HISTORY

Subject	:	History (For under graduate student)
Paper No.	:	Paper-VI History of Modern Europe
Unit No. & Title	:	Unit-1 Europe between 1780 & 1871
Lecture No. & Title	:	Lecture-17 Industrial Revolution: The British Textile Revolution

Script

Revolution in British textile industry and its impact on other industries

Before the industrial revolution, the manufacturing sector used to be organised under two categories –
the gild controlled workshops of the urban areas and
the cottage industry of the countryside.

proto-industry as alternative to guild system

In the sector controlled by the gilds, some skilled journeymen and some apprentices used to work under

the aegis of the owner of the workshop and the master craftsman. In this system, all the production decisions were taken by the gild – i.e. what is to be produced, how is it to be produced, how much to produce, what would the price be, etc. On account of such tight regulation by the gild, it was often not possible to meet any sudden surge in the demand, or the demand for a new commodity altogether. Thus an alternative manufacturing sector emerged in the countryside to meet shifts in the market, bypassing the tight gild regulations – this alternative manufacturing sector we speak of as proto-industry. In this system, the village- based artisan produced merchandise with raw material either purchased from the market or provided by the merchant on contract – here the artisan and his artisanal skills were the principal factor in the production system.

The Proto-industrial system

In the proto-industrial system, it was economical for the merchants to deploy the rural artisan for the purpose of production because agriculture tended to be the principal occupation of most rural artisans. The main objective of

the rural artisan used to be to supplement his income during the agricultural season by working as an artisan in other seasons. But in this dispensation, the merchant tended to be at the mercy of the artisan, because the artisan worked to the extent it was necessary for him. Thus the merchant was hard put to find any artisan during the agricultural seasons; artisans were available only during the non-agricultural seasons. Thus if a new demand was to arise or an existing demand was to increase during an agricultural season, there would be no way for the merchant to address it.

There were other problems associated with the proto-industrial system as well. If the artisan was to buy his own raw materials from the market, there was no guarantee for the merchant that he would be able to acquire the finished commodity. Thus, most of the time, the merchant preferred to himself provide (or put out) the raw materials to the artisan upon the condition that only he would have access to the finished product – this was known as the putting out system. But if the artisan was nevertheless to sell the finished product to someone

else, there was no way the loss could be made up. Besides, the merchant was required to meet the market demand within a specific time, and if the artisan failed to deliver the product within the stipulated time, the loss had to be borne entirely by the merchant.

In other words, in the proto-industrial system, the merchant had little or no control over the actual process of production. In such a dispensation the capital required for bringing about any technological shifts in the production process was difficult to mobilise, because the artisan had none, and the merchant was unwilling to invest more than was absolutely given the vagaries of the production process. The industrial revolution, properly speaking, began when in the second half of the 18th century the possibility of making profits began to far exceed the risk of losses.

Cotton Textile

revolutionary transformation in cotton textile production

The revolutionary transformation of the British industrial sector began in the cotton textile sector. In terms of British textile industry, as late as the middle of the 18th century, cotton was not really that significant. In *the*

Wealth of Nations (1776) Adam Smith mentioned English cotton textile industry only once. Precisely twenty-five years from that date, cotton textiles emerged as the most significant and profitable sector of British economy.

There are generally four stages in the manufacture of cloth:

a) First, fibre is drawn out of the raw material (cotton, wool, etc);

b) Second, the process of spinning, when the fibre is spun into a yarn;

c) Third, weaving where, the vertically arranged yarn, known as *warp*, and the horizontally arranged yarn, known as *weft* are placed alternately one on top of the other and are then woven together;

d) The last stage, finishing, is meant to render the fabric smooth, have it dyed, printed, etc.

