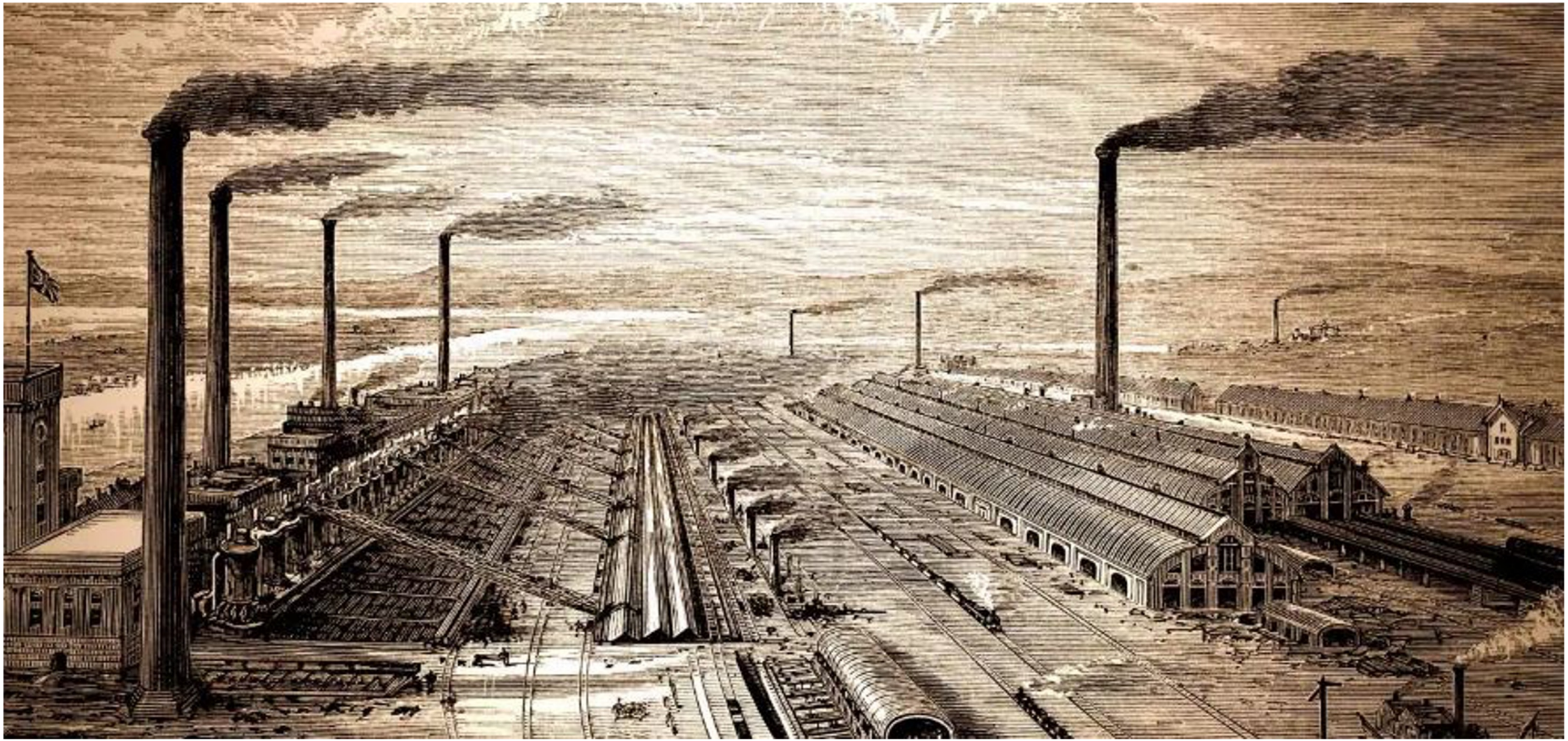
INDUSTRIAL REVOLUTION



Synopsis

1. Introduction
2. Pre-requisites for the later day Industrial Revolution (IR)
3. Background
4. Inventions
5. IR-Meaning,Definition & Progress
6. Summary of Progress of IR
7. Factors responsible for IR in Britain
8. Impact of IR-Economic,Political & Social
9. Impact on Europe & on the non-European World

Questions

1. ‘Latecomer' Industrial Revolution in Japan involved certain factors that were markedly different from what the West had experienced. Analyze (**2013**)
2. Why did the Industrial Revolution first occur in England? Discuss the quality of life of the people there during the Industrialization. How does it compare with that in India at present?(**2015**)

- **Introduction**
  - In the late 18th and early part of the 19th century, there was a change in the life of a lot of people.
  - Industrial Revolution (IR)-a non-violent revolution.
  - It witnessed a shift from living on farms to living in cities.
  - It refers to the time period when goods start to be made by machines rather than human or animal labour leading to large outputs.

❑ Pre-requisites for the promotion of the later day IR

1. Desire for material advancement
2. Supply of raw materials
3. Markets
4. The need of labour force
5. Transportational facilities
6. Developments in the agriculture sector

