Fibres, Yarns and the Invention of the Spinning Jenny

by

John Styles

School of Humanities
University of Hertfordshire
Hatfield AL10 9AB
e: j.a.styles@herts.ac.uk
w: www.spinning-wheel.org

Paper for World Economic History Congress
Boston, MA, 29 July to 3 August 2018

1 The author would like to thank Linda Baumgarten, Karen Clancy, David Celetti, Alice Dolan, Linda Eaton, Ariane Fennetaux, Philip Hoffman, Jane Humphries, Sebastian Keibek, Philippe Minard, Chris Nierstrasz, Georgio Riello, Philip Sykas, Melinda Watt and Nuala Zahedieh for references and suggestions. The research leading to these results has received funding from the European Research Council under the European Union’s Seventh Framework Programme (FP/2007-2013) / ERC Grant Agreement n. 249512.
1. Introduction.

In February 1777, Imbert de St Paul, the French government’s inspector of manufactures at Nimes, witnessed a spinning jenny at work for the first time. An experienced member of the state industrial bureaucracy, he had already heard about the jenny, which had been introduced into France by one of his colleagues in 1771. Nevertheless, he had to confess it ‘is a very ingenious machine, though very simple, and seeing it work, we were all simply astonished we had failed to guess its secret.’ Invented in England in the mid-1760s by the Lancashire weaver, James Hargreaves, this simple but ingenious machine remains a familiar icon of the Industrial Revolution, its origins and its impact repeatedly interrogated in the search for explanations of Britain’s eighteenth-century economic transformation.

The jenny features as a key technical breakthrough – a ‘macroinvention’ – in the two most influential recent interpretations of the Industrial Revolution – Robert Allen’s The British Industrial Revolution in Global Perspective and Joel Mokyr’s The Enlightened Economy: An Economic History of Britain, 1700-1850. For Allen the spinning jenny was a macroinvention because it was a new technology with big effects. Its importance lies in its impact, setting in train a long trajectory of advance that resulted in huge increases in productivity. It is ‘the industrial revolution in miniature’, the machine which exemplifies Allen’s argument that the demand for technological innovation was shaped by the relative prices of factors of production – for the jenny, principally labour and capital – in an eighteenth-century English economy characterised by high wages, but cheap capital.

Mokyr, by contrast, insists that macroinventions are only very weakly related to economic forces, if at all, and that their precise timing is difficult, perhaps impossible, to explain. He presents them as radical new ideas that emerge without clear precedent, but have dramatic economic consequences. Less invested than Allen in the economic theory of induced innovation, he presents the jenny as just one of a cluster of macroinventions in cotton spinning that emerged in Lancashire between 1760 and 1780, a cluster which

---

3 Hargreaves’ spinning jenny was not patented until 1770, but contemporaries dated its invention to between 1764 and 1767. The most dependable date is the one provided in 1822 by Hargreaves’ daughter Mary, who remembered the jenny being invented in ‘the year 1766 or thereabouts’, but her wording is less than conclusive; C. Aspin, ‘New Evidence on James Hargreaves and the Spinning Jenny,’ Textile History, 1 (1968): 120; C. Aspin with S.D. Chapman, James Hargreaves and the Spinning Jenny, Helmshore, 1964: 13. The latter provides an admirably comprehensive analysis of the way the jenny worked and the available evidence for its invention and subsequent history.
6 Mokyr, Lever of Riches, 13.
included Richard Arkwright’s water frame and Samuel Crompton’s spinning mule, ‘the ultimate spinning machine’. Insofar as Mokyr explores the particular causes and timing of these three inventions, he invokes not the narrowly specified economic variables addressed by Allen, but rather the general economic circumstances of the eighteenth-century cotton industry in Lancashire. To explain why the three emerged in cotton textile manufacturing and not in Britain’s staple woollen textile industry, which in the mid-eighteenth century was several times larger, Mokyr insists that cotton was more suited to mechanical spinning than other fibres. Of the three inventions, the jenny, described as ‘small and cheap’, receives the least attention, perhaps because its history reveals fewer traces of those linkages between artisanal knowledge and elite science which inform Mokyr’s broader interpretation of the Industrial Revolution.

Does the jenny deserve its status as one of the key technical breakthroughs of the Industrial Revolution, as a macroinvention? In origin, it was, as Mokyr points out, a small, inexpensive, hand-powered machine, designed for use in a domestic setting. It could only spin weft yarn. Even in its later, larger, more technically sophisticated variants it was not powered by water or steam. Its contribution to the development of the Lancashire cotton industry was short-lived. By the early nineteenth century it was in rapid decline, confined to spinning the coarsest cotton yarns, though it enjoyed a much longer life in the woollen industry. Yet as Imbert de St Paul, the French inspector of manufactures, appreciated on first seeing it at work, the jenny combined simplicity, ingenuity and originality. That originality lay in the way it replaced the fingers of the human spinner with an inanimate mechanism, allowing the machine to incorporate multiple spindles controlled by a single operator.

In eliminating the need for the spinner’s fingers, the jenny had a parallel in Arkwright’s water frame and the earlier spinning machine patented in 1738 by Lewis Paul, on which Arkwright’s frame drew. However, the method used to replace the fingers was not the same. Hargreaves’ jenny and Arkwright’s frame differed fundamentally in the relationship between the process of spinning – drawing out the fibres and twisting them into yarn – and the process of winding – collecting the yarn on a spool once spun. In Arkwright’s machine the two processes were continuous. Spinning and winding took place at the same time, but the machine produced only a high twist yarn, most suited to warp. In the spinning

---

7 Mokyr, Lever of Riches: 97.
8 Mokyr, Lever of Riches: 100. A conservative estimate of the value of the British woollen textile industries made in 1741 suggests their output was worth £5.6 million. An equivalent estimate for the value of the Lancashire cotton industry two decades later was still only £1.2 million. P. Deane, ‘The Output of the British Woolen Industry in the Eighteenth Century’, Journal of Economic History, 17, 1957: 211-12; British Library, Add. MS 38342, Liverpool Papers, vol. 153: ‘History of the Cotton Trade’, f. 234. This document is dated, in a later hand, to ‘Before 1776’, but internal evidence suggests it actually dates from the early to mid-1760s, at the time of the debates over free ports in the British West Indian colonies.
9 Mokyr, Enlightened Economy: 128.
jenny, the two processes were discontinuous, the machine alternating between spinning and winding. The result was a softer, lower twist yarn, only suitable for weft. The difference reflected the machines’ contrasting technical genealogies among hand spinning wheels and other earlier yarn processing devices. The precursors of the continuous process employed in Arkwright’s water frame lay in silk throwing machinery and the flyer spinning wheel, mainly used for spinning flax. The model for the discontinuous process employed in the jenny was the simple spindle spinning wheel, used predominantly for spinning wool and cotton.  

Neither Mokyr nor Allen devote much attention to these genealogies, technical or material. For Mokyr, explaining precisely how and why each machine emerged is not a priority; for Allen explanation lies in a narrow set of economic inducements. Nevertheless, the timing of the machines’ invention remains something of a mystery. The traditional explanation, dating from the mid-nineteenth century and still often repeated today, follows the logic of challenge and response. It holds that John Kay’s flying shuttle, patented in 1733, distorted the relationship between the spinning and weaving processes in cotton manufacture. By radically increasing output per weaver, the flying shuttle is said to have put unprecedented pressure on the supply of yarn, which relied on women working at the hand spinning wheel. The result was a bottleneck in the supply of yarn and increases in spinning wages, which encouraged labour-saving inventions. This explanation is inadequate, both chronologically and technically. The flying shuttle was little used in Lancashire cotton weaving prior to the invention of the jenny in the mid-1760s. Even then, its productivity benefits for cotton fabrics were limited, because most were less than a yard and a quarter wide, woven on narrow looms.

