CHAPTER

13

Industrialisation and Social Change

The economy and industries in Britain changed completely between the 1780s and the 1850s. This phase is known as the 'first Industrial Revolution'. The term 'Industrial Revolution' was used by European scholars – Georges Michelet in France and Friedrich Engels in Germany. It was used for the first time in English by the philosopher and economist, Arnold Toynbee (1852-83 CE), to describe the changes in British industrial development between 1760 and 1820 CE. This revolution had widespread effects in Britain. Later, similar revolutions also happened in European countries and the USA. These changes were going to have a major impact on the society and economy of these countries as well as the rest of the world. However, industrialisation in different countries was different from each other, depending upon the country's historical, social and geographical features. This chapter outlines some important changes in the cotton and iron industries in Britain.

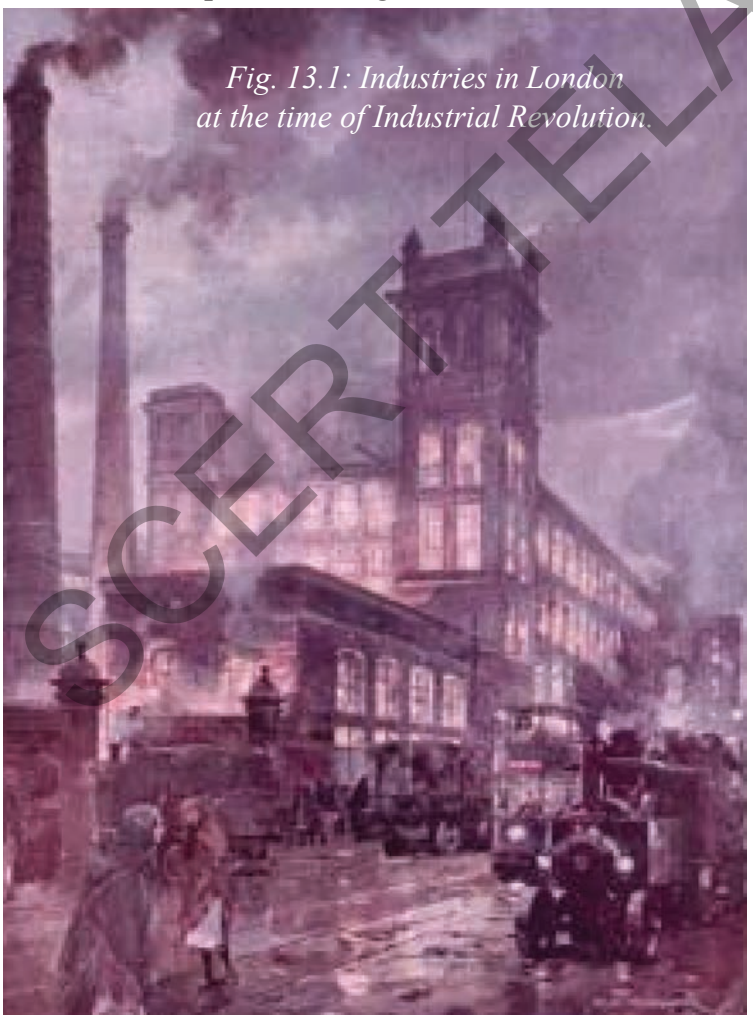


Fig. 13.1: Industries in London at the time of Industrial Revolution.