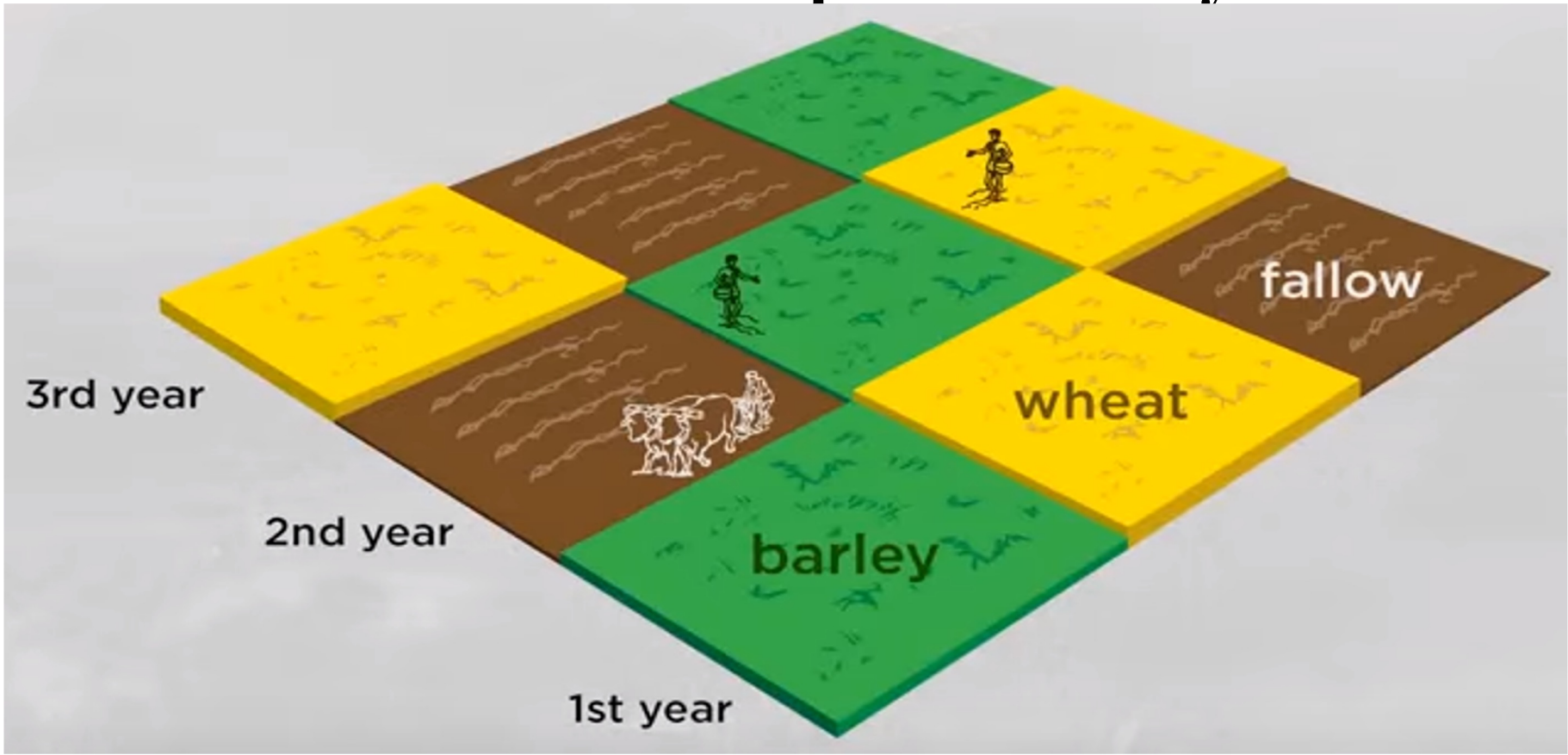
❑Background

- It began in England and very soon spread to the whole of Europe.
- Belgium was the first continental country to experience the IR.
- Later Germany, Switzerland, Russia, Sweden, France, Italy and Japan and later the USA experienced the IR.

- IR began in GBR(Great Britain) in the early part of the 18th century.
- Before IR, life in GBR generally remained unchanged for generations.
- People lived in agrarian societies, farming was ruled by the seasons and harvest was at the mercy of the sun, wind and rain.
- Prior to the IR, most people in GBR lived in open field villages.

- They relied on 'Subsistence farming' which produced enough food for the peasants or tenants of land owners if not anything extra.
- Farmers used the system of rotating crops-3 fields to grow food.
- Each year 2 fields to grow crops(Barley and Wheat),while the 3rd was left fallow to allow the land to replenish lost nutrients.
- Live stock would graze on the fallow field and help to fertilize the soil.

Medieval 3 field Crop Rotation System



- Before the IR, England experienced 'Agricultural Revolution' which increased production enormously creating a surplus capital while simultaneously freeing the labour from rural areas.
- The following inventions contributed to the Agricultural Revolution:

❑ Inventions

1. **Jethro Tull**-1700-invented the '**Horse-drawn Seed Drill**' that could plant 3 rows of seeds at a time.

- It increased crop yield by 5 folds.

Jethro Tull's 'Horse drawn Seed Drill'

2.**Joseph Foljambe** (1730): Invented the '**Rotherham Plough**' which had an Iron Blade rather than wood.

- It was lighter and more effective.
- It required 2 horses and 1 ploughman to plough the land.
- It cut labour costs and saved time.

Rotherham Plough

3. **Lord Turnip Townshend** (1730's): Introduced the '**Dutch 4 crop rotation system**' to Great Britain.

- It rotated **Wheat-Turnip-Barley-Cloves** for example through 4 fields.
- The turnip and Cloves provided enough nutrients to nourish the soil which in turn yielded better Wheat and Barley the following year.

Dutch 4 Crop Rotation System

4. Enclosure Movement (16th c. onwards):Wealthy people bought lands and enclosed it and made it a Giant Mega Farm.

- Now they could experiment with advances made such as the Seed Drill and could also rotate crops which increased productivity.
- It also resulted in enclosing village common lands leading to unemployment for many who then migrated to cities in search of employment.

Enclosure Movement

- The **Agricultural Revolution** helped Britain in many a way:

a. It generated agricultural surplus which in its turn provided the required capital for industrial progress.

b. It provided raw materials.

c. It released the excess labour force from the rural areas and also created a demand for industrial goods.

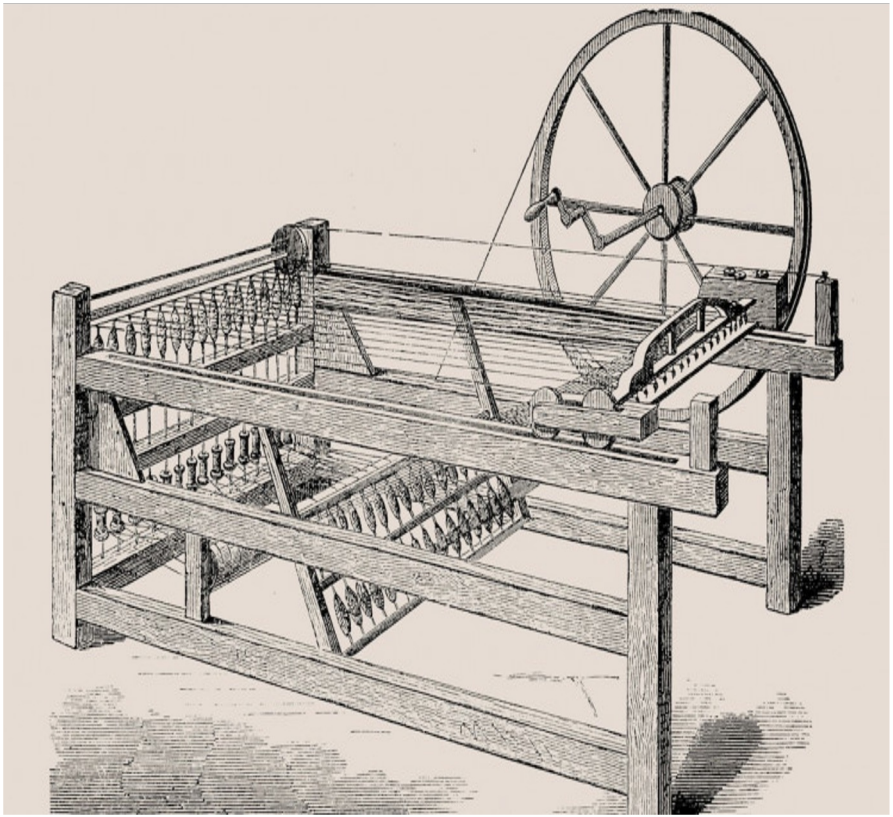
Inventions

❑ TEXTILE SECTOR: Inventions/Improvements

- **1733: Flying Shuttle**-John Kay
- **1765: Spinning Jenny**-James Hargreaves
- **1769: Water Frame**- Richard Arkwright (stronger thread-pure cotton fabrics could be woven rather than fabrics that combined linen & cotton yarn)
- **1779:Mule**- Samuel Crompton (strong & fine yarn)
- **1787:Power loom**- Edmund Cartwright
- **1794:Cotton Gin**- Ely Whitney
- **1844:Sewing Machine-** Elias Howe