Robert Allen highlights wages in his application of the theory of induced innovation to Hargreaves’ invention, but his emphasis is less on the earnings of Lancashire spinners, and more the relationship between the costs of labour, capital and other factors of production across the British economy as a whole, which he characterises as a high wage economy. Insofar as Allen uses spinning wages to explain the timing of the invention of the spinning jenny, it is in terms of centuries rather than years or decades. He offers only six estimates for real English spinning wages between 1580 and 1767, all but one drawn from the evidence provided by contemporary commentators and none of them for spinning cotton in Lancashire. On the basis of this evidence, he concludes that ‘a woman earned one-third as much as a man at the end of the sixteenth century or in the first half of the seventeenth. By

---

1750 her earnings had jumped to two-thirds of male earnings.'\textsuperscript{15} He suggests these earnings were very high compared to those in other countries, offering an especially detailed comparison with France. His analysis has been challenged for employing questionable assumptions about earnings in both countries, as well as for its analysis of working practices.\textsuperscript{16}

Questionable, too, is Mokyr’s suggestion that special characteristics of cotton fibres made their mechanical spinning an easier problem to solve than mechanically spinning flax or wool. In fact, the opposite was true. John Platt of Platt Brothers, the great Oldham textile machinery firm, noted in 1866 ‘the special difficulties of dealing by machinery with so delicate and irregular a material as the raw cotton fibre’.\textsuperscript{17} Indeed, spinning cotton by hand is also considered to require more technical skill than spinning long-staple wool and flax, because of its shorter fibre length.\textsuperscript{18} However, the materiality, immediate circumstances and timing of invention are not Mokyr’s focus. He is more concerned to trace the roots of the key macro-inventions of the British Industrial Revolution in what he calls ‘the great synergy of the Enlightenment: the combination of the Baconian program in useful knowledge and the recognition that better institutions created better incentives’.\textsuperscript{19}

This paper argues the origins and timing of one of the classic inventions of the British Industrial Revolution can be explained. To do so it adopts an explicitly comparative approach. Like Robert Allen, it offers an international comparison between the cotton industries of England and France. In addition, it employs a local comparison between the different textile industries of eighteenth-century Lancashire, which included not only cottons, but also worsteds, woollens, linens, silks and smallwares, in what was one of the nation’s most vibrant industrial regions. These comparisons are not confined to the relative prices of factors of production, the key issue for the economic theory of induced innovation.

\textsuperscript{19} Mokyr, Enlightened Economy: 129, 122.
They extend to the organisation of work, the changing shape of product markets, and the materiality of tools, machines, raw cotton, yarns and finished products.\textsuperscript{20}

The paper is divided into two main sections. The first argues that between the 1660s and the 1760s, the Lancashire cotton industry differed from its equivalents in continental Europe in ways that were crucially important for the invention of the spinning jenny. The second goes on to show how these distinctive characteristics of the Lancashire industry contributed to the invention of the jenny and made an equivalent invention elsewhere highly unlikely.

2. The peculiarities of Lancashire’s cotton industry, 1660-1760.

Between 12th-century beginnings of fustian manufacturing in Italy and the onset of the Industrial Revolution, usually dated to about 1760, cotton spinning spread across many parts of western Europe.\(^{21}\) A large, but difficult-to-judge proportion of the yarn produced was destined for candlewicks, for which cotton was the best, though most expensive material available, coarse spun from the cheapest, low grade, raw cottons.\(^ {22}\) Of the rest of the cotton yarn produced, the majority went to serve as weft in mixed fabrics, mainly those, like fustians, where it was combined with linen or hemp warps. In English, these mixed fabrics were often referred to simply as ‘cottons’.

Large-scale fustian manufacture began in Britain around the turn of the sixteenth and seventeenth centuries, principally in Lancashire, copying the kinds of fustians already being made in northern Italy and southern Germany. The manufacture of similar mixed cotton-linen fustians was introduced into various cities in France about the same time. Roughly a century later, the same combination of cotton wefts and linen warps began to be incorporated in adaptations of lighter all-cotton fabrics imported in rapidly increasing numbers during the 17th century from India, at first especially in dimiters, checks and stripes. In Britain this new manufacture developed principally in Lancashire, in parallel with the established production of fustians such as thicksets, pillows and jeans.\(^ {23}\) In France, its major centre was Rouen in Normandy, which had not previously been associated with the manufacture of cottons on any scale.\(^ {24}\) Shortly after, Lancashire began to produce plain, unbleached cotton-linen fabrics, known as Blackburn greys, for printing with Indian colour-fast techniques.\(^ {25}\) France’s 1686 ban on printed fabrics inhibited an equivalent development in Normandy, but it did occur in other continental European centres, for example in Switzerland.

As far as fibre-mix and product-mix are concerned, therefore, the manufacture of cottons in Lancashire between 1660 and 1760 shared important features with other centres of cotton manufacturing in Europe. In other crucial respects, Lancashire was different, especially with regard to spinning. In spinning, there were four broad areas of divergence.


\(^{23}\) Wadsworth and Mann, *Cotton Trade*: chapters 1, 2 and 6.


\(^{25}\) According to Rees, Blackburn greys for printing were being produced as early as 1727. By 1736 they were well-established in the Blackburn area, which saw large-scale public festivities to celebrate the passing of the Manchester Act (9 Geo. II, c. 4), confirming the legality of printing on cotton-linens. Rees, *Cyclopaedia*, vol. 10, London, 1819: ‘Cotton’; *Derby Mercury*, 8 April 1736.
(i) Raw materials.
Lancashire was the only major European centre of cotton manufacturing before the mid-1730s to use predominantly New World raw cotton (Fig. 1).\textsuperscript{26} Other centres, including Switzerland, relied on raw cotton from the eastern Mediterranean – often termed Levant cotton – and continued to do so into the late eighteenth century.\textsuperscript{27} The principal exception was Normandy, but it began to import large quantities of raw cotton from the French West Indian islands only in the late 1730s and thereafter suffered severe supply interruptions during the wars of the mid-eighteenth century. Normandy remained heavily reliant on Levant cotton. In war years it largely replaced New World cotton, while in the years of peace during the early 1750s it accounted for close to 40\% of the region’s raw cotton supply. Indeed imports of Levant raw cotton to France saw dramatic growth between the start of

\textsuperscript{26} In 1788 Patrick Colquhoun provided estimates for the weight of raw cotton used annually for candlewicks in Britain in 1786 and 1787. If those estimates are projected backwards to the 1730s, deflated in line with excise data for production of tallow candles, all the raw Levant cotton imported in that decade, as well a significant proportion of the lower quality West Indian cotton, would have been used for candlewicks. The National Archives (hereafter TNA), BT 6/140: Board of Trade miscellanea, Cotton, 1787-1792, ‘An important crisis in the cotton manufactory of Great Britain explained’; P. Deane and W.A. Cole, \textit{British Economic Growth, 1688-1959}, Cambridge, 1967: 72.

the eighteenth century and the 1780s, mainly in return for exports of French woollen textiles, which increasingly dominated Ottoman markets.\textsuperscript{28} England, by contrast, started importing New World cotton from Barbados during the 1630s, in what Russell Menard calls the island’s ‘cotton boom’, which preceded the more familiar Barbados sugar boom of the 1640s and 1650s.\textsuperscript{29} After 1660 Jamaica and other British Caribbean islands also began to supply raw cotton. Available statistics for the later 17th century are incomplete, but across the period 1660 to 1780 the available data show that imports of West Indian raw cotton were almost always larger, and often very much larger, than those of Levant cotton. Imports of spun cotton yarn were small and declining.

West Indian cotton outpaced Levant cotton in Britain despite being consistently more expensive (See Fig. 7). The cost differential reflected the superior quality of New World cotton, which lay principally in the length of its cotton fibres, but also in their strength and fineness. The two American species of cotton both have longer fibres (staples) than the two Old World species, which make them more suitable for finer yarns (Table 1).

\begin{table}
\centering
\begin{tabular}{|l|c|c|}
\hline
 & cm & inch \\
\hline
\textbf{New World Origin:} & & \\
\textit{Gossypium barbadense} & 3.25 & 1.28 \\
\textit{Gossypium hirsutum} & 2.92 & 1.15 \\
\hline
\textbf{Old World Origin:} & & \\
\textit{Gossypium herbaceum} & 2.25 & 0.88 \\
\textit{Gossypium arboreum} & 1.88 & 0.74 \\
\hline
\end{tabular}
\caption{Average fibre length in the four domesticated species of cotton (Genus \textit{Gossypium}).}\textsuperscript{30}
\end{table}

These differences emerge clearly in modern studies of cotton biology, but they were already familiar in the eighteenth century. When the trainee French Inspector of Manufactures, François Latapie, asked a Rouen merchant about the cottons available in 1773, he was told that cottons from the French Caribbean territories of Cayenne (now French Guiana) and St Domingue (now Haiti) were considered the best, for their pure white colour, lustre,

\begin{footnotesize}
\end{footnotesize}
suppleness and ease of spinning, but they were scarce. Most plentiful was cotton from the Caribbean island of Gaudeloupe, but it was redder and somewhat shorter in staple. Levant cotton he dismissed as ‘the type that is least valued. It is short and hard.’

