

UNIT 13 – UPSC - World History: Industrial revolution from 18th century

In history, it is documented that the Industrial Revolution of the late 18th and early 19th centuries was radical because it changed the industrious capability of England, Europe and United States. These revolutionary changes were in seen in development of new machines, smoke-belching factories, increased productivity and an augmented standard of living. The Industrial Revolution was an era during which principally agrarian, rural societies in Europe and America became industrialised and metropolitan. Earlier to the Industrial Revolution, manufacturing was done in homes. People used hand tools or basic machines. Industrialization was observed as a period of shifting to powered, special-purpose machinery, factories and mass production. The iron and textile industries, along with the development of the steam engine, played vital roles in the Industrial Revolution, which also saw advanced systems of transportation, communication and banking. Though industrialization brought advancement of technology and variety of manufactured goods and enhanced standard of living for particular group of people but it also caused in unemployment and living conditions for the poor and working classes.



With industrial revolution, English, European, and American society transformed to a deep level. Like the Improvement or the French Revolution, no one was left unaffected. Everyone was affected in one way or another peasant and noble, parent and child, artisan and captain of industry. The Industrial Revolution created modern Western society. Harold Perkin has witnessed that "the Industrial Revolution was no mere sequence of changes in industrial techniques and production, but a social revolution with social causes as well as profound social effects" (The Origins of Modern English Society, 1780-1880 (1969). Many intellectuals explained that The Industrial Revolution was the changeover to new manufacturing processes in the period from about 1760 to between 1820 and 1840. This evolution included going from hand production methods to machines, new chemical manufacturing and iron production processes, improved efficiency of water power, the increasing use of steam power, and the development of machine tools. It also comprised the change from wood and other bio-fuels to coal. Textiles were the foremost industry of the Industrial

Revolution as it offers huge employment, value of output and capital invested. It was observed that the textile industry was also the first to use modern production methods (Landes 1969).

Historical evidences signified that the Industrial Revolution results a major defining moment in history; as every aspect of daily life was influenced in some way. Particularly, average income and population began to reveal unparalleled sustained growth. Several economists stated that the major impact of the Industrial Revolution was enhancement of living standard for the general population. Although other group of scholars have said that it did not begin to profoundly improve until the late 19th and 20th centuries (Feinstein, 1998).

It has been documented in studies that the Industrial Revolution started in Great Britain, and spread to Western Europe and North America within a few decades (Landes 1969). The exact start and end of the Industrial Revolution is still disputed among historians, as is the speed of economic and social changes (Berg, 1998). GDP per capita was generally stable before the Industrial Revolution and the advent of the modern capitalist economy, while the Industrial Revolution began a period of per-capita economic development in capitalist economies (Lucas, 2003). Economic historians agreed that the beginning of the Industrial Revolution is significant event in the history of humankind since the domestication of animals, plants and fire.

The First Industrial Revolution progressed into the Second Industrial Revolution in the transition years between 1840 and 1870, when technological and economic development sustained with the increasing acceptance of steam transport (steam-powered railways, boats and ships), the large-scale manufacture of machine tools and the increasing use of machinery in steam-powered factories. Many modern historian observed that the industrial revolution was basically a technological revolution, and progress in understanding it can be made by focussing on the sources of invention.

Causes:

There were heated debate among historians, intellectuals and scholars to understand the causes of industrial revolution as it is very complicated issue. It is established that some historians visualized the Revolution as a consequence of social and institutional changes brought by the end of feudalism in Britain after the English Civil War in the 17th century. As national border controls became more effective and it also prevent in transmission of various deadly disease. The percentage of children who lived past infancy rose significantly and it resulted in creating huge workforce. The Enclosure movement and the British Agricultural Revolution made food production more effective and less labour-intensive, forcing the excess population who could no longer find employment in agriculture into cottage industry. The colonial expansion of the 17th century with the associated development of international trade, creation of financial markets and accumulation of capital are also mentioned as factors, as is the scientific revolution of the 17th century.

Primary cause of industrial revolution is the population's increase. Since the XVIII century, epidemics of plague were vanishing and the development of agriculture allowed the growth of food production and then there was a decline in catastrophic mortality (hunger, wars and epidemics). In addition, population's increase augmented demand for goods and services. It promoted technical innovations that increased production and profits. Several technological invention also led to the industrial revolution and major enabling technology was the invention and development of the steam engine. These inventions began in England in the textile sector, at the beginning they

were very simple inventions, they were built of wood and made by artisans and people without scientific preparation, but after that, this technological development in the industry made possible the emergence of factory. It is a place where a high production is achieved through the division of labour because each worker takes charge of only in a portion of the process.

Another cause for the industrial revolution was the expansion of foreign trade. The foreign trade led to get inexpensive and plentiful raw materials and achieved broad market for industrial products. So, people generated revenues through reducing of production costs and expanding of their market, take advantage of that opportunity was unquestionably the best option. Although primarily the countries of northern Europe had organized a global trade for their benefit and their privileged status was delaying the industrialization of the rest of the world, the discovery of the optimization of profits through the purchase of raw materials in other markets led to countries realized that it was essential to establish stable relations with markets elsewhere in the world.