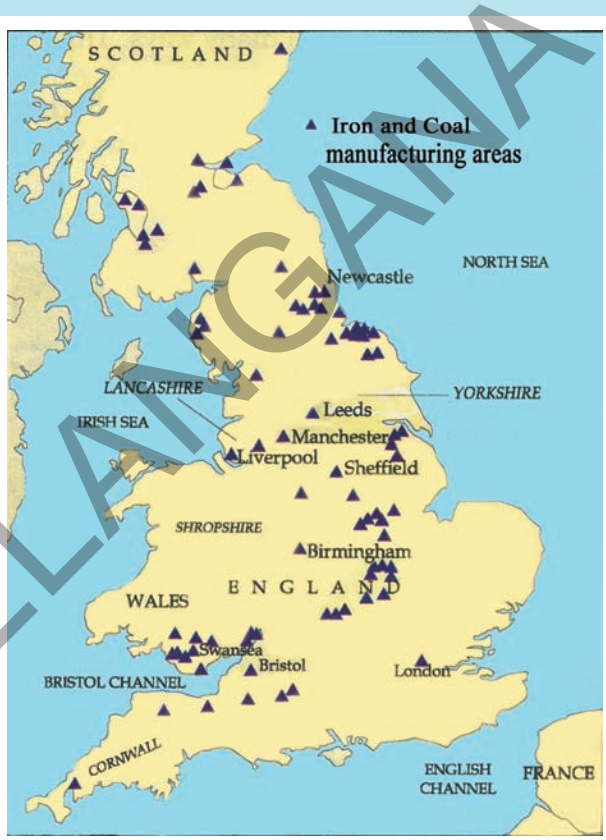
When industrial development started in Britain, new machinery and technologies was invented. Because of the new machinery and technology, it was now possible to produce goods on a large scale as compared to handicraft and handloom industries where production was small scale British industries had now started using steams, a new source of power for their production. Use of steam power made the modes of transportation, like ships and railways, faster. Many of the inventors and businessmen who made these inventions were neither personally wealthy nor educated in basic sciences like physics or chemistry.

Industrialisation brought great brought prosperity for many people. But, initially, it was linked with poor living and working conditions of millions of people, including women and children. After many protests, the government was forced to make laws for improving the conditions of work.

- What were the difficulties faced by women and children during industrial revolution?

Why Britain?

Britain was the first country to experience modern industrialisation. Historians ask the question, why did the Industrial Revolution begin there in the 1750s? What enabled Britain to industrialise? We can think of many reasons for this.



Map 1: Britain(England): The Iron Industry

i. Political Stability and Unified Market: Britain had been politically stable since the seventeenth century, with England, Wales and Scotland unified under a monarchy. This meant that the kingdom had common laws, taxation and a single currency. This enabled Britain to have a market that was not fragmented by local authorities levying local taxes on goods that passed through their area, thus increasing their price. By the end of the seventeenth century, money was widely used as the medium of exchange. By then a large section of the people received their income in the form of wages and salaries rather than in goods. This gave people a wider choice for ways to spend their earnings and expanded the market for the sale of goods. By the end of 17th century, Britain had a parliamentary government which was favourable to commercial and industrial classes. It pursued policies which enabled the growth of trade and industry in England.

ii. Agricultural Revolution: Between 1600 and 1800 England had gone through a process called the 'agricultural revolution'. This was the process by which bigger landlords took over small farms of peasants and enclosed village common lands. They used new methods of cultivation and animal rearing to produce for market. In this manner they created very large estates and increased food

production. This forced landless farmers, and those who had lived by grazing animals on the common lands, to search for jobs elsewhere. Most of them went to nearby towns.

iii. Towns, Trade and Finance: From the eighteenth century, many towns in Europe were growing in area and in population. The population of at least 11 British towns doubled between 1750 and 1800. The largest of them was London, which served as the hub of the country's markets. London had also acquired a global significance. It had become the centre of international trade between Europe, Africa, America and India.

In England the movement of goods between markets was helped by a good network of rivers, and an indented coastline with sheltered bays. Until the spread of railways, transport by waterways was cheaper and faster than by land. Most of Britain's rivers were navigable (small ships and boats could go up them), cargo on river vessels was easily transferred to coastal ships.

The centre of the country's financial system was the Bank of England (founded in 1694). By 1784, there were more than a hundred provincial banks in England, and during the next 10 years their numbers trebled. By the 1820s, there were more than 600 banks in the provinces, and over 100 banks in London alone. The financial requirements to establish and maintain big industrial enterprises were met by these banks. .

iv. Colonies: By the middle of 18th century, Britain had extensive colonies in North America and was beginning to establish control over large parts of India. The colonies provided Britain with a large market for its industrial produce and also supplied it with raw materials like cotton and also food grains. Colonial conquest and trade provided British merchants and banks with a large amount of capital, which could be invested in industries.

Industrialisation requires certain preconditions. Firstly, it requires the concentration of wealth in the hands of those who want to invest money in production and earn profits. As we saw such concentration of wealth took place due to 'agricultural revolution' and colonial conquest and trade. Investible capital was provided by the growth of banking institutions in Britain.

Secondly, it requires availability of workers who are willing to work for low wages. Again we saw how the 'agricultural revolution' forced a large part of the rural population to go to the towns in search of work.

