulk in Lisbon and Oporto), many of which have appeared since 1894.

The Rest of Europe.—Of Sweden, Norway, Denmark, Greece and Macedonia no special mention need be made, nor of other parts where the cotton industry may just exist. It may be mentioned here that among the scattered rural populations of many parts of the continent, even in such advanced countries as France and Germany, hand-looms are still to be found in large numbers.

India.—The hand-cotton-industry has been carried on in India since the earliest times, and for many years English fabrics were protected against the all-cottons of India. Soon after the introduction of spinning by rollers, English all-cottons began to rival the Indian in quality as well as in cost. A large export trade to India has grown up, but Indian hand-loom weavers still ply their craft. In 1851 power-spinning was started, and by 1876 there were in India 1,000,000 spindles. Since then they have nearly reached six millions and importations of yarn have been significantly affected. The growth of Indian power-spinning, which is almost entirely of the ring variety, was attributed by some to the depreciation of the rupee after 1873, but the fall in the value of the rupee was stopped in 1893 and the competition continued. The real explanation, no doubt, is that at the cost of Indian labour it is found cheaper to import machinery and coal than to export or cease to grow cotton and import yarn. This was the conclusion of the majority report of the committee of the Manchester Chamber of Commerce, which made an inquiry into Bombay and Lancashire spinning in 1888. Besides, as regards Indian exports to China, the remission in 1875 of the 3% export duty on yarns must be borne in mind. The efficiency of labour in India is only a small fraction of that of Lancashire operatives. Recently complaint has been made that Indian mills are being run inhumanly long hours with the same set of labour, and that child-labour is being abused, both legally and illegally—legally as regards children over fourteen who are classed as adults. The working of heavy hours began with the electric lighting of the mills; previously all shut down at sunset largely because of the cost of illumination. The outcry which has been raised is, perhaps, sufficient guarantee that the worst evils will be remedied. Indian spinning, it must be remembered, is still very coarse as a rule, though some fine work is attempted and the average of counts spun is rising. Though there are about a ninth as many spindles in India as in the United Kingdom, there are only about one-fifteenth as many power-looms, 46,400 in all, to which figure they rose between 1891 and 1904 from 24,700. The reason for the paucity of power-looms is probably two-fold, (1) the low cost of production of Lancashire weavers, and (2) the habit of hand-loom weaving which is fixed in the Indian people. A rapid increase of power-looms is, however, observable. The hand-loom industry is gigantic, particularly in the Madras Presidency and the Central Provinces; in the latter district alone there were estimated to be 150,000 hand-looms in 1883. The following details relating to the Indian cotton industry are supplied officially:—

Cotton Mills in India, including Mills in Native States and French India.

Mills.	1897-1898.	1903-1904.
Mills (number)	164	204
Capital (thousand £s)	648	1,067
Looms (number)	36,946	46,421
Spindles (thousands)	4,219	5,213
Persons employed (daily average)	148,753	186,271
Yarn produced:—		
Counts (1 to 20 thousand lb)	400,384	474,509
Counts (above „ „ „)	62,212	104,250
Total lb	462,596	578,759
Yarn produced:—		
Bombay (thousand lb)	324,649	414,932
Bengal „ „	44,807	46,487
Madras „ „	32,516	28,714
United Provinces (including Ajmere-Merwara) (thousand lb)	26,747	29,930
Central Provinces (thousand lb)	18,334	24,549
Punjab „ „ „	6,607	11,578
Elsewhere „ „ „	8,936	22,569
Total lb	462,596	578,759
Woven goods:—		
Grey (thousand lb)	83,136	111,494
Others „ „	8,152	26,550
Total lb	91,288	138,044

China.—In China spinning has not met with the same success as India, and power-manufacturing has not yet obtained a sure footing. The ingrained conservatism of the Chinese temperament is no doubt a leading cause. Of the spindles in China—about 600,000 in all—from a half to three-fifths are in Shanghai. The following details

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relating to the inception of the power-industry are quoted from a Diplomatic and Consular Report of 1905:—

"The initial experiment on modern lines was made in 1891, when a semi-official Chinese syndicate started at Shanghai—the Chinese Cotton Cloth Mill and the Chinese Cotton Spinning Company. Its originators claimed for themselves a quasi-monopoly, and prohibited outsiders who were not prepared to pay a fixed royalty for the privilege from engaging in similar undertakings. Although certain Chinese accepted this onerous condition, foreigners resented it as an undue interference with their treaty rights, and it was only when Japan, in 1895, after her war with China, inserted in the treaty of Shimonoseki an article providing for the freedom of Japanese subjects to engage in all kinds of manufacturing industries in the open ports of China, and permitting them to import machinery for such purposes, that outsiders were afforded an opportunity of exploiting the rich field for commercial development thereby thrown open. Accordingly, so soon as the Japanese treaty came into force no time was lost in turning this particular clause to account, and the erection of no less than 11 mills—Chinese and foreign—was taken in hand. At that time the pioneer mill, which was burnt to the ground in October 1893, but subsequently rebuilt, and other Chinese-owned mills were together working some 120,000 spindles and 850 looms."