Other important ground for the industrial revolution is the need to develop effective means of transportation. The increase of population and agricultural production and also the development of trade had created big markets in which it was needed to bring the products from one place to another. Therefore, it was imperative to develop and improve means of transport. Moreover, improving the means of transport was not an easy task because it was a slow and tortuous process. However the growing need for efficient and effective means of transport, it led to the invention of railways and steamboats. All these aspects incontestably reinforced the development of the industrial revolution

The existence of a big domestic market should also be deliberated an important cause of the Industrial Revolution especially in Britain. In other nations, such as France, markets were divided up by local regions, which often imposed tolls and tariffs on goods traded amongst them.

Causes for industrial revolution happened in Europe:

Many historians wanted to explore the reason for eruption of the Industrial Revolution in the beginning of 18th century of Europe only and not rest of the world in the 18th century, particularly China, India, and the Middle East, or at other times like in Classical Antiquity or the middle Ages. Several factors have been proposed, including ecology, government, and culture. Benjamin Elman debated that China was in a high level symmetry trap in which the non-industrial methods were well-organized enough to avert use of industrial methods with high costs of capital. Kenneth Pomeranz, in the Great Divergence, claimed that Europe and China were remarkably similar in 1700, and that the crucial transformations which produced the Industrial Revolution in Europe were sources of coal near manufacturing centres, and raw materials such as food and wood from the New World, which permitted Europe to expand economically in a way that China could not rise. However, most historians challenge the statement that Europe and China were approximately equal because modern estimates of per capita income on Western Europe in the late 18th century are of roughly 1,500 dollars in purchasing power parity (and Britain had a per capita income of nearly 2,000 dollars) whereas China, by comparison, had only 450 dollars.

Other historians such as David Landes and Max Weber gave different causes for industrial revolution in China and Europe. The religion and beliefs of Europe were mainly products of Judaeo-Christianity, and Greek thought. On the contrary, Chinese society was founded on men like Confucius, Mencius, Han Feizi (Legalism), Lao Tzu (Taoism), and Buddha (Buddhism). The major difference between these belief systems was that those from Europe focused on the

individual, while Chinese philosophies focused on relationships between people. The family unit was more important than the individual for the large majority of Chinese history, and this may have important role for the occurrence of the Industrial Revolution in China. There was the additional difference as to whether people looked backwards to a supposedly magnificent past for answers to their questions or looked optimistically to the future. Additionally, Western European peoples had experienced the Resurgence and Improvement; other parts of the world had not had a similar knowledgeable breakout, a condition that holds factual even into the 21st century.

With reference to India, the Marxist historian Rajani Palme Dutt had stated that "The capital to finance the Industrial Revolution in India instead went into financing the Industrial Revolution in England." In contrast to China, India was split up into many rival kingdoms, such as the Marathas, Sikhs and the Mughals. Additionally, the economy was highly dependent on two sectors that include agriculture of subsistence and cotton, and technical innovation was non-existent. Huge wealth were stored away in palace treasuries, and as such, were easily moved to Britain.

Causes for occurrence in Britain:

Historians stated that the beginning of the Industrial Revolution in Great Britain was due to abundant natural or financial resources that Britain received from its many foreign colonies or that profits from the British slave trade between Africa and the Caribbean assisted fuel industrial investment. It has been designated that bondage provided only 5% of the British national income during the years of the Industrial Revolution. A major cause for the Industrial Revolution was the huge spurt of population growth in England. Alongside the fast growth in population, medical systems had also enhanced, thus there was a reduction in the number of epidemics that spread resulting in less of a death toll through lack of medical knowledge.

Otherwise, the greater liberalisation of trade from a large merchant base may have permitted Britain to produce and use emerging scientific and technological developments more efficiently as compared to countries with stronger kingdoms, particularly China and Russia. Britain arose from the Napoleonic wars as the only European nation not ravaged by financial plunder and economic downfall, and possessing the only merchant fleet of any useful size. Britain's wide-ranging exporting cottage industries also safeguarded markets which were already available for many early forms of manufactured goods. The struggle resulted in most British warfare being conducted overseas, reducing the disturbing effects of territorial conquest that affected much of Europe.

Industrial revolution happened in Britain because of a dense population for its small geographical size. Enclosure of common land and the related Agricultural Revolution made a supply of this labour readily available. There was also a local coincidence of natural resources in the North of England, the English Midlands, South Wales and the Scottish Lowlands. Local supplies of coal, iron, lead, copper, tin, limestone and water power, resulted in excellent conditions for the development and development of industry. Also, the damp, mild weather conditions of the North West of England provided perfect conditions for the spinning of cotton, providing a natural starting point for the birth of the textiles industry. Another ground for industrial revolution in Britain was the stable political situation from around 1688, and British society's greater receptivity to change was major factors to favour the Industrial Revolution.

Innovations in the period of industrial revolution:

In the beginning, the Industrial Revolution was closely related to a small number of innovations, made in the second half of the 18th century: Textiles: The progression of the textile industry was major development in Britain's industrialization. Cotton spinning started by using Richard Arkwright's water frame. This was patented in 1769 and so came out of patent in 1783. The end of the patent was rapidly followed by the creation of many cotton mills. Similar technology was afterward applied to spinning worsted yarn for various textiles and flax for linen.