Thirdly, it requires a large market to sell its products. This was provided first by the political unification of Britain and by ending of self-sufficient peasant farms.

The peasants now became workers who had to buy all their requirements from the market instead of producing them on their own farms. Market was also provided by the colonies.

Fourthly, Industrialisation requires cheap raw materials and efficient transport infrastructure. In addition to all this it requires a rapid development of technology and adoption of the new technology in production. We shall see below how this happened.

- Discuss the developments in Britain and in other parts of the world in 18th century that encouraged British Industrialisation.

Technological Developments: Coal & Iron, Spinning & Weaving, Transport

Coal and Iron

Iron and steel are vital for industrialisation and coal is essential not only to generate power but also for making steel. England was fortunate that coal and iron ore, the staple materials required for mechanisation, were available in large quantity. Even other minerals like lead, copper and tin that were used in the industries were easily available. However, until the eighteenth century, usable iron was not easily available. Iron is extracted as pure liquid metal from the ore by a process called smelting. For centuries, charcoal (from burnt timber) was used for the smelting process. This had several problems: it was difficult to transport charcoal across long distances because it was too fragile. Secondly, due to impurities it could not generate high temperatures. Hence, the quality of iron produced was poor. Thirdly, charcoal was produced by burning trees in the forests. As the forest area got reduced, the supply of charcoal too got reduced.

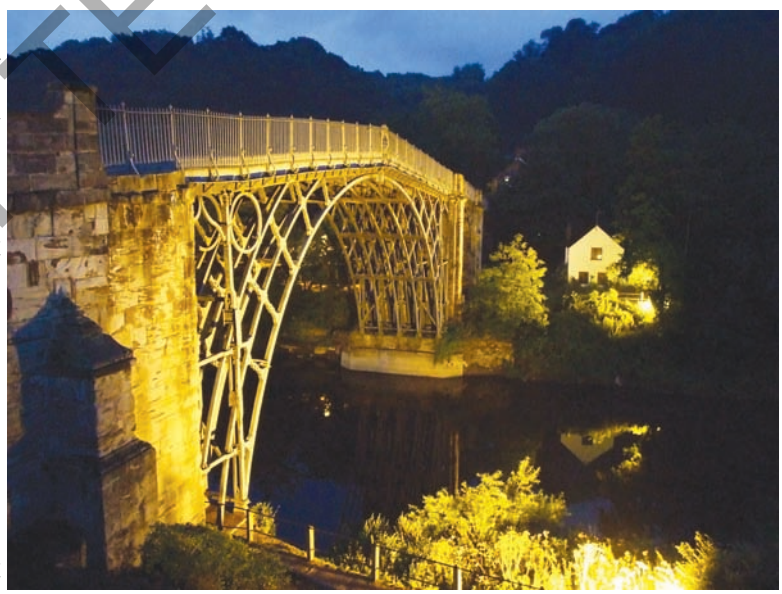


Fig. 132: The Cast Iron Bridge near Coalbrookdale, designed by the third Darby.

British iron smelters built upon a long tradition of metallurgy practiced all over the world, especially India. As you may know Indian iron smelters produced some of the finest quality steel in those times.

After a long study and experimentation, a solution to the problem of steel-making was developed by a family of iron-masters, the Darbys of Shropshire. Within half a century, three generations of this family – grandfather, father and son, all called Abraham Darby – brought a revolution in the metallurgical industry. In 1709 CE, the first Abraham Darby (1677-1717 CE) invented a blast furnace that would use coke which could generate high temperatures. Coke was derived from coal by removing the sulphur and impurities. This invention meant that furnaces no longer had to depend on charcoal. The melted iron that came from these furnaces permitted finer and larger castings than before.

The process was further refined by more inventions. The second Darby (1711-68 CE) developed wrought-iron (which was less brittle) from pig-iron. Henry Cort (1740-1823 CE) designed the puddling furnace (in which impurities would be removed from molten iron) and the rolling mill, which used steam power to roll purified iron into bars. It now became possible to produce a large range of iron products. Since iron was durable, it was a better material than wood for everyday items and for machinery. Unlike wood, which could burn or splinter, the physical and chemical properties of iron could be controlled.

Britain was lucky that it had excellent coking coal and high-grade iron ore available in the same basins or even the same seams. These basins were also close to ports. There were five coastal coalfields which could deliver their products almost straight into ships. As a result, ship building and the shipping trade increased.