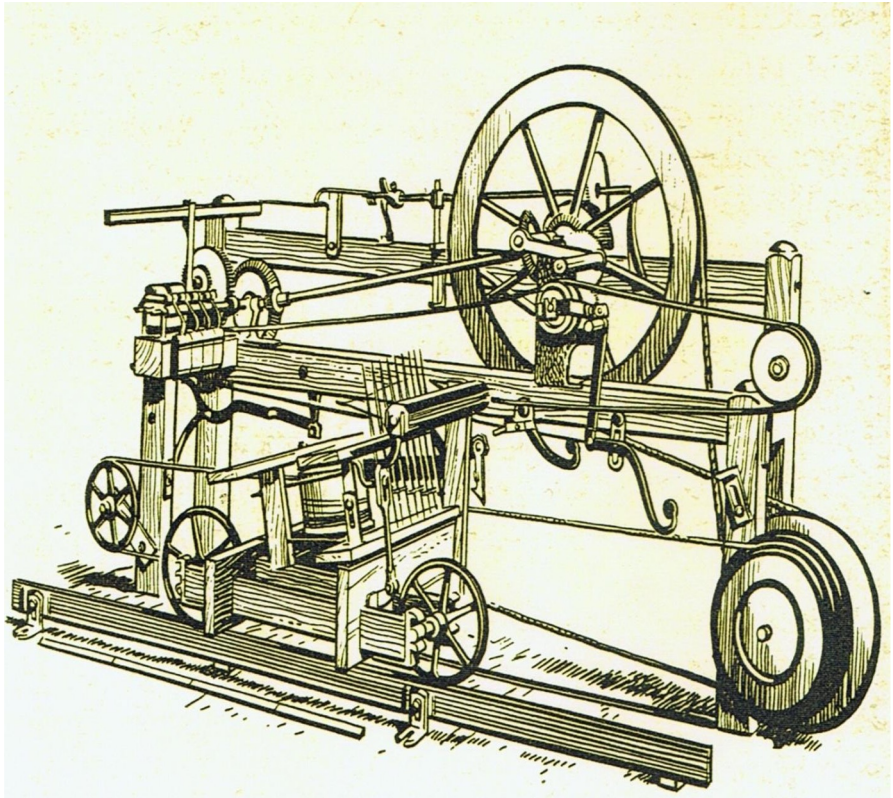
John Kay and the Flying Shuttle -1733

Spinning Jenny of James Hargreaves -1765

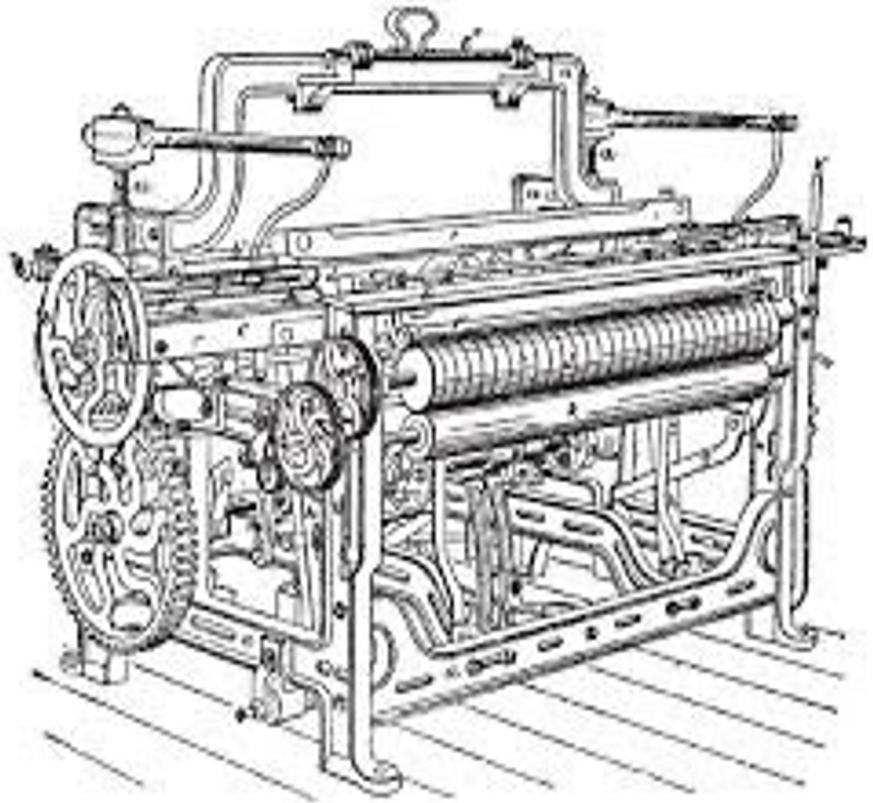


Richard Arkwright's **Water Frame-**1769

Samuel Crompton's **Spinning Mule**-1779

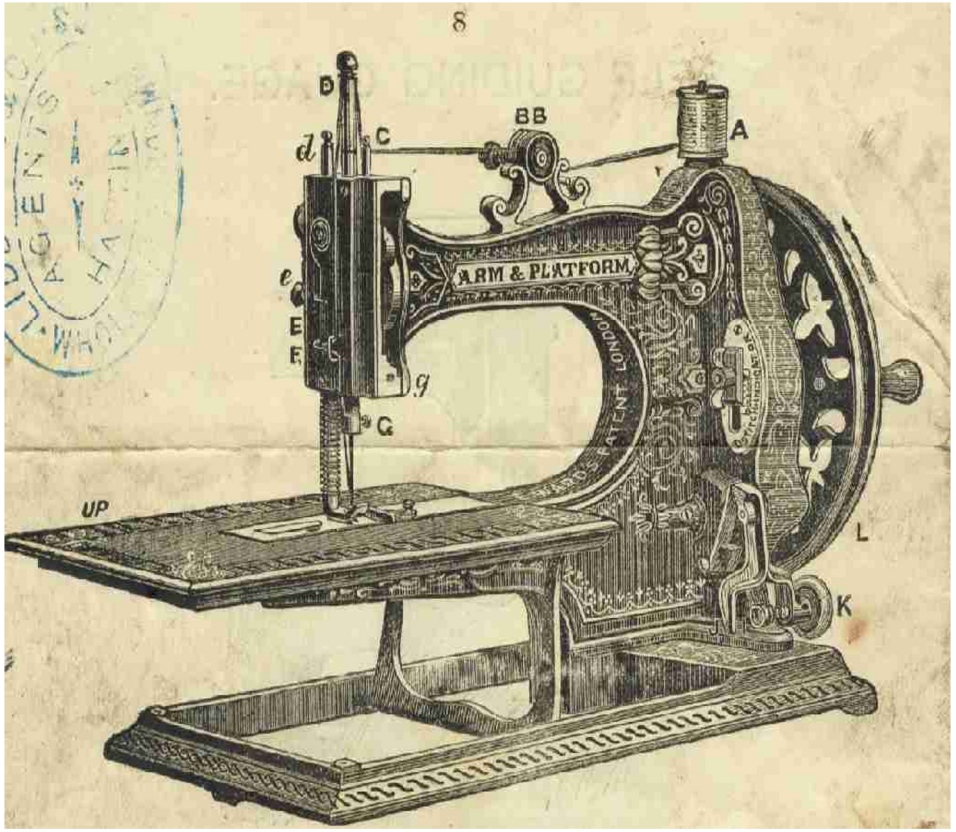


Edmund Cartwright's **Power loom**-1787



Ely Whitney's **Cotton Gin**-1794

Elias Howe's **Sewing Machine**-1844



❑ METALLURGY: Major inventions/improvements

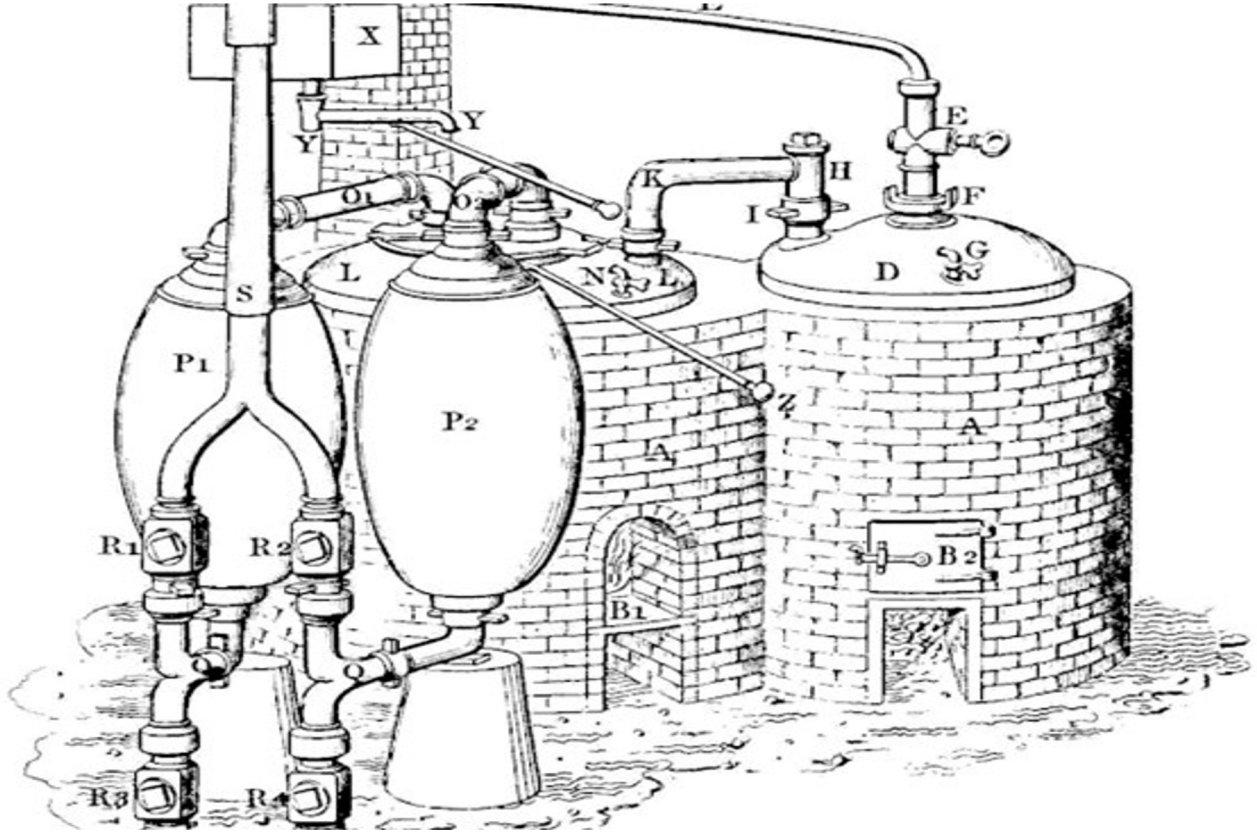
- **1709:Abraham Darby(First)-Blast Furnace**(used coke)-finer/larger castings possible
- **Darby (2nd): Wrought Iron** (strong under tension;less brittle from pig iron)
- **Henry Cort: Puddling Furnace**(in which molten iron could be rid of impurities) and **Rolling Mill** (used steam power to roll purified iron into bars)