Inventions in the Textile Industry:

1733 - Flying shuttle invented by John Kay - an improvement to looms that enabled weavers to weave faster.

1742 - Cotton mills were first opened in England.

1764 - Spinning jenny invented by James Hargreaves - the first machine to improve upon the spinning wheel.

1764 - Water frame invented by Richard Arkwright - the first powered textile machine.

1769 - Arkwright patented the water frame.

1770 - Hargreaves patented the Spinning Jenny.

1773 - The first all-cotton textiles were produced in factories.

1779 - Crompton invented the spinning mule that allowed for greater control over the weaving process.

1785 - Cartwright patented the power loom. It was improved upon by William Horrocks, known for his invention of the variable speed batton in 1813.

1787 - Cotton goods production had increased 10 fold since 1770.

1789 - Samuel Slater brought textile machinery design to the US.

1790 - Arkwright built the first steam powered textile factory in Nottingham, England.

1792 - Eli Whitney invented the cotton gin - a machine that automated the separation of cottonseed from the short-staple cotton fibre.

1804 - Joseph Marie Jacquard invented the Jacquard Loom that weaved complex designs. Jacquard invented a way of automatically controlling the warp and weft threads on a silk loom by recording patterns of holes in a string of cards.

1813 - William Horrocks invented the variable speed batton (for an improved power loom).

1856 - William Perkin invented the first synthetic dye (Bellis).

Steam power: The enhanced steam engine developed by James Watt which was mainly used for pumping out mines, but from the 1780s, it was applied to power machines. This permitted rapid development of efficient semi-automated factories on an earlier unimaginable scale in places where waterpower was not available.

Iron founding: In the Iron industry, coke was finally applied to all stages of iron smelting, replacing charcoal. This had been attained much earlier for lead and copper as well as for producing pig iron in a blast furnace, but the second stage in the production of bar iron depended on the use of potting and stamping. These signify three major sectors in which innovations were recognized and which allowed the economic launch by which the Industrial Revolution is usually demarcated. Later inventions such as the power loom and Richard Trevithick's high pressure steam engine were also become important in the development of industrialisation in Britain.

Transfer of knowledge:

There were various means to transfer knowledge of new innovation. Employees who were trained in the technique might move to another employer or might be stolen. A common method was for someone to make a study tour, gathering information where he could. During the Industrial Revolution and for the century before, all European countries and America involved in study-touring; some nations, like Sweden and France, even trained civil servants or technicians to assume it as a matter of state policy. In other countries, particularly Britain and America, this practice was done by individual manufacturers anxious to improve their own methods. Study tours were common then, as now, as was the keeping of travel records. Records made by industrialists and technicians of the period are an unparalleled source of information about their methods.

Another way to the transmit innovation was by the network of informal philosophical societies, like the Lunar Society of Birmingham, in which members met to discuss 'natural philosophy' and often its application to manufacturing. The Lunar Society succeeded from 1765 to 1809, and it has been said of them, "They were, if you like, the revolutionary committee of that most far reaching of all the eighteenth century revolutions, the Industrial Revolution".

There were publications that explains technology. Encyclopaedias such as Harris's Lexicon technicum (1704) and Dr Abraham Rees's Cyclopaedia (1802-1819) encompass much of value. Cyclopaedia contains huge information about the science and technology of the first half of the Industrial Revolution, very well illustrated by fine engravings. Foreign printed sources such as the Descriptions des Arts et Metiers and Diderot's Encyclopedie explained foreign methods with fine engraved plates. Periodical publications about manufacturing and technology began to appear in the last decade of the 18th century, and many frequently included notice of the latest patents. Foreign periodicals, such as the Annales des Mines, published accounts of travels made by French engineers who observed British methods on study tours.

Technological developments in Britain:

In Britain, there were huge technical progression in every field due to industrial revolution. Textile manufacture: In the beginning of 18th century, British textile manufacture was based on wool which was processed by individual artisans. They performed spinning and weaving task at their own premises. This system is called a cottage industry. Flax and cotton were also used for fine materials, but the processing was problematic because of the pre-processing needed, and thus small quantity of goods in these materials were produced. Use of the spinning wheel and hand loom limited the manufacture capacity of the industry, but incremental advances increased efficiency to the extent that manufactured cotton goods became the dominant British export by the early decades of the 19th century. India was displaced as the leading supplier of cotton merchandises.

Metallurgy:

In the period of industrial revolution, the major change in the metal industries was the replacement of organic fuels based on wood with fossil fuel based on coal. Much of this occurred before the Industrial Revolution, based on innovations by Sir Clement Clerke and others from 1678, using coal reverberator furnaces known as cupolas. These were operated by the flames, which contained carbon monoxide, playing on the ore and reducing the oxide to metal. This has the benefit that impurities (such as sulphur) in the coal do not migrate into the metal. This technology was useful to lead from 1678 and to copper from 1687. It was also applied to iron

foundry work in the 1690s, but in this case the reverberatory furnace was known as an air furnace. The foundry cupola is a different invention.