- Why is high quality steel and iron necessary for industrialisation? Discuss in the class.
- Why do you think the mining of iron ore and coal received equal importance?
- Why do you think the early industrial centres were situated near the iron and coal mines?

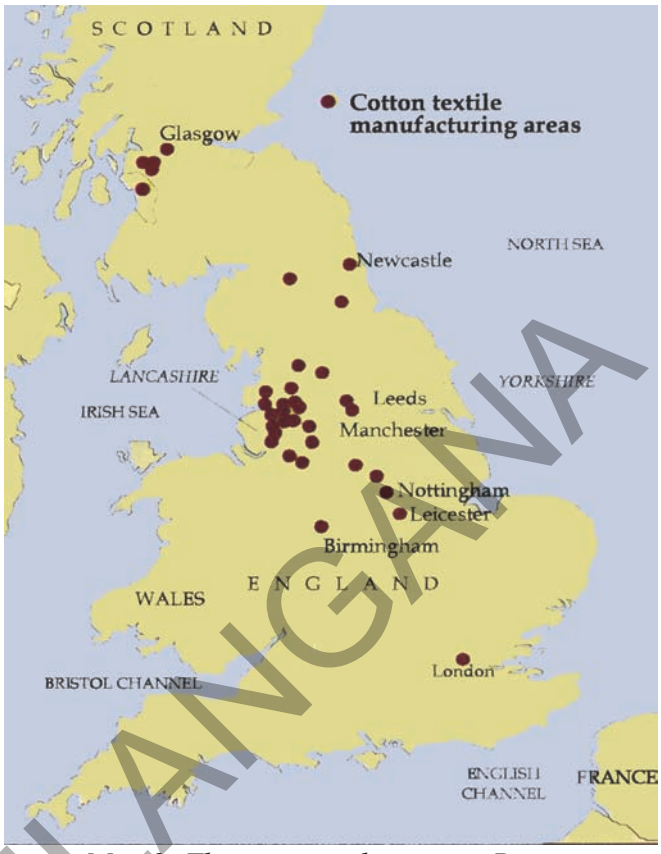
The British iron industry increased its output four times between 1800 and 1830 CE, and its product was the cheapest in Europe. In 1820 CE, a tonne of pig iron needed 8 tonnes of coal, but by 1850 CE, it could be produced by using only 2 tonnes. By 1848 CE, Britain was smelting more iron than the rest of the world put together.

Cotton Spinning and Weaving

The British had always woven cloth out of wool and flax (to make linen). Since the seventeenth century, the country had been importing bales of cotton cloth from India at a high cost. As East India Company's political control in parts of India was established, it began to import raw cotton along with cloth. This raw cotton could be spun and woven into cloth in England itself.

- Write two important inventions which revolutionised the textile industry.

Till the early eighteenth century, spinning had been so slow and laborious that a single weaver worked on the yarn produced by 10 spinners. Therefore, while spinners were busy spinning all day, weavers waited idly for the yarn. But with new technological inventions, the time gap was reduced between spinning of raw cotton into yarn or thread, and weaving the yarn into fabric. These industries were heavily dependent on the work of women and children in factories. To make it even more efficient, production was gradually shifted from the homes of spinners and weavers to factories.



Map 2: The cotton industries in Britain.

From the 1780s, the cotton industry symbolised British industrialisation in many ways. This industry had two features which were also seen in other industries. Raw cotton was entirely imported and a large part of the finished cloth was exported to other countries. Britain had its control over the sources of raw cotton as well as the markets where they sold cloth. This helped to increase its control over the colonies.

Steam Power

Steam power was first used in mining industries. As the demand for coal and metals increased, people made more efforts to obtain them from deeper mines. Flooding in mines was a serious problem and steam engines were used to drain the water from the mines. But the technology was still not useful on a large scale.

