Technological Changes and the Changing Nature of Labor

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Technology

Steam engines were the icons of the new age. Thomas Jefferson visited the Albion Mill, a steam- powered corn mill, when he went to London in 1785. Although most power generation at the end of the century was still by traditional methods, steam engines offered an alternative source of power. They were best suited to enterprizes where substantial quantities of energy were required for long periods, such as pumping water out of mines. Steam engines were also used for winding and, by the end of the century, for driving machinery. Continual change and the search for improvement were an important part of the process of the Industrial Revolution, and the Newcomen engine was improved as the casting and boring of cylinders developed, particularly thanks to the new boring machines produced by John Wilkinson in 1774 and 1781. This enabled the steam engine to become more efficient in its fuel use and more regular in its operation. In 1769, James Watt, the first to perfect the separate condenser for the steam engine, patented an improved machine that was more energy-efficient and therefore less expensive to run, although more expensive to buy. In 1782, Watt patented fresh innovations that gave a comparative uniformity of rotary motion, and thus increased the capacity of steam engines to drive industrial machinery. In 1779, James Pickard, a Birmingham button-manufacturer, had fitted a crank and flywheel to his Newcomen engine in order to use its steam power to drive a mill that could grind metals. This innovation greatly enlarged the market for steam engines which was exploited by the partnership of Watt and the Birmingham industrialist Matthew Boulton. The Wheal Virgin steam engine of 1790, produced by Boulton and Watt, could do the work of 953 horses. In 1802, Richard Trevithick patented beam engines powered by high-pressure steam, such as those near Redruth. They were

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used for pumping water out of mines and for winding up men and are to the surface. As a mobile source of energy, the steam engine enabled industry to move away from previous locations, particularly the fast-flowing rivers important for water-driven mills. Industry could be concentrated on coalfields, near the new energy source, but also in towns: coal could be transported.

Sectors of Expansion

There were also important developments in metallurgy and textiles. Coke replaced charcoal for smelting iron and steel. Henry Cart’s method of puddling and rolling, invented in 1784, but not adopted until the 1790s, produced malleable iron with coal more cheaply than the charcoal forge and refinery.

Combined with the application of steam power to coal mining, blast furnaces, and the new rolling and slitting mills, these changes led to a new geography of economic activity. Steam power freed industries from having to locate near riverine sites where water power could be obtained. Instead, industry was increasingly attracted to the coalfields. This was true, for example, of South Staffordshire, and also of South Wales, which also attracted copper-smelting. Coastal shipping and

canals helped overcome communication problems. The copper works in the lower Swansea Valley depended on sea-borne supplies and used Cornish, Irish, and Welsh copper. The valley dominated the non-ferrous smelting industry in Britain.

Demand for iron helped stimulate mining. The national production of iron rose from an annual average of about 27,000 tons in 1720-4 and 1745-9, to 80,000 in 1789. The production of coal rose from about 3 million tons in 1700 to 5.2 in 1750, 8.8 in 1755 and 15 by 1800, with the rate of growth accelerating from mid-century. Coal also became more important to the national economy as mining developed outside North-East England, which had been the most important coalfield in 1700, and which continued growing. From mid-century there was also major growth in South Lancashire South Wales, Cumberland and South Staffordsire.

Demand for coal, copper and iron helped to bring great wealth to landowners. George Hunt of Lanhydrock benefited hugely from tin and copper mining on his Cornish estates. The Gibside estate in County Durham was improved on the coal wealth of the Bowes family. Plas Newydd was improved by Henry Paget, 1st Earl of Uxbridge and 1st Marquess of Anglesey, thanks to the coal in his Staffordshire estates and his Welsh copper mines. The 3rd Marquess of Londonderry created the harbour and town of Seaham to export from 1831 the coal from his Durham pits.

Textiles

Coal and canals were vital to the industrialising regions of Britain, but there were also other important changes. This was particularly, but, not only, true of textiles, an industry that benefited from the growing consumerism of the period. There a series of techlogical changes attracted and continued to attract attention because they dramatically

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altered what individual workers could achieve and transformed the organisational basis of industry. John Kay's flying shuttle of 1733 increased the productivity of handloom weavers by making it possible to both to weave double-width cloths and to weave more speedily, although it took half a century before it came into general use. Woollen textile manufacturmg was greatly changed by the early machinery that raised the productivity of labour, such as James Hargreaves' hand-powered spinning jenny of 1764. The same period also saw developments that produced machine-spun cotton yarn strong enough to permit all-cotton cloth. These included Richard Arkwright's water frame of 1768, which applied the principle of spinning by rollers, and Samuel Crompton's mule of 1779 with its spindle carriage. In 1773, Arkwright produced a cloth solely of cotton, and two years later he patented a process enabling yarn manufacture on one machine.