By 1905 the mills increased to 17, the spindles to 620,000 and the looms to 2250, but there is little inclination to expansion. Yarns for the hand-looms are obtained primarily from India and secondarily from Japan. The following are the recent figures relating to imported yarns:—

In million lb

	1898.	1899.	1900.	1901.	1902.	1903.
	lb	lb	lb	lb	lb	lb
British	9.1	7.8	4.1	7.0	4.3	2.2
Indian	186.7	254.2	131.5	228.9	251.6	250.8
Japanese	64.7	104.0	62.9	66.4	69.7	110.9
Hong-Kong . . . . .	..	..	..	.7	.8	1.2
Tongkinese . . . . .	..	..	..	..	..	.01
Total	260.5	366.0	198.5	393.0	326.4	365.1

Japan.—If in China the factory cotton industry reveals no prospects as yet of a great future, the same cannot be said of Japan.

The chief centres of spinning with their outputs in value of yarn for a year at the beginning of the 20th century are stated beneath:

	Thousands.		Thousands.	
	£	s.	£	s.
Osaka	1226.5		Nara	111.5
Hyogo	495.5		Hiroshima	91.3
Okayama	374.4		Kyoto	82.2
Miye	238.1		Wakayama	79.2
Tokyo	227.9		Ehime	72.5
Aichi	224.3		Kajawa	36.4
Fukuoka	168.1			

The following table gives other valuable information:—

Year.	Gross Amount of Capital invested.	Average Number of Spindles used daily.	Quantity of Raw and Ginned Cotton demanded.	Total Production of Cotton Yarn.	Average Number of Male Operatives daily employed.	Average Number of Female Operatives daily employed.	Annual Working Days.	Daily Working Hours.	Average Daily Wage of Male Operatives.	Average Daily Wage of Female Operatives.
	Thousand £	Thousands.	Million lb.	Million lb.						
1892-1894	1123	420	112.9	97.9	6,316	21,695	290	22	4d. to 4½d.	2d. to 2½d.
1900-1902	3569	1209	335.3	288.0	13,373	59,271	312	19	4½d. to 5d.	4½d. to 5d.
1903	3441	1290	375.5	322.7	13,169	57,166	308	20	7½d. to 8d.	4½d. to 5d.
1904	3470	1306	332.1	285.9	13,967	52,115	309	20	8d.	5d.

With amazing adaptability the Japanese have assumed the methods of Western civilization as a whole. But hand-weaving more than holds its own, and power-weaving has as yet met with little success. The custom already mentioned as a cause of the continued triumph of the hand-loom in India and China is strong also in Japan, and the economy of the factory system is greater relatively in spinning than in manufacturing. In Japan it is ring-spinning which prevails; 95% of the spindles are on ring-frames. Ring-spinning entails less skill on the part of the operative, and ring-yarn is quite satisfactory for the sort of fabrics used most largely in the Far East. The counts produced are low as a rule. Generally mills run day and night with double shifts, and the system seems to pay, though night-work is found to be less economical than day-work there as elsewhere. More operatives are placed on a given quantity of machinery in Japan than in Lancashire—possibly more "labour" as well as more operatives, because labour as well as operatives may be cheaper. On the same work the output per spindle per hour is less in Japan than in England, even when day-shifts only are taken into account.

Japanese work has been severely criticized, but the recency of the introduction of the cotton industry must not be forgotten.

BIBLIOGRAPHY.—The literature relating to the cotton industry is enormous. The most complete bibliographies will be found in Chapman's *Lancashire Cotton Industry* (where short descriptions of the several works included, which relate only to the United Kingdom, are given); Hammond's *Cotton Culture and Trade*; and Oppel's *Die Baumwolle*. The list of books set forth here must be select only.