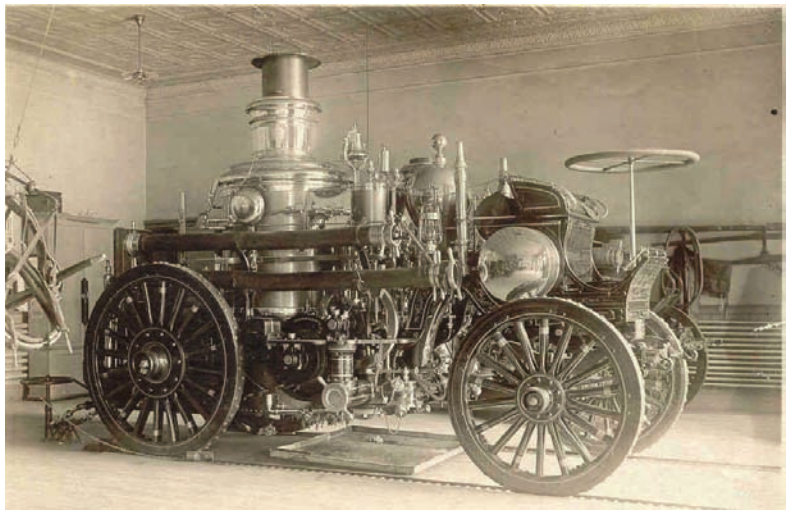


Fig. 13.3: James Watt's Steam Engine.

James Watt's (1736-1819 CE) invented a new steam engine. This invention

converted the steam engine from a mere pump into a 'prime mover'. He made the steam engine capable of providing energy to power machines in factories. With the help of a wealthy manufacturer, Matthew Boulton (1728- 1809 CE), Watt created the Soho Foundry in Birmingham in 1775 CE. At the foundry, James Watt's steam engines were produced in growing numbers. By the end of the eighteenth century, Watt's steam engine was beginning to replace hydraulic power. In 1840 CE, British steam engines were generating more than 70 per cent of all European power.

Transportation

Because of growing industrialization, there was increased need to transport raw materials and manufactured products. For this, the roads were improved and the digging of canals was done in England. Mc Adam devised the method of making '*pakka*' or 'macadamised' roads.

Canals were initially built to transport coal to cities. This was because coal was very heavy and required in large quantities. So, its transport by road was much slower and more expensive than by boats on canals. The demand for coal as industrial energy and for heating and lighting homes in cities was increasing. The first English canal, the Worsley Canal (1761 CE), was built by James Brindley (1716-72 CE). It was built to carry coal from the coal deposits at Worsley (near Manchester) to that city. After the canal was completed, the price of coal fell by half. Thousands of kilometres of canals were built by 1830 CE and were used to transport commodities cheaply. They were mostly built by landowners to increase the value of their properties.

The first steam locomotive, Stephenson's Rocket, was made in 1814 CE. Railways was the new means of transportation that was available throughout the year. It was both cheap and fast and it could carry passengers and goods. They combined two inventions; the iron track replaced the wooden track in the 1760s, and the power of the steam engine.

The invention of railways took the process of industrialisation to its second stage. The first railway line connected the cities of Stockton and Darlington in 1825 CE, a distance of 9 miles that was completed in two hours at the speed of up to 5 mph. The next railway line connected Liverpool and Manchester in 1830 CE. Within 20 years, trains had started moving at the speed of 30 to 50 miles an hour.

In the 1830s, the use of canals revealed several problems. Too many large ships made the movement on canals slow. Another problem was if there was frost, flood or drought in the canal, the ships could not use it.

Who were the inventors?

It is interesting to read about the individuals who brought these changes during industrialisation. Few of them were trained scientists. Education in basic sciences like physics or chemistry was extremely limited until the late nineteenth century, even after the technological inventions described above. Since these inventions did not require a full knowledge of the laws of physics or chemistry on which they were based, advances in science could be and were made by brilliant, intuitive thinkers and experimenters. They were helped by the fact that England had certain features which other European countries did not. Dozens of scientific journals and published papers of scientific societies appeared in England between 1760 and 1800 CE. There was a widespread thirst for knowledge even in the smaller towns. This was met by the activities of the Society of Arts (founded in 1754 CE), by travelling lecturers, or in 'coffee houses' that multiplied through the eighteenth century.

Most inventions happened because of determination, interest, curiosity, even luck, rather than the application of scientific knowledge. Some inventors in the cotton industry, like John Kay and James Hargreaves, were familiar with the skills of weaving and carpentry. Richard Arkwright, however, was a barber and wig-maker, Samuel Crompton was not technically skilled and Edmund Cartwright studied literature, medicine and agriculture, initially wished to become a clergyman and knew little of mechanics.