- **1770's: John Wilkinson-Cast Iron** (strong when compressed)-iron pipes for transporting water, iron chairs, vats for breweries and distilleries
- **1779:Darby (3rd):** Built the world's **first Iron Bridge** in Coalbrookdale on the River Severn.
- **Bessemer** and later **Siemens and Martin Process** of Steel Making suspension bridges, skyscrapers, railroads, elevators, etc.

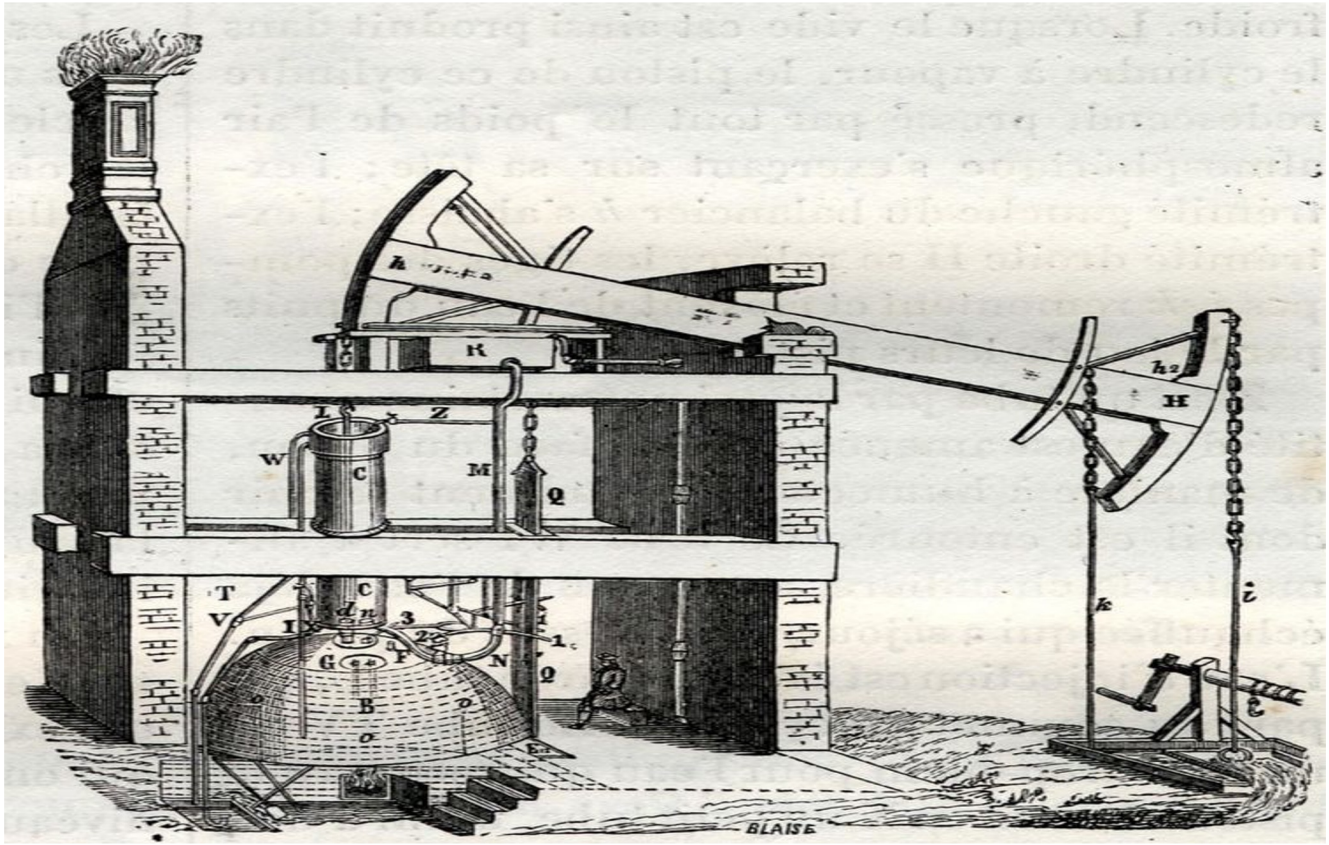
Coalbrookdale Iron Bridge built in 1779

- **STEAM: Inventions/Improvements**
- **1698: Thomas Savery-Miner's Friend**-to drain mines (worked slowly in shallow depths, boiler burst)
- **1712: Thomas Newcomen**-another steam engine-lost energy due to continuous cooling of condensing cylinder.
- **1769: James Watt's Steam Engine**