(ii) Industrial organisation.
Across early-modern Europe, spinning textile yarns was undertaken by women and children in their homes and, to a lesser extent, in welfare institutions. There was a markedly gendered division of labour, with weaving of the yarn into fabric being undertaken mainly by men. This manner of organising industrial work was predominantly domestic, but there was no single domestic system. When spinning was undertaken in the spinner’s household, the flow of materials into and out of the spinner’s hands could be organised in a variety of ways.

Sourcing of raw fibre could take three broad forms. First, the spinner might spin a fibre such as flax, hemp, or wool grown on her household’s farm or plot. This was not an option for cotton, because it was not grown in most of Europe. Second, as was the case for other textile fibres, the spinner might buy small quantities of raw cotton to spin on her own account. The spinner then had the option of either household autoconsumption – putting the yarn to use in her own household – or securing an income in money or in kind by selling the yarn to an outsider, who might be the a local village weaver, but might equally be a heavily capitalised yarn merchant or manufacturer. Third, in the more industrialised parts of Europe, the spinner often had the option of spinning yarn in her own home for a wage, usually calculated at a piece rate, from an employer who supplied the raw fibre under the putting-out system.

Examples of all three modes of organisation could be found among spinners of various fibres in both Britain and France. However, during the eighteenth century there was a marked contrast between the principal cotton spinning regions in the two countries – Lancashire and Normandy. In Lancashire, from at least the 1680s, most spinning of cotton was organised on a putting-out basis, generally by agents employed by medium and large-scale manufacturers, who then received back the yarn and put it out to be woven into fabric to weavers who did not necessarily live in the same locality as the spinner. In Normandy, by contrast, cotton spinning was generally a separate, small-scale commercial activity, conducted by women who spun on their own account. John Holker, the Lancashire Jacobite

32 Classic definitions of the domestic system in English, drawing on German scholarship, treated it as a stage in the development of industry, between the guild system and the factory system. Ownership of the means of production and raw materials was a defining factor. Under the domestic system, the worker was said to have owned the means of production, but not the raw materials, effectively making the domestic system synonymous with the putting-out system. However, this definition was not universally accepted. See W.J. Ashley, An Introduction to English Economic History and Theory, part 2, London, 1893: 219-20; W. Cunningham, The Growth of British Industry and Commerce in Modern Times: The Mercantile System, Cambridge, 1903: 497, note 2; E. Lipson, The History of the Woollen and Worsted Industries, London, 1921, 36-7, 72.
33 Wadsworth and Mann, Cotton Trade, 78-91.
emigré who became one of the French government’s industrial inspectors, recommended in the early 1750s that Rouen manufacturers should buy the cotton wool themselves and use putting-out agents in the places spinning was done, instead of relying on people ‘who buy cotton wool and resell it in small lots to the spinners’. Nevertheless, thirty years later, in the 1780s, the English agricultural journalist Arthur Young noted that spinners in Normandy continued to ‘buy their cotton, spin it, and then sell the yarn’.

The same was true in a number of other regions of France which subsequently developed cotton spinning in the course of the eighteenth century, although there were exceptions, as in the vicinity of Lille.

(iii) Processes and techniques.
Spinning was not simply a matter of sitting at a spinning wheel and turning raw cotton into yarn. The raw cotton, which arrived in western Europe in large, tightly-packed bales or bags, weighing more than 150 lbs, had to be opened, loosened out, cleaned of any dirt, seeds and other impurities, carded by wooden cards studded with metal teeth into a consistent form that the spinner’s fingers could draft, spun at a spinning wheel or with a drop spindle, then prepared into hanks or skeins for delivery into the weaving process. If we examine these different processes, we discover, once again, a marked contrast between mid-eighteenth century Lancashire and Normandy.

In both Lancashire and Normandy, spinners received raw cotton already broken down into small parcels, weighing two or three pounds. This cotton usually required additional loosening and cleaning. From that stage onwards English and French practice diverged. In Lancashire, the cotton was first washed with soap, which dampened and oiled it, making it easier to card. For carding, two hand cards were used to form the cotton into a loose mass that was consistent and of the correct density for spinning. The Lancashire cotton cards had short, sharp, half-hooked teeth, all of equal length, made with hand-operated machines. These teeth were mounted diagonally at equal intervals in supple leather to provide elasticity. The slots for the teeth were also made by a hand-operated machine, which ensured uniformity. These cotton cards were expensive. During the 1740s and 1750s, the Latham family of Scarisbrick in west Lancashire paid 30d. a pair, compared to only 15d. a pair for cards for sheep’s wool.

At the end of the carding process, the loose mass of cotton was formed into tubes, which were joined together. These tubes were transformed into a roving – a loosely-spun,
but very coarse proto-yarn – by the carder on a hand spinning wheel. This roving was then spun a second, final time into finished yarn of the required fineness by ‘another woman who perfects it … according to what is necessary to use it in the fabric for which it is intended and to avoid spoiling the spinner’s hand’. The spinning wheel used for cotton spinning in Lancashire was a small, non-flyer 20 inch wheel with an expensive steel spindle, at which the spinner could sit as she spun (Fig. 2). The ratio of carders to final spinners was described by John Holker in 1755: ‘There have always been for 3 [final spinners] one who cards and begins to spin coarse … The 3 each pay her a third of their earnings.’

Fig. 2. Carding, roving and spinning cotton by hand in Lancashire, as illustrated in Richard Guest, A Compendious History of the Cotton Manufacture, Manchester, 1823. Two hand cards lie on the floor. The woman on the right is preparing coarse rovings from the carded raw cotton. The woman on the left is spinning the rovings into yarn.

The finished yarn was spooled on the spinning wheel and then removed to be reeled into hanks. Reeling was a means of arranging the yarn into convenient bundles, but it could also be a means of measuring and policing its fineness, and hence its quality. If a reel was of a standard length or circumference, and a hank consisted of a standard number of turns, then the number of hanks per pound weight provided a measure of the yarn’s fineness, termed its count. Reels were adapted to enhance this process. Circular snap reels made a sound after a certain number of revolutions, while clock reels had a clock-like face with a pointer indicating the number of revolutions.42 This was the system that prevailed in the Lancashire cotton industry by the later seventeenth century, although the use of industry-wide standard reels in English textile manufacture can be traced back to the new worsted manufactures established in eastern England during the second half of the sixteenth century.43 Lancashire cotton yarn was reeled on a 54 inch circumference reel. 560 turns of the reel, in other words 840 yards, made a hank. The count of a cotton yarn was the number of these hanks per pound weight. Under this measuring system, the higher the number, the finer the yarn. It came to be known in eighteenth-century France as ‘le tarif anglois’ and remains in international use as English cotton count, with the letter code Ne.44

Whereas Lancashire cotton spinning was both labour intensive and capital intensive, broken down into an extended series of separate tasks each employing costly specialised equipment, hand cotton spinning in Normandy involved fewer tasks, less labour and less specialised equipment. The raw cotton was not washed before carding. French cards were hand-made, and their teeth were cut irregularly, aligned inconsistently and mounted rigidly. A mid-eighteenth century French report concluded, ‘French cards are very inferior in all respects to cards from Holland and England’, but they were cheaper.45 The cotton wool was carded more quickly and less thoroughly than in England. After carding, it was taken directly off the cards as laquettes (short cardings or slivers) and given its final spinning in that state, without the intermediate step of coarse spinning into rovings. The spinning wheel employed

---

43 In in 1575 piece rates for spinners employed by bay and say makers in Essex were already calculated according to length, measured on a yard reel; J.E. Pilgrim, ‘The Cloth Industry in Essex and Suffolk, 1558-1640’, Unpublished MA thesis, University of London, 1938: 157. Wadsworth and Mann in their Cotton Trade: 176-7 suggest that pre-spinning of rovings in Lancashire and the use there of a standard reel to establish yarn counts may have been confined to the manufacture of cotton velvets, but other evidence indicates their use was widespread throughout the Lancashire cotton industry. For rovings, see Bibliothèque Mazarine, Paris, Ms 2723/5: ‘Mémoire sur les filatures de coton en Angleterre, par Holker, traduction de Morel’, c.1750. The inventory of Joseph Hampson of West Leigh, chapman, taken in 1727 before the introduction of cotton velvets, distinguishes between different finenesses of cotton weft yarn by the price per pound paid for spinning; Lancashire Archives, WCW: inventory of Joseph Hampson. The 1743 piece rates quoted in Baines, Cotton Manufacture: 131 show the count system being used to set the rate for commonly used yarns.
was the large great or walking wheel with an iron spindle, otherwise used for spinning sheep’s wool, at which the spinner stood upright (Fig. 3).\textsuperscript{46}

![Fig. 3. Hand spinning cotton on the great wheel, Normandy, 1773; AN, F12/560, Latapie, ‘Réflexions préliminaires’.]