By contrast, in the area of steam engines, Thomas Savery, an army officer, Thomas Newcomen, a blacksmith and locksmith, and James Watt, with a strong mechanical bent, all had some knowledge relevant to their inventions. The road-builder, John Metcalf, who personally surveyed surfaces for roads and planned them, was blind. The canal builder James Brindley was almost illiterate, with such poor spelling that he could never spell the word 'navigation', but he had tremendous powers of memory, imagination and concentration.

Competition, Technological Change and Workers

Industrial Revolution also gave birth to a peculiar system of production. We saw that factories were set up using machines which were worked by labourers who were hired by the factory owners. They also bought raw materials from distant places, and sold their produce in distant markets. Through this process they earned profits. However, at any time there are many factory owners. Each of them tries to sell maximum to earn maximum profit. To attract more customers they try to sell the product cheaper than others. Thus they compete with each other in the market. In order to keep the prices low they cut costs by rationally using all the raw materials, machines and workers and also by using new technologies or machines which can produce more at less cost. The use of new machines enables the factory owners to produce more by employing fewer workers and thus cuts down the cost and also

helps in improving the quality of the product. Thus factory owners in order to be able to sell in the market, have to invest a part of their profit in new technology. In the long run, this leads to technological development in the society. At the same time many workers loose their jobs and have to seek employment elsewhere. Often since many factory owners are producing for the market, there may be overproduction. There would be too much of a produce, which no one wants to buy. In such situations, the owners cannot sell their produce to recover the money they have invested. They stop production, dismiss the workers so that they don't have to waste more money. Workers have to look for new employment or wait for the demand for the old product to pick up be re-employed.

We can thus see how in a capitalist system of production, competition among factory owners leads to both technological development and also to unemployment for workers. Often, the new technology may lead to setting up of new industries, in which case the dismissed workers can find new work. However, if not many new factories are being set up, then the workers will face unemployment for a long time.

Changed lives

In this period, it was possible for talented individuals to bring revolutionary changes in science and technology. Similarly, there were many rich individuals who took risks and invested money in industries in the hope of making profits and 'multiplying' their wealth. In most cases, this money – capital – did multiply. Wealth increased dramatically, in the form of goods, incomes, services, knowledge and productive efficiency.

At the same time, there was a massive negative human cost. Families were breaking down, life in the cities was degrading and people had to work under horrible working conditions in factories. In 1750 CE, there were just 2 cities with a population of over 50,000 in England. But, by 1850 CE there were 29 such cities

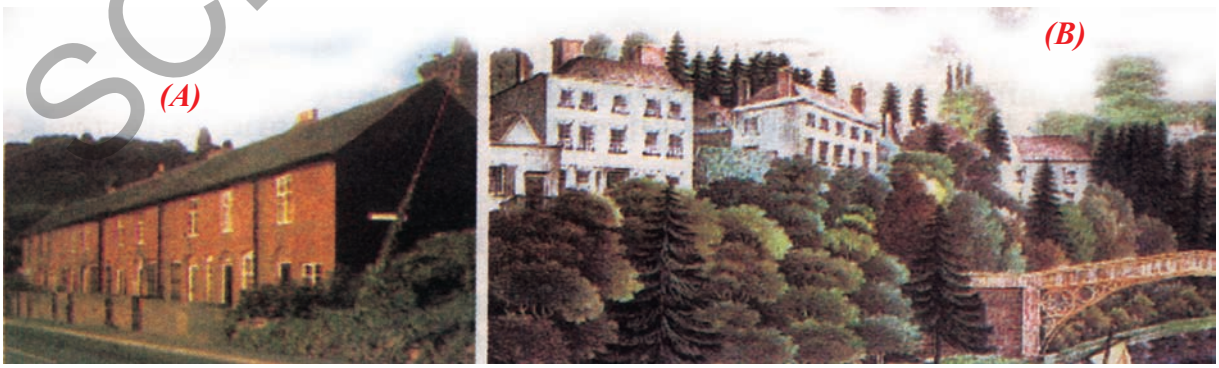


Fig. 13.4: (A) Coalbrookdale, Carpenters' Row, cottages built by the company for workers in 1783 CE; (B) The houses of the Darbys; painting by William Westwood, 1835 CE.

with a population of over 50,000. But there was not enough arrangement for housing, sanitation or clean water for the rapidly growing urban population. Newcomers were forced to live in overcrowded slums in the central areas of towns near factories. The rich people escaped this situation, by shifting their homes to the suburbs where the air was clean and the water safe to drink.