The miner's friend 1698

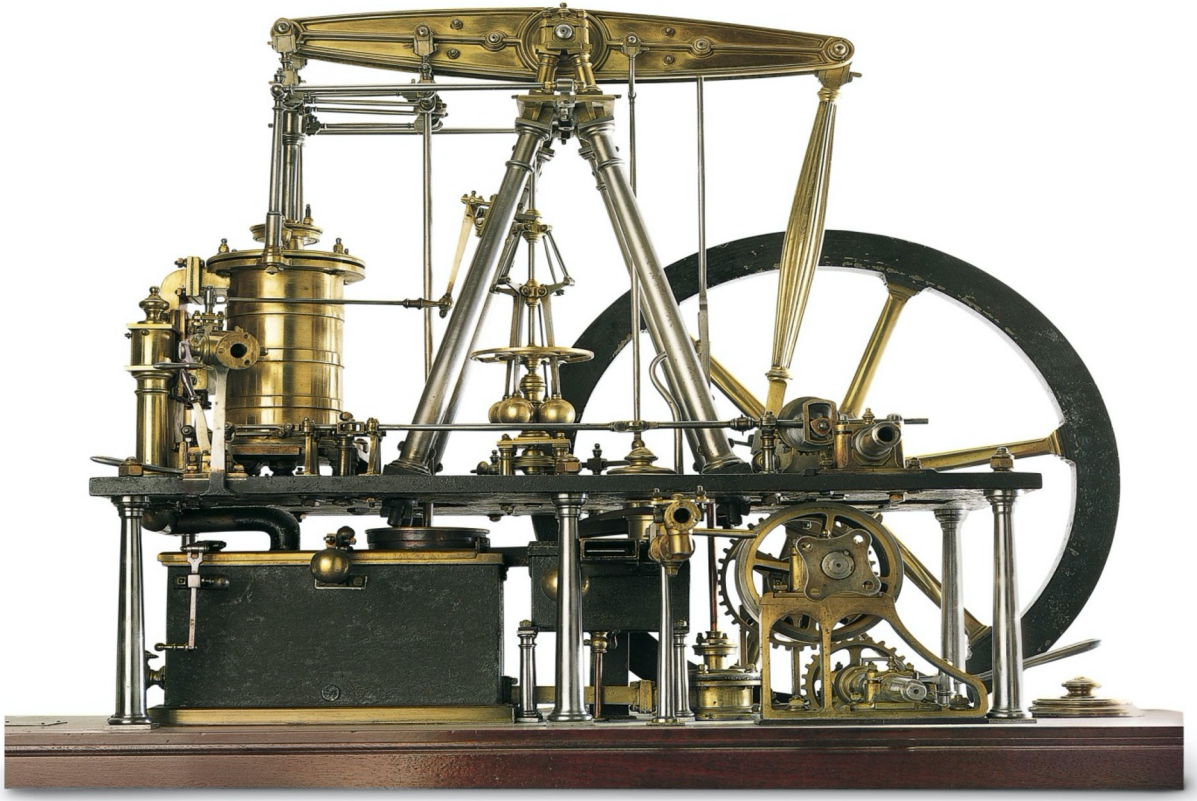


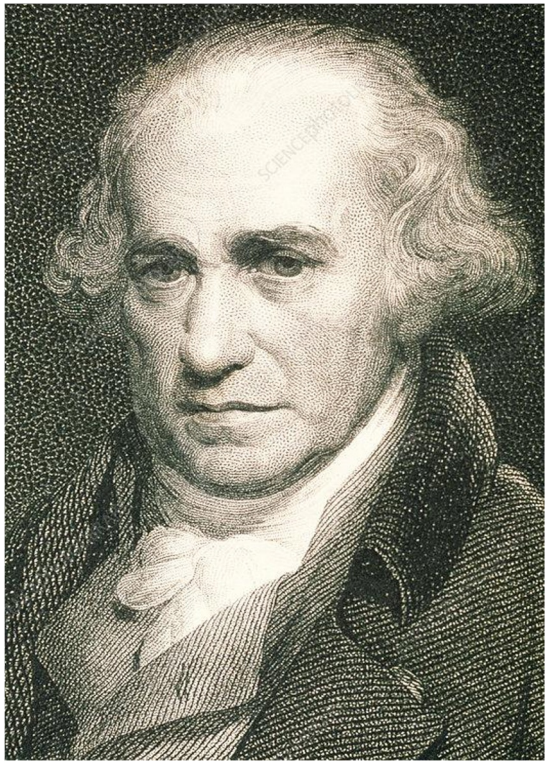
Atmospheric Steam Engine 1712



Thomas Newcomen

James Watt's Steam Engine 1769





Industrial Revolution: Meaning, Definition & Progress

- **Introduction:**
- 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), to describe the changes that occurred in British industrial development between 1760 and 1820 (date coincides with the reign of King George III)
- Later historians T.S Ashton, Paul Mantoux and Eric Hobsbawm, broadly agreed with Toynbee.

❑Definition of Industrial Revolution:

- Industrialization is the process of social and economic change whereby a human group is transformed from a preindustrial society into an industrial one.
- It is a subdivision of a more general modernization process, where social change and economic development are closely related with technological innovation, particularly with the development of large-scale energy and metallurgy production.

- It is the extensive organization of an economy for the purpose of manufacturing.
- An economy based on manual labour was replaced by one dominated by industry and the manufacture of machinery.
- Industrialization also introduces a form of philosophical change, where people obtain a different attitude towards their perception of nature.

- **Progress:**
- There was remarkable economic growth from the 1780s to 1820 in the cotton and iron industries, coal mining, building of roads and canals and foreign trade.
- The transformation of industry and economy in Britain between the 1780s and 1850s is called the **'First Industrial Revolution'**.

- In the **second** one, after about 1850, new areas like the chemical and electrical industries expanded. In that period, Britain fell behind, and lost its position as the world's leading industrial power, as it was overtaken by Germany and the USA.
- IR had far-reaching effects in Britain. Later, similar changes occurred in European countries and in the USA. These were to have a major impact on the society and economy of those countries and also on the rest of the world.

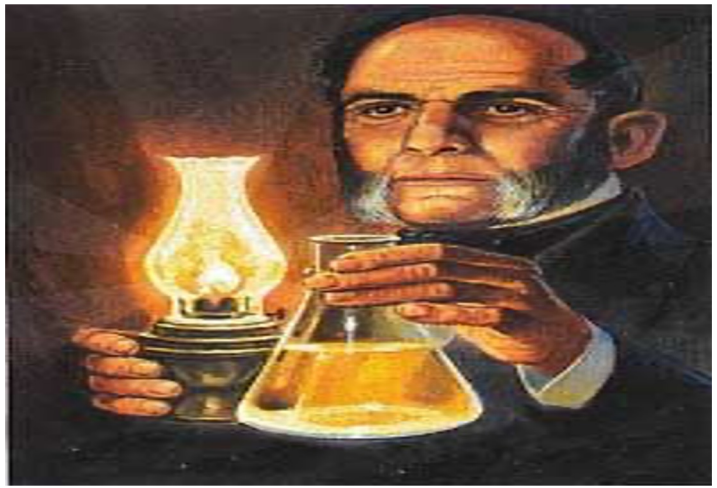
- This phase of industrial development in Britain is strongly associated with new machinery and technologies. These made it possible to produce goods on a massive scale compared to handicraft and handloom industries.
- Industrialization led to greater prosperity for some, but in the initial stages it was linked with poor living and working conditions of millions of people, including women and children. This sparked off protests, which forced the government to enact laws for regulating conditions of work.