After spinning, the yarn was reeled, but into hanks of a variety of lengths. There was no industry-wide standard or regulation for either the dimensions of the reel, or for how many turns of the reel comprised a hank. In 1773 an inspector of manufactures visiting Rouen noted ‘not all the reels are of the same size, which results in considerable variation in the hanks.’\textsuperscript{47} Twenty years previously, the Lancastrian John Holker had been more blunt, complaining that the spinners simply spun the yarn as they pleased (‘à leur fantaisie’).\textsuperscript{48}

(iv) Quality standards.
At the heart of these contrasts between mid-eighteenth century cotton spinning in Lancashire and Normandy was quality, for which the most important consideration was cotton fibre length. Lancashire’s long-established use of long-staple, New World cotton


\textsuperscript{47} AN, F12/560: Latapie, ‘Réflexions préliminaires’, 1773.

\textsuperscript{48} Bibliotheque Mazarine, Ms 2723/5: ‘Mémoire sur les filatures de coton en Angleterre, par Holker, traduction de Morel’, c.1750.
allowed finer, more expensive, higher-count yarns to be spun (Fig. 4). Using finer yarns resulted in final products that were superior in quality and commanded a higher price.

![Fig. 4. Origin of raw cotton and fineness of yarn spun in Lancashire, c. 1750.](source: Bibliothèque Mazarine, 2723/5, ff. 129-133)

At Rouen in 1750, just over a decade after the town began to receive large imports of New World cotton, it was the soft and silky cottons from the French West Indian islands that were ‘destined for the manufacture of goods of superior quality’. As for cottons from the Levant, ‘consisting of a hard, short wool, their spinning can be neither beautiful nor even, so they are normally used in common siamoises (cotton-linen stripes and checks) and other coarse manufactures’. 49

Quality also depended on processes and techniques. The stiff, rough, irregular cotton cards used in Normandy tore the fibres, compromising their quality, especially the quality of

---

49 AN, F12/1411A: ‘Mémoire de Sieur Corsel, élève inspecteur des manufacture sur les especes de cotons quie sont employés dans les manufactures de la généralité de Rouen’, 1750. P. Parthasarathi, Why Europe Grew Rich and Asia did not: Global Economic Divergence, 1600-1850, Cambridge, 2011, 148-50 notes the coarseness of Rouen’s siamoises, but suggests it was the result of copying English worsteds rather than Indian cottons. This paper contends the stripes and checks produced in Normandy did attempt to copy Indian and Levant cotton fabrics, but did so within limitations imposed by the available techniques and raw materials.
the longer-staple New World cottons, and produced a hairy, uneven yarn. In France, uneven yarn also resulted from the failure to coarse spin the cardings into rovings before the final spinning, as well as from the use of the great wheel rather than the smaller English cotton wheel. Crucially, the lack of a standard reel for cotton in Normandy made it difficult to secure the specific yarn counts required for different fabrics, or to pay for spinning according to the fineness of the yarn, incentivising the spinners to spin higher, more valuable counts.

The difficulty was exacerbated by the way spinning was organised in Normandy. In the absence of standard measurements, specifications of fibre quality and yarn quality, as well as the challenge of policing those specifications, were managed through a series of market transactions between spinners, yarn dealers and the manufacturers who arranged the weaving of the yarn into finished fabric. Under the putting-out system that prevailed in Lancashire, these transactions were internal to the manufacturing firm, making it simpler to align fibre quality with yarn quality and with spinners’ skill and remuneration, all regulated according to the industry-wide yarn quality measure.

---

51 Guest, Compendious History: 7.
3. Why the spinning jenny?
The distinctive characteristics of the early-modern Lancashire cotton industry underpinned the invention of the spinning jenny. Nevertheless, understanding the form taken by the jenny and the timing of its invention also requires attention to its immediate Lancashire context, specifically to the Lancashire industry’s performance in the middle decades of the eighteenth century and to local circumstances in the vicinity of Oswaldtwistle where James Hargreaves lived, worked and constructed his first jenny.

The 1750s and 1760s, when the jenny was conceived and initially developed, emerge as particularly challenging decades for the Lancashire cotton industry – a combination of unprecedented expansion and unprecedented obstacles. It was an industry producing fabrics made overwhelmingly from combinations of cotton yarn and linen yarn. Both were largely imported. Raw cotton came predominantly from the West Indies, and to a limited extent from the Levant, to be spun locally. Linen yarn arrived, ready-spun, from the Baltic, from Ireland and, to a lesser extent, from Scotland. The best statistical indicator of the industry’s fortunes is therefore provided by the quantities of these two materials imported from overseas, considered together (Fig. 5). A very large, though unknowable proportion of both the raw cotton and the linen yarn imported into Britain was employed in Lancashire.

Fig. 5. Cotton wool imports and linen yarn imports, England, 1700-1779.

Sources: The National Archives, CUST 3/70-9; E. Schumpeter, English overseas trade statistics, 1697-1900, Oxford, 1960, Table 16.
Between the 1720s and the 1740s, both domestic and overseas demand were fairly stagnant, although the period saw developments in lighter fabrics such as stripes, checks and plain-weave Blackburn greys for printing. From the late 1740s, however, imports of raw materials increased. There was strong growth in the domestic market for the industry’s traditional and especially its newer products. At the same time, novel opportunities arose overseas among the rapidly growing populations of the British North American colonies and also in the African slave trade, where a combination of contracting Indian supply and rising Indian prices enabled Lancashire manufacturers to establish a strong presence in the market for cotton-linen versions of Indian all-cotton checks and stripes, even though Indian fabrics remained the preferred choice in West Africa.

The capacity of Lancashire manufacturers to respond to these opportunities was hampered by rising costs, both for spinning labour and for raw and intermediate materials. Labour costs are especially difficult to gauge, because no sustained runs of wages actually paid to Lancashire hand cotton spinners survive. However, the long-term trajectory of labour costs in Lancashire across the century before 1770 can be reconstructed, using Lancashire manufacturers’ business records and probate inventories.

Fig. 6. Yarn counts of cotton weft spun for six Lancashire manufacturers, 1683 to 1769.

Yarn count is a weighted average of the counts of the cotton weft yarn held by each manufacturer. Sources: see Appendix.
Labour costs increased during that century, for two reasons. First, the average count of the cotton yarn being spun increased, from a very coarse average count of Ne 7 during the late-seventeenth century, to between Ne 9 and Ne 10 in the 1720s, to over Ne 15 by the late 1760s (Fig. 6). This increase in the fineness of yarn partly reflected the industry’s shift to lighter fabrics, especially stripes, checks and Blackburn greys, but there may also have been a shift towards lighter versions of traditional fustians. The shift to lighter fabrics brought about an increase in labour costs because, in Lancashire, where yarn was reeled to a fixed standard, every increase in the yarn count earned an increase in the piece rate per pound spun. The rate of increase was steep. For the more commonly used yarns in the 1750s, an increase of one in the yarn count secured an increase of about a penny per pound on the rate. So while spinning a pound of West Indian cotton to Ne 12 earned 11d. for each pound spun, spinning it to Ne 24 secured 27d. Spinning finer counts took considerably more time and skill than spinning coarser counts. Nevertheless, spinners had a clear incentive to climb the quality ladder (Fig. 7).

Fig. 7. Piece rates per pound paid for spinning cotton by count, Lancashire, c.1750

Source: Bibliothèque Mazarine, 2723/5, ff. 129-133

---

52 The trend in Lancashire cloths towards finer yarns and lighter fabrics identified by Harley for the century after the mechanisation of spinning was already well-established during the century before mechanisation. C. Knick Harley, ‘Cotton textile prices and the industrial revolution’, Economic History Review, 51, 1998: 49-83.
In addition, there appears to have been an upward shift in the level of piece rates overall. As was often the case with eighteenth-century wage payments, customary piece rates for cotton spinning remained stable for long periods, but were subject to short-term adjustments – deductions or advances – depending on trade conditions. As a consequence, establishing long-term trends from spot prices is perilous.\(^53\) However, the rates paid for spinning cotton in Lancashire do appear to have undergone a long-term increase across the century up to 1770, by as much as 50%, which is probably too large a change to be accounted for by short-term adjustments alone. In the 1680s each one count increase in the fineness of a typical coarse yarn was worth an additional 0.75d. on the piece rate per pound. By the 1740s and early 1750s it was worth approximately 1d. extra. By 1769 it was worth 1.25d.\(^54\)

Cost pressures on Lancashire’s cotton manufacturers in the mid-eighteenth century were not confined to wages. There were also dramatic increases in the prices of materials. There are no surviving local price series for either raw cotton or linen yarn. Both commodities were, however, sourced at a distance and widely traded internationally, so available price series from Scotland and Amsterdam can provide evidence of trends, even if the prices they quote were not those actually paid in Lancashire (Fig. 8).\(^55\) Amsterdam raw cotton prices doubled in the course of the 1740s. They were subsequently extremely volatile, with very high peaks. Scottish linen yarn prices rose too, especially in the 1740s and the later 1750s, following the same trajectory as raw cotton, but less dramatically. Nevertheless, linen yarn continued to be substantially cheaper than cotton yarn, selling at around half of its price per pound, or less.