The Workers

A survey in 1842 CE revealed that the average lifespan of workers was lower than that of any other social group in cities: it was 15 years in Birmingham, 17 in Manchester, 21 in Derby. In the new industrial cities, people died at a younger age than in the villages. Half the children failed to survive beyond the age of five. The increase in the population of cities was because of immigrants, rather than by an increase in the number of children born to families who already lived there.

Deaths were primarily caused by epidemics of disease like cholera and typhoid that spread from the pollution of water, or tuberculosis from the pollution of air. More than 31,000 people died from an outbreak of cholera in 1832 CE. Until late in the nineteenth century, municipal authorities did not pay any attention to these dangerous conditions of life. People did not have the medical knowledge to understand and cure these diseases.

Women, Children and Industrialisation

The Industrial Revolution brought many important changes in the way children and women worked. In the rural areas, children usually worked at home or in the farm under the watchful eye of parents or relatives. They did jobs that changed during the day or between seasons. Similarly, in villages, women were actively involved in farm work; they looked after the livestock, gathered firewood and spun yarn on spinning wheels in their homes.

But in the factories, they had to work for long hours without a break. They did the same kind of work under strict discipline and sharp forms of punishment. The women and children were forced to work to supplement men's meagre wages. As the use of machinery spread, fewer workers were needed. Industrialists now preferred to employ women and children because they would easily agree to work in poor working conditions and for lower wages than men.

Women and children were employed in large numbers in the cotton textile industry in Lancashire and Yorkshire. Women were also the main workers in the silk, lace-making and knitting industries, as well as (along with children) in the metal industries of Birmingham. Machinery like the cotton spinning jenny was designed to be used by child workers with their small fingers and bodies. Children worked in textile factories because they were small enough to move between tightly packed machinery. The long hours of work, including cleaning the machines on Sundays, allowed them no fresh air or exercise. Children sometimes caught their

Fig. 13.5 : Woman in gilt-button factory, Birmingham. In the 1850s, two thirds of the workforce in the button trade was women and children. Men received 25 shillings a week, women 7 shillings and children one shilling each, for the same hours of work.

hair in machines or crushed their hands. Some even died when they fell into machines as they dropped off to sleep from exhaustion.

Coal mines were also dangerous places to work in. Roofs caved in or there could be an explosion, and injuries were common. The owners of coal mines used children to reach deep coal faces where the path was too narrow for adults. Younger children worked as 'trappers' who opened and shut doors as the coal wagons travelled through mines, or carried heavy loads of coal on their backs as 'coal bearers.'

Factory managers considered child labour to be an important training for future factory work. The British factory records reveals that about half of the factory workers had started working when they were less than ten years old and 28 per cent, when they were under 14. Though women got financial independence and self-esteem from their jobs; but had to tolerate humiliating terms of work. They lost the children at birth or in early childhood and had to live in squalid urban slums.

- Mention two important industrialisation effects on women and children's life.

Industrialisation in Germany and France

While industrialisation began early in England in the 18th century, it was not until 1850s and 1870s that industrial production became prominent in Germany and France. As you may remember, Germany was not united till 1870 CE and France was facing wars and revolutions. Unlike Britain, which had extensive colonies, Germany and France did not have colonies and access to colonial resources. Thus they had to make up for these disadvantages.

In both the countries, industrialisation increased with the introduction of railways in 1830s. Railways increased trade, communication and economic growth.

By 1850 CE, various German states had constructed half as many railways as Britain and twice as many as France.

- Discuss the effects of early industrialisation on British town and villagers and compare these with similar situation in India.

Prussia exploited its rich coalfields (Silesia and the Rhineland -the Ruhr) and iron deposits (Bohemia) in order to create a flourishing steel industry. Alfred Krupp had established a small iron foundry at Essen in 1810 CE. By 1870 CE, Krupp of Essen, had been transformed into a giant company with its railway locomotive and armaments production. They employed thousands of workers and made a fortune for the Krupp family. The invention of the electric dynamo by Werner Siemens in 1866 CE laid the foundation of a new electrical industry in which Germany would lead the world. The defeat of France in 1870 CE and the creation of a united Germany in 1871 CE stimulated industrialisation even further. The new politically united Germany could now exploit the rich iron-fields of Lorraine taken from France.