Other innovation was done by Abraham Darby, who made great strides using coke to fuel his blast furnaces at Coalbrookdale in 1709. Nevertheless, the coke pig iron he made was used mostly for the production of cast iron goods such as pots and kettles. He had the advantage over his competitors in that his pots, cast by his patented process, were thinner and cheaper than theirs. Coke pig iron was hardly used to produce bar iron in forges until the mid 1750s, when his son Abraham Darby II built Horsehay and Ketley furnaces (not far from Coalbrookdale). By then, coke pig iron was inexpensive than charcoal pig iron.

Till that time, British iron industrialists had used considerable amounts of imported iron to supplement native supplies. This came principally from Sweden from the mid 17th century and later also from Russia from the end of the 1720s. However, from 1785, imports reduced because of the new iron making technology, and Britain became an exporter of bar iron as well as manufactured wrought iron consumer goods. Since iron was becoming cheaper and more abundant, it also became a major structural material following the building of the innovative Iron Bridge in 1778 by Abraham Darby III. Upgrading was made in the production of steel, which was luxurious commodity and used only where iron would not do, such as for the cutting edge of tools and for springs. Benjamin Huntsman developed his crucible steel technique in the 1740s. The raw material for this was blister steel, made by the cementation process.

The supply of cheaper iron and steel aided the development of boilers and steam engines, and eventually railways. Developments in machine tools permitted better working of iron and steel and further enhanced the industrial progression of Britain.

Mining:

Coal mining in Britain, especially in South Wales began early. Before the steam engine, pits were often narrow bell pits following a seam of coal along the surface which were abandoned as the coal was extracted. Shaft mining was done in some areas, but the limiting factor was the problem of removing water. It could be done by carrying buckets of water up the shaft or to a sough (a tunnel driven into a hill to drain a mine). In either case, the water had to be discharged into a stream or ditch at a level where it could flow away by gravity. The introduction of the steam engine greatly enabled the removal of water and allowed shafts to be made deeper, enabling more coal to be extracted. These were developments that had begun before the Industrial Revolution, but the acceptance of James Watt's more efficient steam engine from the 1770s reduced the fuel costs of engines, making mines more lucrative.

Steam power:

In the beginning of industrial revolution, there was development of the stationary steam engine however, for most of the period of the Industrial Revolution, the majority of industries still depend on wind and water power as well as horse and man-power for driving small machines. The industrial use of steam power began with Thomas Savery in 1698. He created and patented in London the first engine, which he called the "Miner's Friend" since he intended it to pump water from mines. The first successful machine was the atmospheric engine, a low performance steam engine developed by Thomas Newcomen in 1712. Newcomen actually conceived his machine quite independently of Savery. His engines used a piston and cylinder, and it operated with steam just above atmospheric pressure which was used to produce a partial vacuum in the cylinder when

condensed by jets of cold water. The vacuum sucked a piston into the cylinder which moved under pressure from the atmosphere. The engine produced a succession of power strokes which could work a pump but could not drive a rotating wheel. They were effectively put to use for pumping out mines in Britain, with the engine on the surface working a pump at the bottom of the mine by a long connecting rod. These were large machines, requiring a lot of capital to build, but produced about 5 hp. They were incompetent, but when located where coal was inexpensive at pit heads, they were usefully employed in pumping water from mines. Despite using a lot of fuel, Newcomen engines continued to be used in the coalfields until the early period of the nineteenth century because they were trustworthy and easy to maintain.

Around 1800, the most common pattern of steam engine was the beam engine, which was built within a stone or brick engine-house, but during that time various patterns of portable (readily removable engines, but not on wheels) engines were invented such as the table engine. Richard Trevithick, a Cornish blacksmith, began to use high pressure steam with improved boilers in 1799. This permitted engines to be compact enough to be used on mobile road and rail locomotives and steam boats. In the beginning of 19th century after the expiration of Watt's patent, the steam engine had many enhancements by a host of inventors and engineers.

Chemicals:

During the Industrial Revolution, huge number of chemicals were produced. The first of these was the production of sulphuric acid by the lead chamber process developed by the Englishman John Roebuck (James Watt's first partner) in 1746. He was able to greatly increase the scale of the manufacture by substituting the relatively expensive glass vessels formerly used with larger, less expensive chambers made of riveted sheets of lead.

The production of an alkali on a large scale became an important goal as well, and Nicolas Leblanc succeeded in 1791 to introduce a method for the production of sodium carbonate. These two chemicals were very important because they enabled the introduction of a host of other inventions, replacing many small-scale operations with more lucrative and controllable processes. Sodium carbonate had many uses in the glass, textile, soap, and paper industries. Early uses for sulphuric acid included pickling (removing rust) iron and steel, and for bleaching cloth.

Scottish chemist Charles Tennant developed the chemical component bleaching powder (calcium hypochlorite) in about 1800, based on the discoveries of French chemist Claude Louis Berthollet which revolutionised the bleaching processes in the textile industry by radically reducing the time required (from months to days) for the traditional process then in use, which required repeated exposure to the sun in bleach fields after soaking the textiles with alkali or sour milk.