\(^{53}\) In 1743, it was reported that in Lancashire during the previous twelve months a 2d. in the pound abatement on the 12d. per lb. piece rate for spinning coarse cotton yarns of Ne 12 had been reduced to a 1d. in the pound abatement; Baines, *Cotton Manufacture*: 131. For abatements from wages for spinning sheep’s wool at the same period, see *Reasons offered by the manufacturers of combing and spinning in England against taking the duty off Irish yarn imported*, 1738. For fluctuations in Lancashire wages for spinning flax and sheep’s wool in the 1720s and 1730s, see J. Harland, *The Autobiography of William Stout*, London, 1851: 104, 107, 113, 117, 120, 123, 126, 138.

\(^{54}\) Wadsworth and Mann, *Cotton Trade*: 87; Baines, *Cotton Manufacture*: 131; Bibliothèque Mazarine, Ms 2723/5: ‘Mémoire sur les filatures de coton en Angleterre, par Holker’; John Rylands Library, Eng. Ms. 1199: Cardwell, Birley and Hornby, stock inventory, 1769. Upward pressure on cotton spinning piece rates in the 1750s and 1760s is also indicated by the one surviving English wage series for cotton spinning. It is for paupers spinning cotton at the workhouse at Marlborough in Wiltshire in the south of England, probably for ‘Wiltshire candlewick’ at a coarse Ne 7 or less. Between 1751 and 1773 the rate paid increased from 4d. per pound to 7d. per pound, with no indication that the fineness of the yarn was increasing; Wiltshire and Swindon History Centre, PR/Marlborough St. Peter and St. Paul/871/190: Parish of St. Peter and St. Paul, Marlborough, Account notebook giving details of the employment of the Marlborough poor in Cotton Spinning, 1751-1773; Rees, *Cyclopaedia*, vol. 22: ‘Manufacture, Cotton’.

\(^{55}\) For Scottish (Perth) linen yarn prices, 1741-1776, A. Bald, *The Farmer and Corndealer’s Assistant*, Edinburgh, 1780: unpaginated; for Amsterdam raw cotton prices, 1705-1780, Medieval and Early Modern Data Bank, Prices (Posthumus) and Harvard Business School, Baker Library, Kress Collection, ‘Notitie der prysen van diverse waaren en Koopmanschappen uyt de prys couranten’, Amsterdam, 1709-1787, vols 1 and 2.
An expanding, higher quality product range, increasing demand, rising labour costs, soaring material costs – were these the short-term economic inducements that impelled James Hargreaves to invent the spinning jenny in the mid-1760s? The limited evidence available indicates the Lancashire cotton industry produced a number of attempts at this period to develop multi-spindle machines for spinning cotton, although interest in Britain in mechanical cotton spinning was not new. It dated back to the less economically pressured environment for cotton manufacturing of the 1720s and 1730s. Some of the same pressures, moreover, affected other textile industries in the 1750s and 1760s, especially worsteds and sailcloth in the north of England, without inducing technical innovation. In order to understand the precise form taken by James Hargreaves’ invention, we need to consider how the impact of the economic pressures of those decades on the Lancashire cotton industry varied according to the material makeup of its products and the ways work was organised. Technical innovation was not necessarily the appropriate response.

As we have seen, the vast majority of the textiles that comprised the Lancashire ‘cotton’ industry before 1770 were mixtures of cotton and linen. However, the ratio of cotton yarn to linen yarn was not fixed. Many of the checks and stripes, for example, contained a good deal more linen than cotton. The survival of five thousand fabric swatches left with

---

56 Wadsworth and Mann, Cotton Trade: 472-6 and, for the 1720s and 1730s, chapter 21; R. Dossie, Memoirs of Agriculture and other Oeconomical Arts, vol. 1, London, 1768, 93-8.
babies at the London Foundling Hospital between 1742 and 1760, consisting largely of the newer, lighter, cotton-linen fabrics of the types manufactured in Lancashire, enables us to employ microscopic analysis to assess the fibre content of a significant proportion of the Lancashire industry’s output on the eve of the Industrial Revolution (Table 2).

Table 2. Fibre content of yarns used in printed, checked and striped fabrics made from cotton and linen: London Foundling Hospital Billet Books, July 1759 and January 1760.

<table>
<thead>
<tr>
<th>Fibre</th>
<th>Prints</th>
<th>Checks</th>
<th>Stripes</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warp cotton, weft cotton</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Warp silk, weft cotton</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Warp linen, weft cotton</td>
<td>42</td>
<td>1</td>
<td>5</td>
<td>48</td>
</tr>
<tr>
<td>Warp linen, weft linen &amp; cotton</td>
<td>-</td>
<td>12</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Warp linen, weft linen</td>
<td>35</td>
<td>17</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Unclear</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td>31</td>
<td>22</td>
<td>140</td>
</tr>
</tbody>
</table>

Source: London Metropolitan Archives, Foundling Hospital Billet Books, A/FH/A/9/1/149 (July 1759) and A/FH/A/9/1/166 (January 1760).

Most of the mixed-fibre checks and stripes contained more linen yarn than cotton yarn. In checks and stripes, often it was only the more richly coloured yarns that were cotton, while all the rest were linen (Fig. 9). Among the Foundling Hospital’s cotton textiles, it is only the Blackburn greys, the fabrics produced in Lancashire for printing with wooden blocks in the printing works that ringed London, that have an exclusively 50:50 ratio of cotton yarns to linen yarns.

57 For the background to the Foundling Hospital textiles, see J. Styles, *Threads of Feeling: The London Foundling Hospital’s Textile Tokens, 1740-1770*, London, 2010. Fibre analysis was undertaken with a Dino-Lite AM7013MZT USB microscope at x60 magnification.
Fig. 9. Cotton-linen check, 1759. The image on the right is at x60 magnification. All the white yarns and the horizontal blue yarns are smooth linen. Only the vertical blue yarns are fluffier cotton. Note how poorly the blue dye takes on the horizontal linen stripe compared with the deep blue of the wider vertical stripe in cotton. London Metropolitan Archives, A/FH/A/9/1/149: Foundling Hospital, Billet book, July 1759, Foundling number 13416. © Coram.

Where a strict 50:50 ratio between the two fibres was not essential, trade-offs were possible. Any inducement to cut costs by technical innovation was reduced. Linen yarn prices rose from the later 1740s at the same time as the prices of raw cotton, but the increase in linen yarn prices was more muted. Linen yarn remained substantially cheaper than cotton yarn. Indeed, the cost of spun linen yarn suitable for many Lancashire fabrics was close to that of unspun, low quality Levant cotton (Fig. 8). So for fabrics like checks and stripes, where the cotton:linen ratio varied, substitution of cheaper linen yarn for costlier cotton was a feasible cost-reduction strategy. According to the Manchester merchant and checkmaker Samuel Touchet, in 1750 ‘the high price of cotton had obliged them to use coarse linen instead’. Consequently, one type of fabric, ‘which used to be made all of cotton one way, was now made not above 1/4 part cotton: and in another species, 1/4 part less cotton was used than formerly.’ Wholesale purchasers were all too aware of this tactic. A Manchester merchant partnership was informed in 1772 that a New York purchaser had ‘complained of the checks having some threads of blue linen mixed with the cotton, but [I] told him there certainly was as much cotton in them as could be afforded for the price.’

This option was not available to manufacturers of Blackburn greys for printing. A 50:50 cotton to linen ratio, with a thick, fluffy, richly coloured cotton weft and a finer, smoother and less visible linen warp, was essential for producing the desired printed finish.