- The **First Industrial Revolution** merged into the **Second Industrial Revolution** around **1850**,when technological and economic progress gained momentum with the development of steam-powered ships and railways, and later in the 19th century with the Internal combustion engine and electric power generation.
- The **Second Industrial Revolution** was a phase of the Industrial Revolution; sometimes labeled as a **separate Technical Revolution.**

- From a technological and a social point of view there is no clean break between the two.
- Major innovations during the period occurred in the chemical, electrical, petroleum, and steel industries.
- **Specific advancements** included the introduction of oil fired steam turbine and internal combustion driven steel ships, the development of the airplane, the practical commercialization of the automobile, mass production of consumer goods, the perfection of canning, mechanical refrigeration and other food

preservation techniques, and the invention of the telephone.

- The modern petroleum industry started in 1846 with the discovery of the process of refining kerosene from coal by Nova Scotian Abraham Pineo Gesner.



Ignacy Lukasiewicz

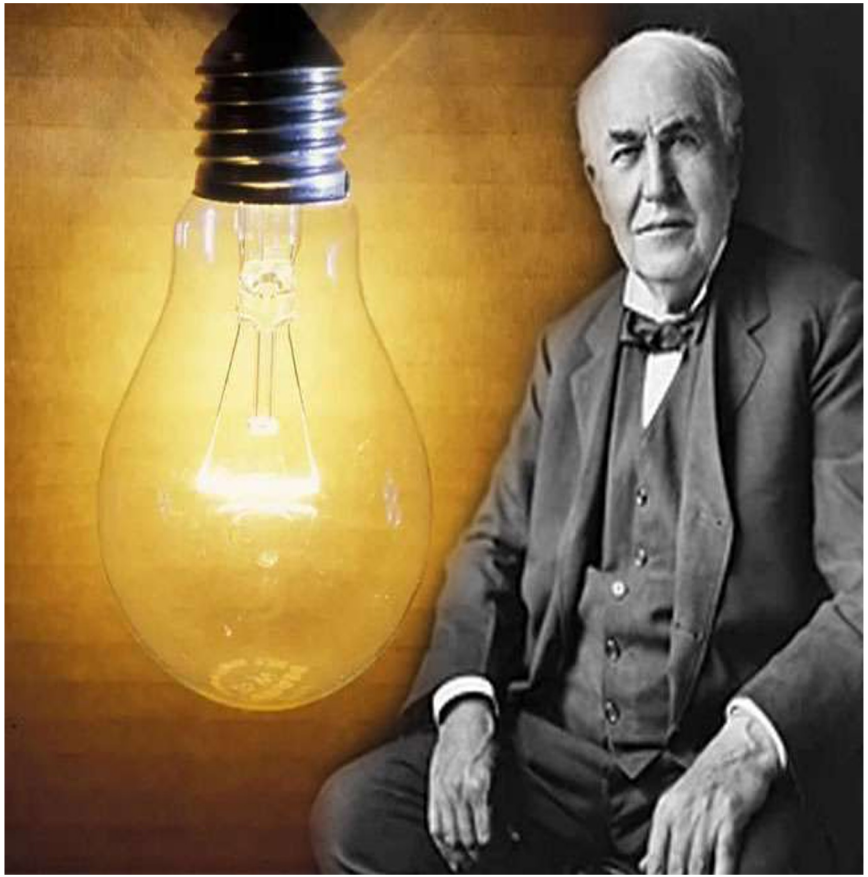
- Ignacy Lukasiewicz improved Gesner's method to develop a means of refining kerosene from the more readily available "rock oil" ("petroleum") seeps in 1852

  (The first rock oil mine was built in Bobrka, near Krosno, Poland in the following year)

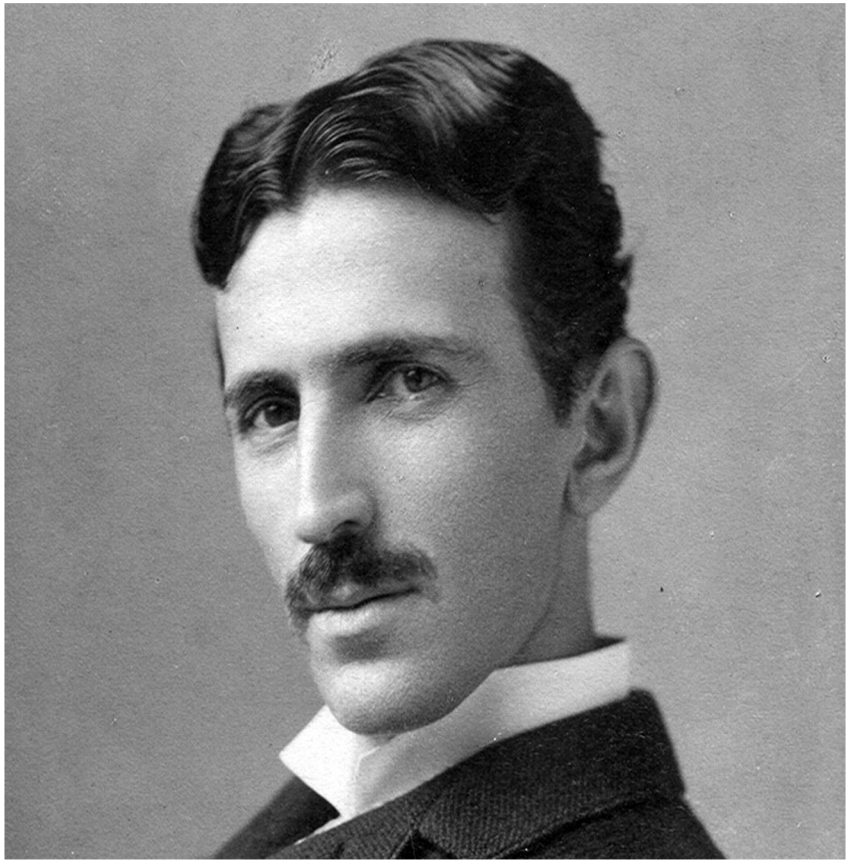
- In 1854, Benjamin Silliman (Yale University, New Haven) was the first to fractionate petroleum by distillation.
  These discoveries rapidly spread around the world.

- Engineering achievements of the revolution ranged from electrification to developments in materials science.
- The advancements made a great contribution to the quality of life.
- In the latter part of the Second Revolution, Thomas Alva Edison invented many devices which influenced life around the world. He also created the first industrial research laboratory.
- Similarly Nikola Tesla made many contribution in the field of electricity and magnetism.

Thomas Alva Edison



Nicolo Tesla



Summary of Progress of IR

Phase I:1780-1850-Britain was centered on **textiles and iron production**

- GBR's American colonies had shipbuilding and iron production industries
- Some German states began to industrialize their metal working
- IR in France was stalled by French Revolution
- Belgium-first continental country to industrialize

Phase II:1840-70: Belgium, Germany, Switzerland & USA

- Centered on **chemicals, heavy engineering and steel production** aided by the Bessemer process.
- Germany-industrialization accelerated after its Unification in 1871.
- European industrialization made possible due to technology and a workforce freed from Serfdom.
- USA-skilled immigrants made industrialization possible.

Phase III:1890's onwards-Russia, Sweden, France, Italy and Japan

- Centered on the application of industrial processes to chemical and electrical engineering, car manufacture and increasingly armaments.

Factors responsible for the Industrial Revolution in Britain

1. Agricultural Revolution had first taken place in GBR. It helped Britain in many a way:

a. It generated agricultural surplus which in its turn provided the required capital for industrial progress.

b. It provided raw-materials.