The development of the English industry can be traced through the following:—Aikin, *A Description of the Country from Thirty to Forty Miles round Manchester* (1795); Andrew, *Fifty Years' Cotton Trade* (1887); Baines, *History of the Cotton Manufacture in Great Britain* (1835); Barks, *A Short Sketch of the Cotton Trade of Preston for the last Sixty-Seven Years* (1888); Butterworth, *Historical Sketches of Oldham* (1847 or 1848); Butterworth, *An Historical Account of the Towns of Ashton-under-Lyne, Stalybridge and Dukinfield* (1842); Chapman, *The Lancashire Cotton Industry* (1902); Cleland, *Description of the City of Glasgow* (1840); *A Complete History of the Cotton Trade, &c.*, by a person concerned in trade (1823); Ellison, *The Cotton Trade of Great Britain including a History of the Liverpool Cotton Market and of the Liverpool Cotton Brokers' Association* (1886); Léon Faucher, *Études sur Angleterre* (1845); French, *The Life and Times of Samuel Crompton* (1859); Guest, *A Compendious History of the Cotton-manufacture, with a Disproof of the Claim of Sir Richard Arkwright to the Invention of its Ingenious Machinery* (1823); Guest, *The British Cotton Manufacture and a Reply to the Article on Spinning Machinery, contained in a recent Number of the Edinburgh Review* (1828); Helm, *Chapters in the History of the Manchester Chamber of Commerce* (1902); Kennedy, *Miscellaneous Papers on Subjects connected with the Manufactures of Lancashire* (1849); Ogden, *A Description of Manchester . . . with a Succinct History of its former original Manufactories, and their Gradual Advancement to the Present State of Perfection at which they are arrived, by a Native of the Town* (1783); Radcliffe, *Origin of the New System of Manufacture, commonly called "Power-Loom Weaving" and the Purposes for which this System was invented and brought into use, fully explained in a Narrative concerning William Radcliffe's Struggles through Life to remove the Cause which has brought this Country to its Present Crisis* (1828); Rees' *Cyclopaedia*, articles on Cotton (1808), Spinning (1816) and Weaving (1818); Ure, *The Cotton Manufacture of Great Britain, investigated and illustrated, with an Introductory View of its Comparative State in Foreign Countries* (2 vols.); Ure, *The Philosophy of Manufacture; or An Exposition of the Scientific, Moral and Commercial Economy of the Factory System of Great Britain* (1835); Watts, *Facts of the Cotton Famine* (1866); Wheeler, *Manchester: its Political, Social and Commercial History, Ancient and Modern* (1836).

In addition there are many short papers in the Manchester public library. Much valuable information may be obtained from parliamentary papers; a list of relevant ones is printed as an appendix to Chapman's *Lancashire Cotton Industry*, but it is too lengthy to repeat here. The most important are the reports relating to the hand-loom weavers, those on the employment of children in factories (of which a list will be found in Hutchins and Harrison's *History of the Factory Legislation*), and the state of trade and the annual reports of the factory inspectors. On labour questions there is a list of authorities in Chapman's *Lancashire Cotton Industry* and also of

parliamentary papers containing useful material. Printed copies of the "Wages Lists" are issued by the trade unions. The Factory Acts are dealt with in Hutchins and Harrison's *History*, mentioned above, as well as the literature relating to them; while the handbooks by Redgrave and by Abraham and Davies are specially useful.

On the industry abroad the following are the fullest authorities:—Besso, *The Cotton Industry in Switzerland, Vorarlberg and Italy* (1910) (a report made as a Gartside Scholar of the University of Manchester); Chapman's *Cotton Industry and Trade* (1905); Hammond, *The Cotton Industry*; Hasbach's article, "Zur Charakteristik der englischen Industrie," in *Schmollers Jahrbuch*, vol. ii. (1903); Leconte, *Le Coton*; Lochmüller, *Zur Entwicklung der Baumwollindustrie in Deutschland* (1906); Montgomery, *The Cotton Manufacture of the United States of America contrasted and compared with that of Great Britain* (1840); Oppel, *Die Baumwolle* (1902); Schulze-Gaevernitz, *Der Grossbetrieb: ein wirtschaftlicher und sozialer Fortschritt: eine Studie auf dem Gebiete der Baumwollindustrie* (1892; translated as *The Cotton Trade in England and on the Continent*); T. M. Young,

American Cotton Industry (1902); Uttley, *Cotton Spinning and Manufacturing in the United States of North America* (1905; a report of a tour as Gartside scholar of the university of Manchester); and the Gartside reports on the cotton industries of France and Germany by Forrester and Dehn respectively. Information will also be found in Diplomatic and Consular Reports, and fragments may be gathered from other books such as G. Drage's *Russian Affairs*, Dyer's *Dai Nippon*, and Huber's *Deutschland als Industriestaat*. Japan has published since 1901 a very full financial and economical annual, and the British government issues annually a good statistical abstract for India. The American census contains much detailed information, and there are, in addition to the statistics issued by the Federal government, those of Massachusetts, the Bureau of Statistics of which has also reported the results of an investigation into the industry in the Southern states. Among official matter the semi-official Bombay and Lancashire cotton spinning inquiry of the Manchester Chamber of Commerce may be included. The census of production of the United Kingdom must be mentioned, and the reports of the International Congresses of Cotton Spinners and Manufacturers. As to labour, see the reports of the International Textile Congresses.

The periodical literature is of good quality and much of it is filed in the Patent Office library. We may notice particularly the *Cotton Factory Times*; *Textile Journal*; *Textile Manufacturer*; *Textile Mercury*; *Textile Recorder*; *Textile World Record* (American); *Der Leipzige Monatsschrift für Textilindustrie*; and the French *Textile Journal*. Shepperson's *Cotton Facts* is an annual which relates chiefly, though not entirely, to raw cotton, as does also *Cotton*, the periodical of the Manchester Cotton Association. For technical works we may refer here to the well-known treatises of Brooks, Guest, Marsden, Nasmith and Walmsley, and to Johannsen's ponderous two-volumed *Handbuch der Baumwollspinnerei, Rohweissweberei und Fabrikanlagen*.
(S. J. C.)