In 1824 Joseph Aspdin, patented a chemical process for making portland cement which was an important development in the building trades. This process involves sintering a mixture of clay and limestone to about 1400 °C, then grinding it into a fine powder which is then mixed with water, sand and gravel to produce concrete. It was used several years later by the famous English engineer, Marc Isambard Brunel, who used it in the Thames Tunnel. Cement was used on a large scale in the construction of the London sewerage system by next generation.

Machine tools:

In the era of the Industrial Revolution, several machine tools were developed. They have their origins in the tools developed in the 18th century by makers of clocks and watches and scientific instrument makers to assist them to batch-produce small mechanisms. The mechanical parts of

early textile machines were sometimes called 'clockwork' because of the metal spindles and gears they integrated. The manufacture of textile machines drew craftsmen from these trades and is the basis of the modern engineering manufacturing. Machines were built by various craftsmen such as carpenters made wooden framings, and smiths and turners made metal parts. Machine tools changed manufacturing process in Birmingham, England, in 1830. The invention of a new machine by William Joseph Gillott, William Mitchell and James Stephen Perry permitted mass manufacture of vigorous, inexpensive steel pen nibs. The process had been laborious and expensive. Due to difficulty in manipulating metal and the lack of machine tools, the use of metal was kept to a minimum. Wood framing had the drawback of changing dimensions with temperature and humidity, and the various joints tended to rack (work loose) over time. As the Industrial Revolution advanced, machines with metal frames became more common, but they required machine tools to make them economically. Before the initiation of machine tools, metal was worked manually using the basic hand tools of hammers, files, scrapers, saws and chisels. Besides workshop lathes used by craftsmen, the first big machine tool was the cylinder boring machine used for boring the large-diameter cylinders on early steam engines. The planing machine, the slotting machine and the shaping machine were developed in the early period of the 19th century. Although the milling machine was developed at this time, it was not developed as an important workshop tool until during the Second Industrial Revolution.

Gas lighting:

In the later period of industrial revolution, another major industry was gas lighting. Though others made a similar invention elsewhere, the large scale introduction of this was the work of William Murdoch, an employee of Boulton and Watt, the Birmingham steam engine pioneers. The process consisted of the large scale gasification of coal in furnaces, the purification of the gas (removal of sulphur, ammonium, and heavy hydrocarbons), and its storage and distribution. The first gas-lighting utilities were established in London between 1812 to 1820. They soon became one of the major customers of coal in the UK. Gas-lighting had immense impact on social and industrial organisation because it permitted factories and stores to remain open longer than with tallow candles or oil.

Transport in Britain:

In the start of the Industrial Revolution, inland transport was by navigable rivers and roads, with coastal vessels employed to move heavy goods by sea. Railways or wagon ways were used for carrying coal to rivers for further shipment, but canals had not yet been built. Animals supplied all of the motive power on land, with sails providing the motive power on the sea. The Industrial Revolution enhanced transport infrastructure of Britain with a turnpike road network, a canal, and waterway network, and a railway network. Raw materials and finished products could be transported more rapidly and inexpensively than earlier period.

Coastal sail:

Coastal sail were improved during industrial revolution period. Sailing vessels had been used for moving goods round the British coast since long time. The trade transporting coal to London from Newcastle had begun in mediaeval times. The major international seaports such as London, Bristol, and Liverpool, were the means by which raw materials such as cotton might be imported and finished goods exported. Transporting goods onwards within Britain by sea was common during the whole of the Industrial Revolution and become down with the development of the railways at the end of the period.

Navigable rivers:

In the period of the Industrial Revolution, all the major rivers of the United Kingdom were navigable. Some were anciently navigable, particularly the Severn, Thames, and Trent. Some were enhanced, or had navigation extended upstream. River, The Severn mainly used for the transportation of goods to the Midlands which had been imported into Bristol from abroad, and for the export of goods from centres of production in Shropshire and the Black Country.

Canals:

Another development in Britain during industrial revolution era was construction of canals. Canals began to be built in the late eighteenth century to connect the major manufacturing centres in the Midlands and north with seaports and with London, at that time itself the largest manufacturing centre in the country. Canals were the first technology to allow bulk materials to be easily transported across nation. By the 1820s, a national network was in existence. Canal construction served as a model for the organisation and methods later used to build the railways.

Roads:

The original British road system was poorly maintained well by thousands of local communities, but from the 1720s, turnpike trusts were established to charge tolls and maintain some roads. Increasing numbers of main roads were turnpiked from the 1750s to the extent that almost every main road in England and Wales was the responsibility of some turnpike trust. New planned roads were constructed by John Metcalf, Thomas Telford and John Macadam. The major turnpikes radiated from London and were the means by which the Royal Mail was able to reach the rest of the country. Heavy goods transport on these roads was by means of slow broad wheeled carts dragged by teams of horses. Lighter goods were transported by smaller carts or by teams of pack horses.