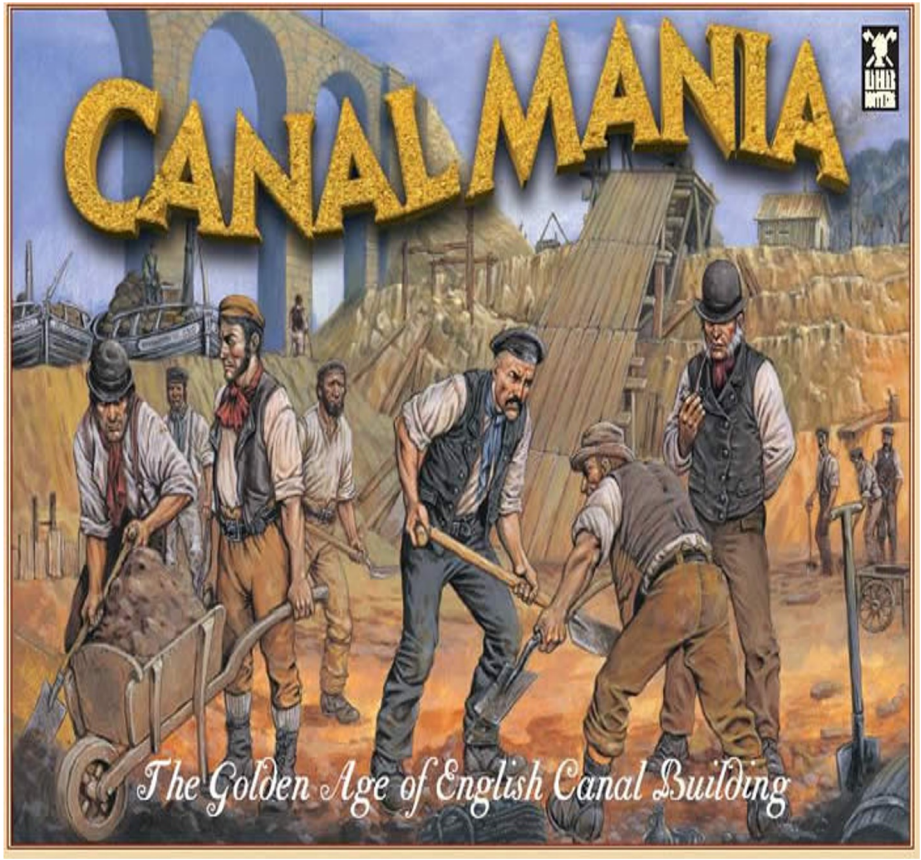
c. It released excess labour force from the rural areas and also created a demand for industrial goods.

2. England had an empire where Sun never sets. Thus, the colonies not only supplied the raw materials to the industries but also served the purpose of markets.
3. In England coal was found in abundance in juxtaposition with iron.
4. Britain enjoyed a labor force that was mobile and skilled
5. Likewise the Scottish Primary Education System created a literate labour force and hence it became easier to teach industrial skills to literate laborers than to illiterate ones.

6. England also developed by this time adequate transportation facilities. England witnessed a veritable mania of canal and road making. England was criss-crossed with canals that could be used for transportation. During this period England experienced a new system of road making (Thomas Telford & John McAdam)

7.The English church got itself separated from the Roman Catholic Church. In England the church lands were confiscated and thus 1/4th of the national resources were brought into productive use.

Canal Mania (1790's-1810's)



‘Macadam Road’ of John Loudon McAdam

8. In England special recognition was given to the material advancement. The English did not look down upon the 'New Rich'. In fact the rising middle classes were absorbed in the higher social classes. Thus, the reward for material advancement was greater in England than elsewhere.

9. The agricultural surplus and the surplus wealth of England were not in the possession of the feudal lords, who normally spend it for conspicuous consumption, but in the hands of those who were interested in investing it for further productive exercises.

10. The Bank of England (1694) provided ready money for economic and industrial developments at a nominal rate of interest.
11. The IR provided England with money for her wars against Revolutionary France and Napoleon. As a matter of fact these wars gave a further fillip to the English Industrial Revolution and encouraged greater production. Thus it is said:

"Napoleon's career enabled the Industrial Revolution to go forward in England and the Industrial Revolution enabled England to overthrow Napoleon".

12. England had been politically stable since the 17th century, with England, Wales and Scotland unified under a monarchy. This meant that the kingdom had common laws, a single currency and a market that was not fragmented by local authorities levying taxes on goods that passed through their area, thus increasing their price.

13. By the end of the 17th 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.

14. In the 18th century, England had been through a major economic change later described as the 'agricultural revolution'. This was the process by which landlords bought up small farms near their properties and enclosed the village common lands, thus creating very large estates and increasing food production (**Enclosure Movement**).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.

❑Impact of the Industrial Revolution

The IR brought a series of changes in the method of manufacture, production and distribution and drastically affected the economic, social and political life of the people. It transformed an overwhelmingly agricultural society into an industrial society.

- **Economic impact**

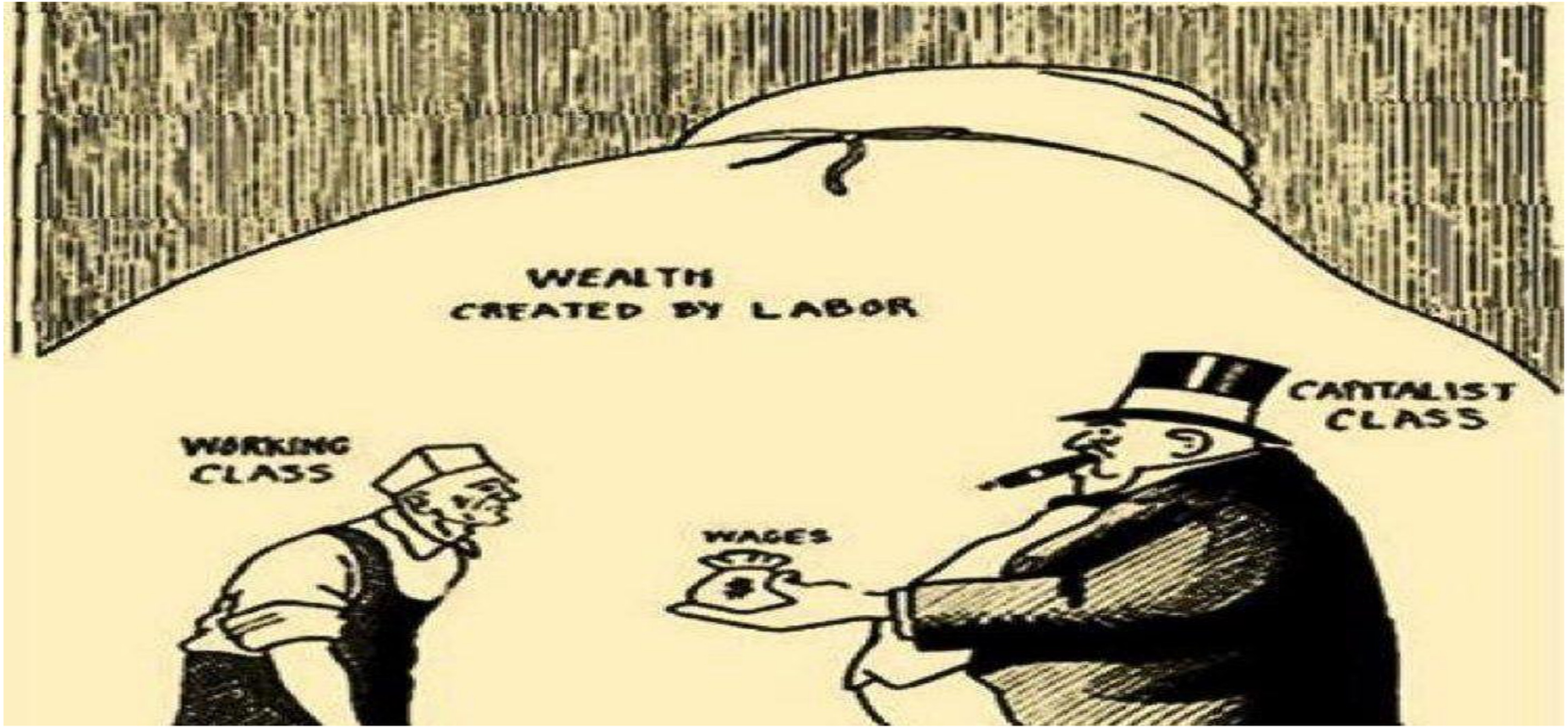
1. The Industrial Revolution paved the way for Factory System. A variety of articles and goods began to be manufactured in large quantities in big establishments which came to be called '**factories**'.
2. With the application of division of labour, the use of machines and the factory system man was able to produce goods on such a scale never even imagined before. This gave tremendous acceleration for the development of internal and international trade.