Machine-produced yarn was smoother and more even than hand-spun cotton. This encouraged the move of spinning from home to factory production. From 1771, Arkwright and his partners built a number of water-powered cotton-mills in Lancashire and the Midlands that displayed the characteristics of the factory system, including the precise division of labour and the continual co-operation of workers in the different manufacturing processes. The first worsted spinning mill was erected in 1784, and in 1790 Arkwright erected a Boulton and Watt steam engine in his Nottingham mill. The cylinder printing machine invented in 1783 transformed the basis of calico-printing industry. The following year, Samuel Greg opened Quarry Bank Mill to spin cotton south of Manchester. Six years later, he built the Apprentice House for the pauper children from the workhouses who made up about a third of the work-force.

While it is important not to exaggerate the scale of economic change, especially the number of factories, it was, nevertheless, more extensive in Britain than elsewhere in Europe or the world. Furthermore, a new economic geography of Britain, of expansion and decline, winners and losers, was being created. By the 1790s, industrial change had a clear regional pattern that was reflected in indicators such as expenditure on poor relief by head of population. Seasonally unemployed labourers, many of whom worked in farming, were a major call on poor relief, although the poor elderly also required relief. In 1801, the average figure per head for England and Wales was 9s 1d (45p), but in the industrial counties it was far lower-- 4s 4d in Lancashire and 6s 7d in the West Riding of Yorkshire--while counties with hardly any industry, such as Sussex, or with declining industries, such as Essex, Norfolk and Suffolk, had to pay far more than the average. The Suffolk yarn industry had collapsed by 1800, unable to compete with the uniform quality and lower prices of machine-spun yarns from the West Riding of Yorkshire. De- industrialisation was due to far more than the absence of coal. Bruton in Somerset had been a major centre of silk production, with the largest manufacturer employing 700-900 hands on about 15,700 spindles in 1823, but, due to foreign competition, by 1831 he was down to 230 hands, 7,000 spindles and a four-day week. Winners and losers could also be seen in so far as the manufacturing process was concerned. New technology brought skilled jobs for some who managed and worked the machines but others were very much subordinated to the machines and ‘deskilled’. Furthermore, previously acceptable customary working practices, for example machine hands taking a portion of the produce for themselves, were made illegal. [...]

Slumps in manufacturing and mining also occurred in expanding or buoyant areas. They could lead to severe conditions, especially given the limited nature of social welfare. In March 1800, William Jenkin, land agent at Lanhydrock in Cornwall, reported that the local copper miners had been hard hit:

> There are a great number of families in this neighbourhood who never provide themselves with any kind of food but Barley Bread, Potatoes and Salt Pilchards from one week to another, with which they sip what they call Tea, little better than warm water without milk or sugar.

Industry became especially important in central Scotland, in England in the North and the Midlands, and in South Wales; in all cases in and near coalfields. The population rose rapidly in such areas: in County Durham from about 70,000 in 1700 to 150,000 by 1801. Lancashire, Yorkshire and the West Midlands were the principal centres of industrialisation, In contrast to an annual average increase in population in England and Wales in 1750-70 of 0.75%, the percentage for the West Riding of Yorkshire was 1.7%. In addition, urban manufacturing was very important, with towns such as Derby, Newcastle, Nottingham and Stockport becoming major centres of activity. The national population shot up, especially in such centres-- in the borough of Liverpool from 83,250 in 1801 to 375,955 in 1851, in Stockport from 3,144 in 1754 to 4,975 in 1779 and 14,830 in 1801 (for a detailed discussion see Chapter 5). The relationship between urbanisation and industrialisation became closer, with the growing cities closely associated with manufacturing or with related commerce and services.

Yet economic change was not restricted to the major cities and the coalfields. Furthermore, the whole country was affected by a greater degree of economic integration. Higher levels of information flow were one characteristic of this process. For example, Woolmer’s *Exeter and Plymouth Gazette* of 30 November 1809 provided not only London grain, meat and butter prices, but also Salisbury, Basingstoke, Devizes, Newbury, Andover and Warminster grain prices. The *Sherborne*

Mercury in 1837 offered reports on Smithfield as well as the local cattle market. Pressure for such material was noted in the *Dorchester and Sherborne Journal* of 27 November 1801:

> In compliance with the request of many of our readers, and it being our wish to render our journal as extensively useful as possible, we have inserted the current prices of all the leading articles of merchandize, which we mean to continue weekly; and as the greatest care will be taken as to accuracy, we have no doubt it will prove highly interesting to merchants and traders of every description.