In the textile industry, use of machineries had begun in the early 18th century, but it was confined to the finishing stage and that too in the silk and woollen textile industries. Also at that time, there were some other

changes taking place whose significance was not readily apparent. Chief among this was the invention of the spinning wheel, which expedited the process of spinning. Most of these innovations were limited to the woollen textile industry, because from the 17th century onwards, woollen industry was the most significant component of British textile industry. During 1700-10, when only a million pounds of cotton was being imported for production purpose, woollen textiles sector was importing 40 million pounds of wool. As late as 1741, when the volume of cotton imports did not exceed 1.5 million pounds, the volume of wool imports for production purpose exceeded 60 million pounds, valued at £1.5 million.

mechanization limited to woollen textile industry in early 18th century

According to David Landes, use of machines in the early part of the 18th century did not cause any revolutionary transformation in woollen textiles industry, because such use remained within the confines of the proto-industrial system. In the framework of proto-industry, all the four stages of the manufacture of cloth used to be completed by the artisan along with his family. Besides the

why mechanizaton did not revolutionize woollen textile industry in the 18th century?

(1) persistence of proton-industrial system

(2) difficulty in procurement of raw wool

machines that came into use from the 1760s would have increased the demand for wool for production that would have been difficult to meet. On the other hand it was relatively easier to increase the supply of raw cotton if the demand for cotton grew, quite apart from the steady supply of cotton from India in the 18th century and America in the 19th.

factors for the rise in market demand for cotton

The reason why industrial revolution began with cotton textiles was, of course, the market demand. Cotton fabric tended to be light and easily washable. The same features were found in linen from the 15th century, but linen was a luxury item for the wealthy people, beyond the reaches of the working population. When the population of Britain began to grow continually from the 1740s, the demand for clothes also grew proportionately. Being lighter than woollen fabric and cheaper than linen, the demand for cotton fabric grew the most. Additionally, the temporary disruption in the supply of cotton textiles from India by the East India Company created a demand for British cotton textiles in Europe as well. Hence, the prospects of higher profits grew by

supplying cotton fabric and piece goods, and generated the need for technological innovation.

technological innovations in cotton textile industry: Kay's Flying Shuttle (1733); Hargreaves' Spinning Jenny (1764); Arkwright's Water Frame (1769); Crompton's Mule (1779) in spinning; Cartwright's power loom (1785) in weaving

In the second half of the 18th century, in order to keep pace with the ever-rising demand, entrepreneurs associated with the textile industry began to take greater recourse to machines for production purpose. Kay's *Flying Shuttle*, devised in the 1730s to mechanise spinning began to spread fast in the 1750s. Generally, the yarn spun by three or four people used to be woven into cloth by one weaver. The invention and use of Flying Shuttle increased the pace of weaving so much that more spinners had to be employed. The need to spin faster resulted in James Hargreaves' Spinning Jenny. Invented in 1764 and patented in 1770, Spinning Jenny was not the first machine used for the purpose of spinning yarn. Nevertheless it became one of the pivots of mechanisation of the cotton textile industry. In its first stage, the Jenny had 8 spindles; by 1774 the number of spindles was raised to 16, to 80 in 1780 and by 1800 there were Jennies with as many as 120 spindles.

Following on the invention of the Spinning Jenny came Richard Arkwright's Water-frame in 1769. The quality of the yarn spun in England not being very good, the standard practice was to mix linen with cotton while weaving the yarn into cloth. The use of Water-frame improved the quality of the yarn so much that it was possible to weave pure cotton cloth, without mixing linen, and therefore pushing down the cost of production. In 1779, Crompton's Mule brought the virtues of Spinning Jenny and Water-frame into the same machine, improving the quality of both the yarn that was spun and the cloth that was woven. The quality of the cloth improved to the extent that British textiles began to be rated as better than even Indian textiles. With the invention of steam engine by Boulton and Watt in 1785, and its use in the Water-frame, the productivity of the Water-frame increased even faster. The use of the machine spread even faster because the patent on the Water-frame lapsed in the same year.

impact of mechanization

Mechanisation of the process of spinning increased the rate of production several times over. The time that an

artisan would previously take to spin a unit of yarn now saw him producing, five, ten and even twenty-times as much. This caused a substantial economy of both time and money for the producers. By 1812, there are some instances where the use of Water-frame increased production by a factor of 200. The machines, however, were fairly expensive, and the artisan could not afford to install them. The person who suffered most if the producer did not meet the market deadline, the merchant came forth to invest in the new machinery to raise productivity. In order to remove the element of uncertainty from the process of production, however, the investing entrepreneur also took measures the control the entire production process.

rise of factory system of production; decline in the importance of skilled artisans due to mechanization; transformation of skilled artisan into labor