3. Another important impact is that concentration of machinery in large factories meant that investors who could mobilize large amounts of money for equipment came to own the means of production. This is one of the hallmarks of the Capitalist system. In fact, with IR **Industrial Capitalism** or what is known as Mature Capitalism was born.

4. The IR produced the Capitalist class and the Working class.

- The developments that occurred in the internal and international trade enabled the capitalist class to amass abnormal profits.
- The wages earned by the working class were not in tune with the profits secured by the capitalist class.Thus, IR paved the way for the unequal distribution of wealth.

Working class & Capitalist class



5. **Led to Economic Imperialism**

The third quarter of the 19th century witnessed certain changes.

i. U.S.A. Russia, Holland, Belgium, Germany, Italy and Japan were industrialized.

ii. Substantial advancements were made in the scientific and technological sectors.

iii. Productive capacity of the industries was increased by leaps and bounds.

- Thus, the industrial revolution reached its dazzling pinnacle. The resultant effect of it was that there occurred ruinous competition between the industrialized countries for raw-materials and markets. They tried to establish colonies, protectorates and spheres of influence. This '**Economic Imperialism**' not only created bad blood between the industrialized countries but also paved the way for the outbreak of the First World War.

6. IR led to International Economic Dependence.

- The textile industries of Britain depended upon the steady supply of raw cotton from the U.S.A. and India.As urbanization progressed in Britain and Europe, less food was grown in these countries which became heavy importers of wheat, meat and tropical food products from Asia, South-East-Asia, etc. Europe exported manufactured goods in exchange for food.

7. IR had its impact on agriculture also as some of the inventions included agricultural machines, mechanical ploughs, cultivators, drills, thresher, etc; which reduced the labour and time of the farmers who performed their work better.

8 Along with industry, banking, insurance, stock exchange markets and joint stock companies had grown up and the monetization of the economy was complete.

POLITICAL IMPACT:

1. In the political field, the industrial capitalist class did not tolerate much of the state's interference in economic affairs. They supported the policy of laissez faire. It implies two things; i.e; unfettered relations between the seller and the buyer and between employer and employee.
2. The Industrial Capitalists formed the very core of the middle class of Britain. They also championed the cause of the **Bill of Rights** with the right to property and liberty being given the highest importance. Though the capitalists needed the Central Government to see that the business agreements are

honoured,they tried to limit the powers of the state. The growth of democratic governments in West European countries and particularly in England can be seen in this light.

3. As a result of the IR,the military superiority of a country became dependent upon the extent of the industrialization in that country. Industrialized countries could alone produce modern military weapons. For example the Northern states succeeded in the American Civil War (1861 - 65) because they were more industrialized than the Southern states.

Impact on Society

Industrial Revolution also brought changes in society.

1. The feudal social relationship gave way to new social relationships under industrial capitalism. Nobility lost its importance.IR witnessed the birth of the Industrial capitalist class and the working class.
2. The vast majority of the people became wage earners and had to be on the move in search of work. They also had to live in the city as lumpens. Some of the people who could not adjust to the change and could not learn the new trades became destitute.

3. The commonality of the villages was broken and men became rootless. Moreover, in spite of the reduction in working hours man was now subject to the rigorous discipline of factory or office. Thus, a price had to be paid for the progress in material advancement under industrialization.

- However, many of these drawbacks have been overcome in western societies with the growth of trade unionism and welfare statism. States passed laws regulating the work in the industries and in general regulating the labour relations.

4. IR also encouraged scientific investigation.

- The necessity of experts was felt as manufacturing techniques became more and more complex.
- The profession of engineers became an integral part of industrial society.

❑ Nonetheless, one aspect of industrialization that the world has not yet overcome is the pollution problem and the rapid depletion of non-renewable environmental resources. This is the major problem that the world is facing today.

Thus, the IR or technological revolution leading to the factory system brought in its train both good and ill effects.

- The **Socialist Movement** was an attempt to remove the ill effects of the concentration of wealth while retaining the benefits of industrialization. Thus, efforts are still being made to remove the ill effects of the IR.

- The concept of **Mixed Economy** and **Democratic Socialism** are efforts in that direction.

❑ Impact of IR on Europe

1. **Other European countries became industrialized**:

   Belgium, France, Germany, Austria-Hungary, Italy, Russia, USA and the British dominions

2. **Further increase in population of Europe**

- 1750-140 m ,1914-463 m

a) Increased food, clothing, shelter, other necessities of life

b) Famines (to a large extent) became a thing of the past

c) Advances in medical science and public health-vaccination, isolation of patients with infectious diseases,

safeguarding food and water supplies, knowledge of antiseptics etc reduced the death rate.

3. **Increased Urbanization** (1930-1/5th of world's population)

- River valley and floodplains
- Life became city centered

a. Pure water

b. Perfection of centralized sewerage and waste disposal systems

c. Assured supply of food and

d. Prevention of contagious diseases

4.**Exploitation and social disruption**

a) Tenant farmers dispossessed

b) Weavers and craftsmen wiped out

c) People-destitute

d) Women and children

5) General prosperity absorbed at the top

- England:1911-13: 4.93% - 60% wealth
- Middle classes-better housing, food, education
- Poor-crowded tenements, monotonous diets

❑Impact of IR on the non-European World

1. **Political domination of Asia & Africa**

- Prior to 1763-few footholds in Asia & Africa
- Post-1870- '**New Imperialism**'
- Colonies-investment outlets, sources of raw materials & markets

2. **Mass migrations**

i. Sharp increase in population

ii. Availability of transport & communication-Railways,steamships etc

- 1763-emigrations to Americas & British Dominions

- GBR → USA, British Dominions
- Italy → USA, Latin America
- Germans → USA, Argentina, Brazil
- Spain & Portugal → Latin America

'Europeanization of the New World'

3. Political control over 'uncivilized' parts of the earth
   - Raw materials-jute, cotton, rubber, various metals, etc.
   - Domination of the globe by one part of the world

Safeguarding of European investments through:

i. Military missions-trained local armed forces

ii. Financial missions-supervised and controlled local finances

iii. Extra-territorial and capitulatory arrangements-special privileges to Europeans residing/doing business

- **Revised date for IR:1850-1914** (Not 1780-1820's)
- 1760's-1815:Industrialize & fight wars
- From 1760:36/60 years engaged in wars

i. Resumption of trade with North America (after American War of Independence)

ii. After Napoleonic wars (post-1820)-production picked up drastically