The press frequently reported new developments in industry and mining, Particular attention was devoted to details of new machinery. There was similarly little criticism of new developments, as a marked contrast to the position over agriculture, where the issue of a free market in grain aroused strong feelings. [...]

Alongside major changes, however, it is also appropriate to stress the two-tier, gradual and: evolutionary nature of the Industrial Revolution (see also Chapter 6). Technological change was generally slow in the early decades of the nineteenth century, and there was great variety between and within industries. Water rather than coal, for example, continued to provide much of the power for Scottish industry before 1830. Handloom weaving persisted on an appreciable scale in the leading textile county of Lancashire into the 1840s. London and Birmingham were primarily cities of workshops, not factories. Despite the railway, much of Britain remained a horse-drawn society. More generally, it is necessary to be cautious in arguing direct from economic to social change. For example, the chronologies of the growth in the use of steam power and in urban population do not tally.

Allowing for these points, the notion of an Industrial Revolution is still justified. The potential and character of much of British industry changed dramatically. Many of the fastest -growing cities of the early nineteenth century were centres of industrial activity, for example Bradford, Dundee and Merthyr Tydfil. The population of the first climbed from 16,012 in 1810 to 103,778 in 1850, as the city became the global centre of worsted production and exchange. Factory horsepower in the town rose 718 per cent between 1810 and 1830. Mechanisation there brought profit, larger factories and a wave of immigrants. Innovation was continual in Bradford as elsewhere. The mechanisation of yarn spinning was followed in 1826, despite riots by hostile workers, by the spread of machinofacture into worsted weaving. By 1850s the work formerly done in Bradford by thousands of handloom weavers, working in the countryside, was now performed by 17,642 automatic looms contained in factories and mass-producing women’s dress fabrics. By 1821 Manchester had over 5,000 power looms, and by 1850 Sunderland was the greatest ship- building town in the world.

The same process was repeated on a lesser scale in smaller towns. The population of Carlisle, a centre of cotton manufacture, rose from near 10,000 in 1801 to over 35,000 by 1841. Carlisle also saw the development of biscuit manufacturing. Jonathan Dogdson Carr adapted a printing machine to cut biscuits, replacing cutting by hand, and then, helped by

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Carlisle's position as a major transport junction, sold his product through the country by Rail. Companies and towns that wished to stay at the leading edge of economic development had to become and remain transport foci, as long distance economic exchange was increasingly involved in manufacturing. Mills located earlier to benefit from fast-flowing streams in up an areas, such as the western Pennines, faded because they lacked the access enjoyed by large-scale steam-driven urban mills.

New technology affected almost every aspect of the economy and social life. As we will see in Chapter 4, transport innovations new and improved roads, canals, railways, and so on-- were vital in this respect. But technological innovation was diffused far and wide, affecting specific activities, such as the press. In 1814, the largest-selling newspaper, *The Times*, switched to a steam press, which allowed the production of 1,000 impressions an hour, as opposed to the 250 per hour from an unmechanized hand-press. The machinery was secretly prepared to prevent the opposition of workers, who had already mounted a strike in 1810. On 29 November 1814, *The Times* announced 'the greatest improvement connected with printing since the discovery of the art itself.' The new machinery allowed *The Times* to go to press later, and thus to contain more recent news than its competitors, and also to dispense with duplicate composition on the larger number of presses required before the switch to steam, and this cut wage bills. Koenig's steam press, which could produce 400 items per hour, was eclipsed in 1827 with the arrival of Augustus Applegarth's press which produced 4,000 impressions per hour. However, there was no rush elsewhere to introduce steam presses. Instead, the Stanhope press, introduced from 1800, and with the use of an iron frame, permitting a clearer impression and slower rate of production, sufficed. The type was on an iron bed or carriage that was moved into and out of the press by human effort. It was not until the 1820s that some titles began to follow *The Times*, for example the *Morning Herald*, in 1822, the *Manchester Courier*, in 1825, and the *Manchester Guardian*, in 1828. Other papers followed far more slowly. Web rotary presses, which were able to print directly onto continuous rolls, or 'webs', of paper were introduced in Britain from the late 1860s. The Walter press was first used by *The Times* in 1869 and by the *Daily News* in 1873, while the *Daily Telegraph* purchased the American Bullock press in 1870, a sign of growing competition from the United States which was a feature of the later period. Steam power was also used in book publishing. When in 1832 Oxford University Press opened its new site in Walton Street, it introduced a steam engine to power the works. Older industries such as brewing were also affected by new technology.