The entrepreneur's attempts at control gave birth to the factory system of production, where production was carried out by means of machines under the aegis of the factory-owner/entrepreneur. With the increasing dependence on machines for the purpose of spinning, the significance of the artisan's skills in the production process began to decline. As a consequence, the 'de-

skilled' artisan was forced to earn his livelihood selling his labour, instead of skills. Compared to spinning which was done in the factory with the help of machines, weaving continued to depend heavily on the skills of the artisan for some more decades. But the introduction of steam-powered looms, even weaving witnessed the fall of the skilled artisan, as British textile industry became heavily mechanised. This constituted the first stage of the industrial revolution.

ascendency of cotton textile industry

With the mechanisation of the production process, cotton textile industry rose from insignificance in the 1760s to the position of the most significant industry in the British economy. In 1802, 4-5% of British GDP came from cotton textile industry; by 1812 it managed to displace even woollen textiles, as it began to account for 7-8% of the GDP. By that time, more than 100,000 earned their livelihood as spinners, and nearly 250,000 were employed as weavers. In 1815, of the total indigenous British exports, over 40% were cotton textiles, whereas woollen fabric accounted for a mere 18%. By 1830, more than half of all British indigenous exports happened to be

cotton textile products. There were interesting changes in the realm of prices as well. In 1786, one pound of cotton cloth came for 38 shillings; in 1807 it came down to 6 shillings 9 pence. Hence the domestic demand for cotton increased several times over. Additionally, cotton textile exports increased by a factor of four during 1760-1780; by 1800 it increased ten times over that in 1780, and by 1815 three times over 1800.

iron & coal

Apart from the textile sector, the other arena for transformation in British economy in the 18th century happened to be British iron industry, and its ancillary coal industry. British iron industry was the only sector that had overcome the limitations of proto-industry as early as 16-17th centuries. Thus Britain's iron industry was capital intensive at least a century ahead of the textiles industry. But British iron industry experienced major technological improvements only in the 18th century, almost simultaneously with similar improvements in the textile sector.

In England, till the middle of the 18th century, industrial machineries – to the extent they existed – used to be driven by animate sources of energy, such as horse, donkeys or even human beings. The use of charcoal and water as source of energy in mines, mills and workshops used to be confined to areas adjacent to woods or rivers. In iron industry, charcoal tended to be the predominant source of fuel for the furnace, hence ironmongers often tended to be peripatetic, working wherever charcoal was easily available. But in the second half of the 18th century, as population growth generated increasing demand for dwellings and firewood, which in turn increased felling of trees in the woods, pushing up the price of charcoal even as supply began to reduce. Thus by 1750, a large number of the furnaces began to use coal instead of charcoal.

shift from charcoal to coal as fuel in iron industry

One of the principal problems of British iron industry happened to be the low quality of iron ore in Britain. Owing to the high concentration of impurities in the ore available in Britain, furnaces run on charcoal could not remove such other minerals from the ore, resulting in

problems of using low-grade iron ore and limitations of charcoal-run furnaces till mid-18th century

quality of iron as low as pig iron. Hence for products of wrought iron or cast iron, British ironmongers had to rely on iron imported from Sweden. While furnaces run on coal were able to generate adequate heat for the making of cast iron, it was virtually impossible to manufacture wrought iron in Britain till the middle of the 18th century. Thus in 1760, only 14 furnaces in the whole of Britain used to be run on coal furnace.

with the invention of Boulton & Watt's steam engine, steam-powered coal furnaces bettered the quality of iron

In 1775, the invention of the steam engine of Boulton and Watt opened up new horizons of possibilities in the iron industry. The quality of iron produced by steam-powered blast furnace was considerably better because it now became possible to remove impurities much more effectively than earlier. Thus by 1770s, the number of coal-powered furnaces doubled, and the last of the furnaces run on charcoal was also manufactured in the 1770s itself. In 1790, the number of coal furnaces increased to 86, while those run on charcoal came down to 25.

concentration of iron industry in coal-rich areas

The peripatetic character of iron industry also began to disappear, as iron industry began to develop only in regions rich in coal resources. As early as 1806, 87% of Britain's total pig iron production happened to be located in coal-rich regions.

problems associated with using coal solved by Cort's puddling & rolling processes (1784-85), leading to improvement in the quality of pig iron