---

(Fig. 10). Linen yarns absorbed dyes less well than cotton yarns. The combination of a thick cotton weft and a fine linen warp was contrived to minimise the visual impact of this difference. Reducing the proportion of cotton yarn in each piece of cloth any further would have given the pattern an unbalanced, more speckled appearance. A similar obstacle to reducing the 50:50 ratio of cotton weft to linen warp applied to many of the older, heavy fustians characterised by a cut and raised surface, which relied on their cotton weft. Yet during the middle decades of the eighteenth century Blackburn greys were the more successful product, the British-made substitute for the Indian all-cotton calicoes that were the base material for Indian chintzes, banned in Britain. It was estimated in the mid-1760s that Blackburn greys accounted for eighteen percent of the total output of the Lancashire cotton industry, even though they had not existed at the start of the eighteenth century.

Fig. 10. Printed cotton-linen fabric (Blackburn grey), 1760. The image on the right is at x60 magnification. Note how poorly the colours have printed on the vertical linen warp yarns. London Metropolitan Archives, A/FH/A/9/1/166: Foundling Hospital, Billet book, January 1760, Foundling number 15149. © Coram.

Trials for theft at the Old Bailey, the principal criminal court for London, suggest printed Blackburn greys and other cotton-linen gown fabrics took a huge bite out of the market for women’s gowns during the 1730s and 1740s, but as raw cotton prices rose in the 1750s the

---

59 The quality implications of the different capacity of cotton and linen yarns to receive dyes have not always been recognised by historians; see, for example, Harley, ‘Cotton textile prices and the industrial revolution’: 65.

60 Heavy fustians do not appear among the Foundling Hospital textiles, which are largely confined to fabrics worn by infants.

progress of gowns made from cottons stalled. Prints on cheaper Irish or German all-linen fabrics ate into their market, despite inferior colouring (Fig. 11).

![Fig. 11. Cases involving gowns, by material, Old Bailey, London, 1720–1769.](source)

Blackburn greys were the principal fabric produced at Oswaldtwistle, only three miles from Blackburn, where James Hargreaves worked as a cotton weaver for most of the 1750s and 1760s. During these decades, the impact of rising input prices on their manufacture was not confined to the cost of materials. Blackburn greys faced another pressure, an acute shortage of spinning labour, as a result of the way the textile industries developed in Lancashire in the first half of the eighteenth century.

Spinners were predominantly female. Systematic evidence about women's employment in the eighteenth century is notoriously poor. Consequently establishing the geographical incidence of any one type of spinning can often be done only indirectly. The only systematic sources for the geographical distribution of spinning in Lancashire and Cheshire from 1765 to 1789 derive from two sets of convictions for summary offences — frauds in yarn measurement by spinners of worsted yarn and embezzlement of short-staple sheep's wool put out to spin to clothiers and weavers in the Rossendale area of Lancashire. There are no equivalent sources for cotton or flax spinning. Nevertheless, convictions of worsted and woollen spinners make it clear that the core area of Lancashire's cotton industry, between Blackburn, Wigan, Manchester and Oldham, was hemmed in to the north, the west and the south (as well as over the Yorkshire border to the east) by areas where
worsted and woollen spinning offered an alternative employment for women at attractive wages (Fig. 12).

To the south-west there was also flax and hemp spinning, especially around Warrington for its sail-making manufactory, which burgeoned during the 1740s and 1750s. Sail-making benefitted from the growth of the port of Liverpool, from naval demand during the wars of the mid-eighteenth century and from state support for the manufacture of sails in Britain. Like cotton, these were buoyant, rapidly expanding industries. Indeed, worsted manufacturing, with its core weaving area over the Yorkshire border around Halifax, was a more recent arrival in the north of England than cotton. Whereas Lancashire started making
cotton fustians at the end of the sixteenth century, worsteds emerged in Yorkshire on any scale only at the end of the seventeenth.\textsuperscript{62}

Predominantly an export industry, Yorkshire worsteds grew very rapidly during the first half of the eighteenth century, probably faster than Lancashire cottons. They boomed during the 1750s and early 1760s. By the 1770s they accounted for half Britain’s output of worsted fabrics and nearly 20\% of all British woollen textile production, yet they had hardly existed seventy years earlier.\textsuperscript{63} In worsteds the ratio of spinners to weavers was especially high, so to secure a supply of yarn the Yorkshire manufacturers were obliged to source yarn from an enormous area up to 50 miles away across the West and North Ridings of Yorkshire, as well as adjacent parts of Lancashire and Cheshire.\textsuperscript{64} This was a dynamic process. In the course of the eighteenth century, the worsted spinning frontier expanded further and further from the core weaving area in Yorkshire. Competition for labour arising from ‘the great number of the master manufacturers and the rivalship consequential thereon’ boosted worsted spinners’ wages and perquisites, although piece rates at the frontier remained lower than those at the core.\textsuperscript{65} The landowner and miniature painter Samuel Finney, looking back in 1785 at the history of his native township of Wilmslow in Cheshire, recalled that earlier in the eighteenth century the women and children were employed in making silk- and mohair-covered buttons. As fabric-covered buttons became less fashionable around mid-century, the work was replaced by worsted spinning introduced by manufacturers from

\textsuperscript{62} C.R. Foster, \textit{Capital and Innovation}, Northwich, 2004: chapter 9, esp. 275-6 and 280. For state support for sail making, see the 1736 Act of Parliament 9 Geo. II, c. 37. The stimulus sail making provided to flax and hemp spinning did not extend to spinning flax for the all-linen checks and sheets manufactured in this area. The latter were woven from imported Baltic and Irish yarn, because local manufacturers ‘can purchase it spun from those countries, cheaper than our cottagers can afford to work it’; Charles Morduant of Halsall, Lancashire, letter printed in \textit{Annals of Agriculture}, 9, 1788: 288. Herbert Heaton, \textit{The Yorkshire Woollen and Worsted Industries from the Earliest Times up to the Industrial Revolution}, Oxford 1965: 258-276.


\textsuperscript{64} John Sutcliffe, a Holdsworth, Halifax stuff maker, estimated in 1774 that in the Yorkshire worsted industry, there were 4 spinners to every weaver; J. James, \textit{The History of the Worsted Manufacture in England}, London 1857: 281. For Lancashire cottons, it was estimated that in 1760 ‘a weaver required three grown persons to supply him with weft’; Guest, \textit{Compendious History}: 10. However, the ‘three grown persons’ included those preparing the cotton wool for the spinner, by picking, carding and roving. Guest indicated that the number of those actually spinning was roughly half this number, which was an underestimate, but he was correct to point out that hand cotton spinners were expected to prepare the raw cotton. Sheep’s wool for worsted spinning, by contrast, was supplied to the spinners ready-combed, so little or no further preparation was needed.

\textsuperscript{65} \textit{Leeds Intelligencer}, 26 November 1776; James, \textit{Worsted Manufacture}, 281. In the North of England there is little evidence at this date of the monopsonistic tendencies in the employment of worsted spinners that intensified in East Anglia during the second half of the eighteenth century as the local industry stagnated and the use of imported Irish worsted yarn increased; see Humphries and Schneider, ‘Spinning the Industrial Revolution’: 27.
Yorkshire. Yet Wilmslow was only ten miles south of Manchester, the capital of the Lancashire cotton trade.

We may lack direct evidence about the precise extent of cotton spinning in Lancashire in the 1760s and 1770s. Nevertheless the distribution of woollen and worsted spinning, combined with what we know about flax spinning around Wigan and Warrington, indicates that the area devoted exclusively to cotton spinning was hemmed in and surprisingly small. The reason is simple. As we have seen, the vast majority of the textiles that comprised the Lancashire ‘cotton’ industry before 1780 consisted mainly, or at least half of linen yarn. By the 1750s, little of the linen yarn used in these Lancashire-woven fabrics was spun by Lancashire women. Most was sourced in Ireland, on the shores of the eastern Baltic, or to a much lesser extent in Scotland. As a consequence, the geography of spinning for the Lancashire industry was very different from the Yorkshire worsted industry. In Lancashire, less than half the yarn woven (the cotton) was spun within the region, so the spinning field was geographically far less extensive at any level of output than that of the Yorkshire worsted industry, which sourced almost all its yarn, both warp and weft, locally.