Railways:

Wagon ways to transport coal in the mining areas had begun in the 17th century and were often related with canal or river systems for the further movement of coal. These were all horse drawn or relied on gravity, with a stationary steam engine to drag the wagons back to the top of the incline. The first applications of the steam locomotive were on wagon or plate ways. Horse-drawn public railways did not begin until the beginning of the 19th century. Steam-hauled public railways began with the Stockton and Darlington Railway in 1825 and the Liverpool and Manchester Railway in 1830. The building of major railways which connected big cities and towns began in the 1830s but started at the end of the first Industrial Revolution.

Social effects of industrial revolution:

With reference to social structure, the Industrial Revolution perceived the success of a middle class of industrialists and businessmen over a landed class of dignity and gentry. Normal working people found greater opportunities for employment in the new mills and factories, but these were often under strict working conditions with long hours of labour dominated by a pace set by machines. Nevertheless, harsh working conditions were widespread long before the industrial revolution took place as well. Pre-industrial society was very static and often cruel. Child labour, dirty living conditions and long working hours were as predominant before the Industrial Revolution.

Factories and urbanization:

Industrialisation resulted in emergence of many factories. Debatably, the first was John Lombe's water-powered silk mill at Derby was operational by 1721. However, the rise of the factory came somewhat later when cotton spinning was automatic. The factory system was mainly responsible for the development of the modern city, as workers travelled into the cities in search for getting employment in the factories. For much of the 19th century, production was done in small mills, which were typically powered by water and built to serve local needs. Later each mill had its own steam engine and a tall chimney to give an efficient draft through its boiler. The changeover to industrialisation was not solely smooth. It was observed that a group of English workers known as Luddites formed to protest against industrialisation and sometimes damaged factories. One of the earliest campaigners of factory conditions was Robert Owen.

Child labour:

Due to the Industrial Revolution, there was increase in population. Industrial workers were better paid than those in agriculture. With more money, women took nutritious diet and had healthier babies, who were themselves better fed. Death rates weakened, and the distribution of age in the population became more youthful. In the age of industrial revolution, there was limited opportunity for education, and children were expected to work. Employers could pay a child less than an adult even though their productivity was comparable. There was no need for strength to operate an industrial machine, and since the industrial system was completely new and experienced adult labourers were not available. This increased recruitment of child labour for manufacturing in the early phases of the industrial revolution. Child labour had existed before the Industrial Revolution, but with the increase in population and education it became more noticeable. Before the passing of laws protecting children, many were forced to work in awful conditions for much lower pay than their elders.

Politicians and the government took major initiative to curb the practice of child labour by law, but factory owners resisted. They rationalized that they were helping the poor by giving their children money to buy food to avoid starvation, and others simply welcomed the cheap labour. In 1833 and 1844, the first general laws against child labour, the Factory Acts, were passed in England. Children younger than nine were not allowed to work, children were not allowed to work at night, and the work day of youth under the age of 18 was limited to twelve hours. Factory inspectors administered the implementation of the law. About ten years later, the employment of children and women in mining was prohibited. These laws reduced the number of child labourers. However, child labour remained in Europe up to the 20th century.

Housing:

In the period of the Industrial Revolution, life style of people varied from the magnificence of the homes of the owners to the foulness of the lives of the workers. Poor people lived in very small houses in overcrowded streets. These homes would share toilet facilities, have open sewers and would be at risk of damp. Disease was transmitted through a contaminated water supply. Conditions did improve during the 19th century as public health acts were introduced covering things such as sewage, hygiene and making some boundaries upon the construction of homes. The Industrial Revolution created a better living for middle class of professionals such as lawyers and doctors. The conditions for the poor improved over the course of the 19th century because of government and local plans which led to cities becoming cleaner places, still life had not been improved for the poor before industrialisation. However, after the revolution, huge numbers of the

working class died due to disease spreading through the cramped living conditions. Chest diseases from the mines, cholera from polluted water and typhoid were also extremely common, as was smallpox. Accidents in factories with child and female workers were common.

Luddites:

The speedy industrialisation of the English economy disrupted job opportunities to craft workers. The textile industry in particular industrialised primary, and many weavers found themselves abruptly jobless since they could no longer compete with machines which only required relatively limited (and unskilled) labour to produce more cloth than a single weaver. Many such unemployed labours, weavers and others, turned their hostility towards the machines that had taken their jobs and began destroying factories and machinery. These assailants became known as Luddites, supposedly followers of Ned Ludd, a folklore figure. The first attacks of the Luddite movement began in 1811. The Luddites rapidly gained popularity, and the British government had to take strict measures to shield industry.

Organisation of labour:

The Industrial Revolution focused labour into mills, factories and mines, therefore facilitating the organisation of combinations or trade unions to help advance the interests of working people. The power of a union could demand better terms by extracting all labour and causing a consequent termination of production. Employers had to decide between giving in to the union demands at a cost to themselves or suffer the cost of the lost production. Capable workers were difficult to replace, and these were the first groups to effectively advance their conditions through this kind of negotiation.

The main method the unions used to effect change was strike action. Strikes were throbbing events for both sides, the unions and the management. In England, the Combination Act prohibited workers to form any kind of trade union from 1799 until its repeal in 1824. Even after this, unions were still severely controlled. In the 1830s and 1840s, the Chartist movement was the first large scale organised working class political movement which electioneered for political impartiality and social justice. Its Charter of reforms received over three million signatures but was overruled by Parliament without consideration. Unions gradually overcame the legal restrictions on the right to strike. In 1842, a General Strike involving cotton workers and colliers was organised through the Chartist movement which stopped production across Great Britain. Ultimately, effective political organisation for working people was attained through the trades unions who, after the extensions of the franchise in 1867 and 1885, began to support socialist political parties that later merged to become the British Labour Party.