Another problem emerged in association with the use of coal in blast furnace. The use of coal in the furnace introduced a fresh set of impurities in the iron produced. This problem was removed by the puddling and rolling processes, devised and patented by Cort in 1784 and 1785 respectively. Not merely this, puddling and rolling processes improved the quality of British iron to such an extent that British pig iron became as strong and durable as Swedish wrought iron. As a consequence in 1810 it could be seen that while a tonne of Swedish iron cost £35-40, British iron would cost only £18-20.

impact of technological inventions

These inventions had their impact, in turn, on British metallurgical sector. The more durable the iron, the deeper it was possible to mine into coal deposits. With durable iron and adequate coal, it was possible to

manufacture machineries for the textile and other industries which would be made of durable metals rather than brittle wooden frames. During 1790-1815, the production of iron increased nearly four times on account of the wars that broke out in the wake of the French Revolution of 1789. When the cycle of the Revolutionary and Napoleonic Wars came to a close, British iron industry was hit by a slump. At this stage, iron began to be used in the construction of houses, bridges, lamp-post, machineries, water-pipes, etc.

The impact of simultaneous introduction of the new production system in textile and iron industry was readily visible, because the iron industry witnessed a transformation no less dramatic than its textile counterpart. In 1760, Britain produced 60,000 tons of pig iron; in 1800 the figure went past 250,000 tons. In 1760, the iron industry contributed only 2% of Great Britain's GDP; in 1800 this climbed up to 6%. In 1800, Britain contributed 19% of the total global iron output; in 1820 the figure was 40% and in 1840, 52%.

The transformation of British manufacturing sector in the second half of the 18th century was not merely a quantitative transformation; it also served to qualitatively transform the economy as a whole. The need to transport coal from the mines to nearby factories had prompted the use of steam engine for transport as early as 1810. When this proved to be an economical way of bulk transport of heavy goods, it was extended to transport finished products from factories to distant ports. Because this particular mode of steam carriage ran on iron rails, the transport system came to be called rail transport, or to put it simply, railways. In 1820, there were only 20 miles of railway tracks all over the country for the purpose of goods carriage. By 1847, this increased to 6,500 miles – transforming the market space of the entire nation into the equivalent of the local market.

Development of **railways**

Hence gilds, manufactories and workshops run along traditional lines could not afford to continue with their old ways. The desperate urge to survive in the face of stiff competition from the modern industrial system forced

entrepreneurs all over Britain to mechanise their production process. In this process the very character of British industry was completely transformed.

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Summary

Before the Industrial Revolution, the British industrial sector had guild controlled workshops in the urban areas and cottage industries in the countryside. While the guilds exercised too much control over production, the cottage industries were more flexible as the artisans were also agriculturalists. In the proto-industrial system, it was economical for the merchants to deploy the rural artisan for the purpose of production because agriculture tended to be the principal occupation of most rural artisans. The main objective of the rural artisan used to be to

supplement his income during the agricultural season by working as an artisan in other seasons. But in this dispensation, the merchant tended to be at the mercy of the artisan, because the artisan worked to the extent it was necessary for him.

The revolutionary transformation of the British industrial system began in the cotton textile sector. With the rise in population the demand for cotton rose proportionately.
The reason why the industrial revolution began with cotton textiles was, of course, the market demand. Cotton fabric tended to be light and easily washable.

To meet the growing demands the industry took recourse to mechanization and factory system of production. Through the 18th century many technological changes took place in textile production. Chief among them were the invention of the Flying Shuttle, the Spinning Jenny and the Water Frame.

Apart from the textile sector, the other arena for transformation in British economy in the 18th century

happened to be British iron industry, and its ancillary coal industry.

The mechanization of the iron and steel industry and the coal industry, gave a fillip to the transportation system especially the railway which was used to carry goods and people.

In 1820, there were only twenty miles of railway tracks all over the country for the purpose of goods carriage. By 1847, this increased to 6,500 miles – transforming the market space of the entire nation into the equivalent of a local market. Hence guilds, and workshops run along traditional lines could not afford to continue with their old ways. The desperate urge to survive in the face of stiff competition from the modern industrial system forced entrepreneurs all over Britain to mechanise their production process.