Hemmed in by spinning for these other, successful textile industries, a new way of organising the spinning of cotton yarn emerged in the middle decades of the eighteenth century, as production expanded, raw cotton prices rose, and spinning labour became increasingly scarce. Manufacturers of fustians and Blackburn greys began to put out raw cotton for spinning to their weavers each time the weaver received a ready-spun linen warp. The weaver was expected not only to weave the cloth, but also to arrange the spinning of the cotton weft yarn. Spinning weft required less labour than spinning warp, especially the loosely spun weft characteristic of many Lancashire cotton-linen fabrics. Consequently, it was feasible for a weaver to have the cotton weft spun locally, often mainly by his own family. This new variant on the putting-out system was not suitable for making fabrics with coloured or bleached yarns, like checks and stripes, where the yarn had to return to the manufacturer for dyeing and bleaching before being put out to be woven. But it became widespread in the manufacture of Blackburn greys, which were neither loom-patterned nor used bleached cotton yarn.

Oswaldtwistle was at the northern extremity of Lancashire’s core cotton district, where it overlapped with the worsted spinning zone (Fig. 12). In this liminal area, wages for worsted spinning offered an attractive alternative to spinning cotton, just as they did to button making at roughly the same period at Wilmslow, 30 miles to the south. At Clitheroe, nine miles north of Oswaldtwistle, the poor had spun flax in the 1690s, but by 1751 they were spinning worsted. At Whalley, five miles to the north, it was also worsted that was spun.

---

67 Ogden, Description of Manchester: 74 and 88; Guest, Compendious History: 10, which dates the development to about 1750. Also see Wadsworth and Mann, Cotton Trade: 276.
68 This way of organising spinning was not feasible for checks and stripes, even when they contained a large proportion of cotton, because at least part of their cotton yarn had to be bleached and dyed before it was woven. Dyeing tended to be concentrated in specialist plants, especially around Manchester; see J. Stobart, ‘Textile Industries in North-West England in the early Eighteenth Century: A Geographical Approach’, Textile History, 29, 1998: 8-9.
in 1751. Immediately adjacent to Oswaldwistle, in the townships of Rishton and Great Harwood which separated it from Whalley, cotton spinning and worsted spinning intermingled. A 1767 census of these townships’ Catholic minority, which listed women’s occupations, identified 9 spinners of worsted, but also 3 spinners of cotton. Among the worsted spinners, three had husbands who wove cotton check.

At Oswaldtwistle it was weavers of Blackburn greys who confronted the challenge posed by local demand for worsted spinners during the 1750s and 1760s. These weavers now bore the responsibility for having their employer’s raw cotton spun into weft. Hargreaves was probably one of them, given his close association with the Blackburn manufacturer, Robert ‘Parsley’ Peel, who lived less than a mile away and in the mid-1760s established at Oswaldtwistle the first of the Peel family’s cotton printing works. As initially conceived, Hargreaves’ spinning jenny spun only weft, it was domestic in scale, and it was optimised for use by children, indeed physically difficult for adults to use. In the face of competition for spinning labour in the locality, it was a perfectly contrived response by a male head of household to the new, weaver-centred system for organising weft spinning. It allowed weavers to rely more exclusively on family labour to process the cotton wool their employers obliged them to convert into yarn.

At the same time it provided them with direct control over yarn quality, an important consideration in weaving. Hargreaves’ focus on retaining yarn preparation within the household is confirmed by a previous invention credited to him earlier in the 1760s, a method of carding with multiple cards so that ‘one woman could perform twice as much work, and with greater ease than she could do before in the common way.

Ironically, in view of Robert Allen’s focus on the cost of factors of production to explain the emergence of the jenny, under this system spinning labour was not directly priced. A notional payment for the spinning undertaken by a family’s women and children was simply bundled into the weaver’s contract. Allen is right to argue that James Hargreaves’ invention of the spinning jenny was an innovation associated with pressure in the market for spinning labour. Yet that pressure was not, as Allen would have us believe, an epiphenomenon of a distinctively British high wage economy extending to women and children’s earnings across the country. English spinning costs were indeed sometimes higher than those elsewhere in Europe. The huge quantities of relatively coarse grades of linen and worsted yarn imported into England during the eighteenth century reflected lower spinning costs for those yarns in Ireland and the eastern Baltic. Yet little cotton yarn was imported,

---

71 Aspin with Chapman, James Hargreaves and the Spinning Jenny: 12-17.
72 This interpretation of the impact of the spinning jenny has a long pedigree; see John Kennedy, ‘Observations on the Rise and Progress of the Cotton Trade in Great Britain, Particularly in Lancashire and the Adjoining Counties (Read Before the Literary and Philosophical Society, 3rd November 1815)’ in John Kennedy, Miscellaneous Papers on Subjects Connected with the Manufactures of Lancashire, Manchester 1849: 7, and T.S. Ashton, The Industrial Revolution, 1760-1830, Oxford 1997: 58, which insists the effect of small jennies ‘was to strengthen, rather than weaken, the family economy.’
73 Rees, Cyclopaedia, vol. 10: ‘Cotton’.
even though pressure on spinning piece rates in Lancashire in the 1760s co-incided with the beginnings of sustained downward pressure on wages for spinning worsted in East Anglia, associated with increasing use of imported Irish yarn.\textsuperscript{74} Spinning labour markets, like the industries they served, were often markedly local or regional in character. The shortage of spinners in mid-eighteenth century Lancashire emerged in a specific locality at a specific moment. It affected spinners of a range of fibres, among whom those who spun cotton were not the most numerous. The genesis of Hargreaves’ invention cannot be understood simply by considering the relative costs of capital and labour at a national level.\textsuperscript{75} The key inducements to innovation were the costs of labour and raw materials as they impacted the local production system for a relatively new fabric with distinctive material characteristics – the 50:50 ratio, unbleached, cotton-linen Blackburn greys, which supplied the London textile printing industry.

The very different characteristics of the eighteenth-century cotton industry in France meant an invention along the lines of the spinning jenny was most unlikely. Few of the inducements to invent or to take up the jenny observed in Lancashire were present in Normandy:-

(i) The Normandy cotton industry grew exceptionally quickly in the 1730s and 1740s, but the product mix was different from Lancashire. There was no large-scale production of either heavy fustians, or of plain, unbleached fabrics for printing, at least before the 1760s. The dominant product (siamoises) was a loom-patterned fabric incorporating dyed and bleached yarns.\textsuperscript{76}

(ii) The spinning labour market in Normandy was not organised under the putting-out system. There was no particular incentive to combine spinning and weaving as part of an integrated family textile economy. Cotton spinning was less labour and capital intensive than in Lancashire, and it did not face local competition for spinning labour from other fibres. Indeed, in Normandy it was the spinning of non-cotton fibres, such as woollen yarn for cloth manufacturers at Darnétal and Elbeuf, that was threatened by cotton.\textsuperscript{77}

(iii) In Normandy the practice of spinning was plagued with quality problems. Levant cotton, which could be spun only to low counts, was widely used. Carding was poor, spinning wheels were unsuitable for finer yarns, and there was no pre-spinning of coarse rovings. The failure to employ a standard measuring reel resulted in high transaction costs for matching yarn quality to the finished product and ill-defined incentives to improve quality.

\textsuperscript{74} Irish worsted yarn came to account for a fifth of all the yarn employed in the Norwich worsted industry; L.M. Cullen, \textit{Anglo-Irish Trade, 1660-1800}, Manchester, 1968: 54-8; J. Kirby, \textit{A letter to a Member of Parliament stating the Necessity of an Amendment in the Laws relating to the Woollen Manufactory so far as respect the Wages of the Spinners}, Ipswich, 1787: 23.

\textsuperscript{75} Allen exaggerates the capital costs for the jenny. The cost per spindle for Hargreaves’ original jenny was no greater than a typical hand spinning wheel for cotton.

\textsuperscript{76} Chassage, \textit{Le Coton}: 31.

\textsuperscript{77} AN, F12/1365: ‘Mémoire de Goy, inspecteur des manufactures à Rouen, sur les manufactures des draperies de Rouen, de Darnétal, et de Bolbec’, 1767, f. 2; Becchia, \textit{Elbeuf}, 190, 236.
For France the consequence was a predominance of low count, coarse, inconsistent, ill-spun cotton yarns. When the jenny was introduced there in the 1770s, these quality issues were to prove major obstacles to its use. It was John Holker’s son who brought the jenny to France in 1771. He and his father went on to construct jennies to spin fine cotton for their cotton velvet manufactories at Rouen in Normandy and Sens, south-east of Paris. Powerful patrons then pressured the Holkers to supply jennies to other centres of cotton spinning. They included Villefranche sur Sâone, north of Lyon, where a manufactory of printed cottons was established after the ending of their prohibition in 1759. The younger Holker complied, though reluctantly. ‘The machine may not be suitable for this manufacture, any more than for all the others of the same kind which only print on common coarse fabrics, similar to those from Switzerland in quality. It is only advantageous for the spinning of fine cottons.’