Other effects:

The application of steam power to the industrial processes of printing supported enormous expansion of newspaper and popular book publishing, which strengthened rising literacy and demands for mass political participation. During the Industrial Revolution, the life expectancy of children increased dramatically.

Industrial revolution in United States:

The Industrial Revolution in America had impacted greatly in every aspect of society.

The Industrial Revolution began in Great Britain in 1750. At the beginning of the 19th century, America was generally an agrarian (agricultural) society. About six out of seven workers were involved in some type of farming. In 1820, the United States shifted from an agricultural society to one based on wage labour, which was called the American Industrial Revolution. As the number of states increased from 16 to 34 in 1860, the percentage of farmers reduced to half of the workforce.

The main influences for industrialization were the Embargo Act of 1807 and the War of 1812. The Embargo Act was passed by Congress to cease the export of American goods and restrict the importation of certain British products. This generated a greater need for America to produce goods nationally. Also, when America and Great Britain went to war with each other in 1812, the lack of sufficient transportation and communication caused great difficulties for both sides. Industrialization in the United States initiated by borrowing technology from English inventors and innovators. The first textile factory to use a water-powered spinning machine was started by Samuel Slater, a British immigrant, in 1790. Soon, American technology surpassed the British machines they had copied. Besides an incursion of British technology, several other key features led to the manufacturing boom after 1860.

The use of huge deposits of coal in states such as Pennsylvania and West Virginia created a source of fuel for factories. Inventions in railroad technology and communication contributed in creating jobs and allowed goods to be sold to the greater market. The increase in factories led to a higher demand for workers. Competition between businesses to cut costs and win customers led to a drop in prices overall. The money supply could not keep up with the production, which ultimately caused high interest and less credit availability.

There was need for better transportation for the United States. Therefore, Miles of roads and new canals were built to connect the vast open areas of America. The steamboat was an important means of transportation in the Great Lakes and the Mississippi River. Nonetheless, the railroad rapidly dominated the steamboat in the transportation revolution.

Historical reports signified that in 1830, the U.S. only had an estimated 100 miles of track. The railroads expanded rapidly after that. By 1860, 27,000 miles of track were built, and by 1900, 193,000 miles of track were completed. Importantly, these new tracks connected the eastern and western United States, made selling goods more affordable, and allowed a network of national supply distribution.

As in Britain, the United States initially used water power to run its factories, as a result that industrialisation was essentially limited to New England and the rest of the Northeastern United States, where fast-moving rivers were located. However, the raw materials (cotton) came from the Southern United States. It was not until after the American Civil War in the 1860s that steam-powered manufacturing overtook water-powered manufacturing, allowing the industry to fully spread across the nation. The Steel Industry: It was observed that there were rapid growth of the railroad industry which required huge quantity of steel tracks, the steel industry also profited during the Industrial Revolution. Andrew Carnegie was involved in the development and streamlining of the American steel industry. A Scottish immigrant who moved to the U.S. in 1848, his first job was bobbin boy in a textile factory. He finally became one of the wealthiest men of the 19th century.

In United States, The Industrial Revolution was period of growth and transformation. There were numerous changes that were occurred during this time that had remarkable impacts on culture, manufacturing, trade, agriculture, etc. One major change was that people earned more as compared to earlier period. There was a supply and demand now and people were generally earning more money because there were more jobs, although there were people who earned little money and were poor. People started shifted to the cities because that is where the centre of manufacturing was. Cities were prosperous and the populations increased. Many times living conditions were very poor because of congestion.

Continental Europe:

The Industrial Revolution on Continental Europe emerged late than in Great Britain. In many industries, this involved the application of technology developed in Britain in new places. Often the technology was bought from Britain or British engineers and entrepreneurs travelled overseas to explore new opportunities. By 1809 part of the Ruhr Valley in Westphalia were being called Miniature England because of its similarities to the industrial areas of England. The German, Russian and Belgian governments did all they could to sponsor the new industries by the provisions of state funding. In some cases (such as iron), the different availability of resources locally meant that only some aspects of the British technology were implemented.

Industrial revolution in Japan:

Through the Sino-Japanese and the Russo-Japanese Wars, Japan moved its industrial structure from light industry to heavy and chemical industries. Although Europe had played vital role as the "factory of the world," up until then, the region became a battleground when World War I broke out in 1914 and their supply of commodities declined. In the meantime, Japan got amount of orders that prompted the industrial revolution of the country to progress at a rapid rate. Japan became a net creditor during the war, and recognized itself as a nation based on trade. In 1871 a group of Japanese politicians known as the Iwakura Mission visited Europe and the USA to learn western policies of business. The result was a thoughtful state led industrialisation policy to stop Japan from falling behind. The Bank of Japan, founded in 1877, used taxes to fund model steel and textile factories. Education was extended and Japanese students were sent to study in the west.