Condition of child labourers

The horrible condition of child labourers is stated in the evidence collected by a committee of British Parliament in 1816 CE. The following information was collected from a one-time master of apprentices in a cotton mill. He was asked questions by the committee on the condition of child labourers in his factory.

'At what age were they taken?'

'Those that came from London were from about eight or ten to fifteen.'

'Up to what period were they apprenticed?'

'One –and-twenty.'

'What were the hours of work?'

'From five O'clock in the morning till eight at night.'

'Were fifteen hours in the day the regular hours of work?'

'Yes.'

'When the works were stopped for the repair of the mill, or for any want of cotton, did the children afterwards make up for the loss of that time?'

'Yes.'

'Did the children sit or stand to work?'

'Stand.'

'The whole of their time?'

'Yes.'

'Were there any seats in the mill?'

'None. I have found them frequently upon the mill-floors, after the time they should have been in bed.'

'Were any children injured by the machinery?'

'Very frequently.'

German government encouraged industrialization in Germany by providing a large market for its industries, building roads and railways and developing mines. The German army required large quantities of arms and ammunitions. So, many leading industrialists focused on the armament industry. The government also controlled working class movement and provided many social benefits and insurance for the workers. This enabled the factory owners to control their workers and pay less.

- Compare the industrialisation in Germany and France. Identify similarities and differences.
- Why do you think France lagged behind in industrial development?
- What factors enabled Germany to outstrip England and France in industrialisation?

German industry also benefitted from the technical developments achieved by Britain and USA. They borrowed the new technology which other countries had developed over a long time. For this they needed heavy capital investment which they received from large banks. Thus, German industries developed as large units and were bigger than British industries in size and scope.

German industrialisation initially had competition with the Britain in many key sectors like cotton textiles and machine building. However, soon Germany developed iron and steel, chemical and electrical industries which were new generation industries and overtook Britain in these areas. By the beginning of 20th century, Germany had developed a powerful industrial base. It was challenging Britain as Europe's major industrial power. Britain was still producing more coal, but Germany was producing more steel. What was worrying for Britain and France was that a great proportion of this industrial production was used to build up Germany's military and naval power.

France, in contrast, was slow in industrialising. Even by the end of the 19th century, France remained a rural country with a large majority of people cultivating small plots of land. Manufacturers found it more profitable to give out work to rural workers who worked at home rather than to set up factories in towns. Such rural domestic production began to decline after 1850CE resulting in economic adversity for the people. Machines in towns began to do most of the work and only delicate hand work was given out to rural workers. French industrialisation was

The Krupp Family

The Krupp family established what was going to become the world's largest arms factory. This first factory specialised in field gun manufacture and, by 1887, it supplied arms to forty six different countries.

During World War I, the Krupp factories made guns for the German artillery.

The Krupps supported Hitler in the German general election of 1933 CE. As Nazi Germany occupied neighbouring countries, Alfred Krupp seized new land to make more factories. Many of these factories used slave-labour from the Nazi concentration camps.

also a result of the spread of railway and road networks after 1860 CE which created a wide market for its industrial goods.

France also did not develop Banks which could mobilise large amount of capital and lend them to industrialists. As a result, most of French manufacturers depended upon family resources. They remained small companies as a result. It also made them slow in adopting new ideas and technologies.

Heavy industries based on iron and coal also developed very slowly in France as it did not have good reserves of coal. France had to depend upon expensive imports for coal. Thus, French industrialisation remained focused on consumer products like textiles, which were basically small scale enterprises. This was in contrast to the German and British Industrial situation where heavy industries predominated.

Keywords

1. Industrialisation
2. Industrial Revolution
3. Steam Power
4. Hydraulic Power

Improve your learning

1. Write two sentences each on the following aspects in the context of Industrial revolution:
   a) Technology
   b) financing and money
   c) Agriculture revolution
   d) transport systems
2. What do you think is special about inventions happening during the industrial revolution?
3. How were the lives of different classes of British women affected by the industrial revolution?
4. What were the relative advantages of canal and railway transportation?
5. Locate the places where iron and textile industries are mainly concentrated in England during industrial revolution.
6. Prepare a table on inventions during the time of Industrial Revolution.
7. Read the para under the title 'The Workers' of page176 and comment on it.

Project

Mention the consequences of the industrial revolution in the economic field. Write a report and present it in your class.