The printing fabrics made at Villefranche and in nearby centres in Burgundy during the 1760s and 1770s were all-cotton garas (gurrahs), copies of Indian and Swiss cottons used in the cheap prints smuggled into France before 1759. Their yarn was spun from Levant cotton and was coarse.

Louis-Casimir Brown, inspector of manufactures for Picardy, agreed with Holker. In 1779 he reported on the use of a jenny to spin very fine yarn for cotton velvets at Amiens. ‘It is necessary to choose the longest, softest and most consistent [cotton] wools, known by the names of Maraignan [Maranhão, Brazil] and Cayenne, because the finest qualities come from those regions. At a pinch, the cotton which comes to us from St Domingue and Martinique could also be used, but an inferior yarn would be the result. The cotton which comes to us from the Levant, known by the name of Smyrna cotton, should be avoided. Its fibres are too short, too dry, too brittle. Yarn made from it would be too coarse and would not repay the costs of the work. There is no benefit from spinning with this machine except when the yarn is very fine. The preliminary costs are the same for common spinning and for fine.’

To work without breakages, the jenny required careful preparation of the raw cotton, including carding with well-made cards appropriate for the count of yarn to be spun, followed by pre-spinning into rovings. Despite savings in the final spinning, these additional preparatory stages rendered the economics of the jenny unviable for spinning low count, low value yarns from the inferior Levant cotton so widely employed in France, even in Normandy. In Lancashire, where higher quality, New World cottons predominated, these preparatory processes were already well established. Without them, it is hard to imagine the jenny could have been developed, let alone widely adopted. In France, where low quality Levant raw cotton set the standard, preparatory processes were correspondingly cruder. Coarse yarn spun from Levant raw cotton, whether by hand or on the jenny, was unlikely to repay the cost or effort of the English preparatory sequence – washing with soap, slow carding with expensive, time-consuming cards, pre-spinning into rovings. At Rouen in 1773, twenty years after the English techniques were first publicised, it was still ‘rare to see the

78 AN, F12/1340: John Holker fils, Paris, to Trudaine, 8 June 1777.
manufacturers making use of the English cards’, because they were more expensive and did ‘half as much work as is done with the ordinary cards, a disadvantage which, according to them, cannot be outweighed by the perfect regularity of the carding’. Any cost advantage the jenny offered in the final spinning of cheaper, short-staple cottons was nullified by the expense of following the English mode of preparation.

According to John Holker, the maximum yarn count produced on a hand spinning wheel with Levant cotton was Ne 16. The majority of counts spun from Levant cotton must have been a good deal coarser, too coarse for the jenny. A 1793 report on the record of spinning machines in France concluded that jennies ‘have not enjoyed success nor been profitable to the manufacturers, except for yarns between no. 15 up to no. 24’. It was estimated in 1781 that there were more than 1,200 jennies in use in France, but most were probably larger machines with thirty spindles or more, spinning New World cottons in workshops to high counts for speciality fabrics, such as cotton velvets. When employed in the manufacture of coarser fabrics, they failed. At Noyon in Picardy in the 1780s, forty jennies were distributed to spin yarn for the manufacture of coarse cotton-linen fabrics. By 1789, only six remained in use. ‘Their shortcomings have become clear and now only the great wheel is used’.

83 AN, F12/678: ‘Etat général des différentes branches de commerce et d’industrie renfermées dans la Généralité de Soissons’, 1789. For a pre-jenny failure of English spinning techniques with coarse cotton fabrics, see AN F12/1341: ‘Le Sieur Imbert de St Paul ... sur les fabriques de toiles de coton de son département’, Amiens, 1761.
4. Conclusion.
The jenny remains one of the key technical innovations of the Industrial Revolution, original and Janus-faced. In conception and operation, it was embedded in the material and technical divisions of labour distinctive to domestic hand cotton spinning in Lancashire during the previous century. Yet, once in use, it was rapidly re-engineered as a larger, more costly machine installed in non-domestic, proto-factories, while the discontinuous mode of operation it borrowed from hand cotton spinning was copied by Samuel Crompton in his spinning mule of 1779, which went on to dominate Lancashire cotton spinning for the next century and a half.

Nevertheless, James Hargreaves’ spinning jenny is not the Industrial Revolution in miniature, a microcosm of the wider phenomenon and its causes. Considered in isolation, the jenny cannot answer the big questions as to why the key technical innovations of the Industrial Revolution in textiles were British, or why they focused on cotton. The jenny’s origins were narrowly embedded in one part of Lancashire and its cotton industry during the middle decades of the eighteenth century. The genealogy of the other key spinning invention – Richard Arkwright’s water frame – was more elaborate and cosmopolitan, with roots in British mercantilism and the centuries-old history of western European silk manufacture.84

The rise and fall of the spinning jenny does, however, help us clarify the issues at stake in explaining these innovations. Factor costs were important as inducements to technical innovation, especially costs of raw materials and labour, but not because hand cotton spinning in Lancashire formed part of a distinctively British high wage economy, as Robert Allen argues. The incentives to cut labour costs that confronted James Hargreaves in the 1750s and 1760s were first and foremost local. One was the uniquely labour- and capital-intensive, quality-orientated character of hand cotton spinning in Lancashire. Another was pressure on the supply of spinning labour in a mid-eighteenth century industrial district with contiguous and highly successful textile industries. A third was the recent re-organisation of putting-out to facilitate the production of high-demand plain cotton fabrics.

These local inducements were rooted in three defining characteristics of Lancashire cotton spinning on the eve of mechanisation – its reliance on expensive, long-staple New World raw cotton, a well-established trend towards finer, higher quality yarns, and a high degree of specialisation by task, both for spinners and their relatively costly tools. These three characteristics were distinctive to Lancashire and to Britain. Together they highlight the importance of considering materiality – fibres and yarns, tools and processes – if we are to understand the spinning innovations of the Industrial Revolution.85

85 The argument offered here parallels Harley’s for the century after the spinning inventions of the 1760s, in his ‘Cotton Textile Prices and the Industrial Revolution’.
Appendix. Calculating yarn counts for cotton weft spun in Lancashire, 1683 to 1769.

In contrast to eighteenth-century worsteds and linens, no records are known to survive for Lancashire cotton spinning that allow the construction of credible, long-term wage series incorporating both piece rates and the short-term adjustments to the rate that were customarily applied according to market conditions. Some evidence exists for piece rates, but piece rates varied considerably according to the fineness or count of yarn spun (see Fig. 7). Count was the primary measure of a yarn’s quality. Six sources survive which enable us to establish typical counts spun and the rate paid at various dates between 1683 and 1769. They include probate inventories and business records. Only one of them, Cardwell, Birley and Hornby’s stock inventory for 1769, includes the actual cotton yarn count number (Ne).86

It is possible to calculate Ne for the other five sources because they include both the value per pound weight of raw cotton wool and value per pound weight of spun yarn. The difference between the two represents the price paid for spinning. Spinning piece rates were based on count. Knowing the price per pound paid for spinning, we can calculate the count to which the yarns were spun if we know the value of the additional payment per pound spinners received for each increase of one in the Ne number. The premium paid for each step up the quality ladder rose during the period 1683 to 1769, although for typical Lancashire counts the intervals between the steps remained roughly equal. Cardwell, Birley and Hornby’s stock inventory makes it clear that in 1769 an extra 1.25d. per pound was paid for each increase of one in Ne. In the early 1750s the additional payment for each step increase in Ne was only about 1d. for yarns below Ne 30 (see Fig. 7). At Manchester in the early 1740s the extra payment was also 1d. per pound. A few years earlier, however, it had been 0.75d. for counts up to Ne 24 and 1d. only for higher counts.87 Edmund Brooks’ business accounts from 1687 indicate in the later seventeenth century the extra payment for each step increase in Ne was already 0.75d. per pound.

All six sources include yarns spun to different counts, but the relative quantities varied considerably. To establish a typical count for each source it is therefore necessary to calculate an average count weighted by quantity.


86 Joseph Hampson’s 1727 probate inventory distinguishes between counts by the piece rate paid for spinning them – 6 penny weft, 8 penny weft, 10 penny weft, 12 penny weft. Guest in his *Compendious History*: 10 suggests this usage referred to the price paid per pound for weaving with the yarns concerned, but this is not consistent with the evidence of the sources discussed here, which indicate it was the rate paid for spinning. 87 Baines, *Cotton Manufacture*: 131.