Second Industrial Revolution:

The ravenous demand of the railways for more durable rail led to the development of the means to inexpensively mass-produce steel. Steel is often named as the first of several new areas for industrial mass-production, which are said to symbolize a "Second Industrial Revolution", beginning around 1850. This second Industrial Revolution slowly grew to include the chemical industries, petroleum refining and distribution, electrical industries, and, in the twentieth century, the automotive industries, and was noticeable by a changeover of technological leadership from Britain to the United States and Germany.

Creation of hydroelectric power generation in the Alps supported the rapid industrialisation of coal-deprived northern Italy, beginning in the 1890s. The increasing availability of economical

petroleum products also reduced the importance of coal and further broadened the prospective for industrialisation.

The far Americans:

The American Revolution (1775-83) is also called the American Revolutionary War and the U.S. War of Independence. The struggle arose from increasing tensions between residents of Great Britain's 13 North American colonies and the colonial government, which characterised the British crown. Battles between British troops and colonial militiamen in Lexington and Concord in April 1775 kicked off the armed struggle, and after that, the insurgents were conducting a full-scale war for their independence. France entered the American Revolution on the side of the colonists in 1778, turning civil war into an international skirmish. After that the Americans had effectively won their independence, though fighting would not formally end until 1783.

The history of French revolution:

A turning point event in modern world history, the French Revolution began in 1789 and terminated in the late 1790s with the rise of Napoleon Bonaparte. During this period, French citizens destroyed and reshaped their country's political scene, displacing century's old institutions such as absolute kingdom and the outdated system. Like the American Revolution before it, the French Revolution was influenced by Illumination ideals, particularly the concepts of popular dominance and unchallengeable rights. Although it failed to realise all of its goals and at times deteriorated into a disordered massacre, the crusade played a critical role to redesign modern nations by showing the world the power inherent in the will of the people.

It can be established from above review that the revolution of industry and the economy in Britain between the 1780s and the 1850s is termed as the 'industrial revolution'. The industrial development in Britain is intensely associated with new machinery and technologies. These enabled country to produce goods on a huge scale compared to handicraft and handloom industries. This had sweeping effects in Britain. Afterwards, similar changes happened in European countries and in the USA. These were to have a major influence on the society and financial system of those countries and also on the rest of the world. Industrialization led to greater affluence for some, but in the early stages it was related with poor living and working conditions of millions of people, including women and children. This flashed off remonstrations, which forced the government to endorse laws for regulating conditions of work. But the Industrial Revolution and the huge wealth it created was irresistible.

Advantages and drawbacks of Industrial Revolution:

Many historians and intellectuals have observed that the Industrial revolution was period of speedy growth and modification all over America and Europe. Numerous innovations in machinery, methods, and techniques of producing goods created new world. There were progressions in architecture, agriculture, transportation, and communication. It provided huge jobs for people, enhancing the lifestyle of people.

Major benefits of industrial revolution were as under:

1. With the impact of industrialization, classes in the wellbeing of people increased. Nations started to recognize national pride and identities. It increased prosperity.
2. Factories that produce superior products have increased in numbers rapidly. The production rate increased because of the invention in machinery. As a result of the mass production of goods, the price of products reduced resulting to enhanced quality living.
3. Comfortable, strong and cheaper houses were built every day. Cheaper and fashionable houses were growing.
4. The means of transportation reformed extremely. It became cheaper, faster and very comfortable. Easier travel opened up new areas to many people.
5. The increase in production was related to the hike in trade. It offered new jobs and it increased the employment rate.
6. Cities developed and offered a lot of work and opportunity.

Disadvantages of Industrial Revolution:

1. Industrialization in contemporary cities fascinates immigrants. It promises a good life but not all were lucky. It causes congested cities and slum areas developed which created other issues.
2. Industrialization create pollution. Factories, automobiles and aircrafts produces unconceivable air pollution to some progressive cities in the world. Chemicals and wastes that were not properly disposed causes water and land pollution. Such polluted environment degrade the life of humans around the globe.
3. Another negative consequence of industrialization is that it brought a negative influence on culture, values and morality of mankind. Technology drives the change in philosophies, beliefs and faith.

In Britain, industrial revolution had many disadvantages as there were poor living conditions, poor working conditions, and class tensions. A large dissimilarity developed between the industrialized west and the rest of the world. Britain led in exploiting its foreign colonies for resources and markets. As a result, other European countries, the United States, Russia, and Japan followed Britain's lead, grabbing colonies for their economic resources. Imperialism was born out of the cycle of industrialization, the development of new markets around the worked, and the need for resources to supply the factories of Europe.

To summarise, the Industrial Revolution was a major change of technological, socioeconomic, and cultural conditions that happened in the late 18th century and early 19th century in some Western countries. It initiated in Britain and then blowout throughout the world, a process that continued as industrialisation. The start of the Industrial Revolution marked a major defining moment in human social history, similar to the invention of farming or the rise of the first city-states, almost every facet of daily life and human society is, ultimately, in some way influenced. Major grounds for industrial development was explosion of population, extension of foreign trade and the need to develop efficient means of transportation.