

THE INDUSTRIAL REVOLUTION

Begins in Britain in the 1780s

- Contributing Factors
 1. Expanding farmland-
 1. Good weather-better transportation-new crops
 - Led to more food at lower prices
 - With less labor
 - Giving ordinary citizens extra money to buy manufactured goods (as apposed to always making their own)
 2. More food = More Population
 - This provided more workers for the emerging factories
 3. Many Brits had Capital to invest
 - Many rich Entrepreneurs invested in new Technology and experimented in new ways to turn a profit

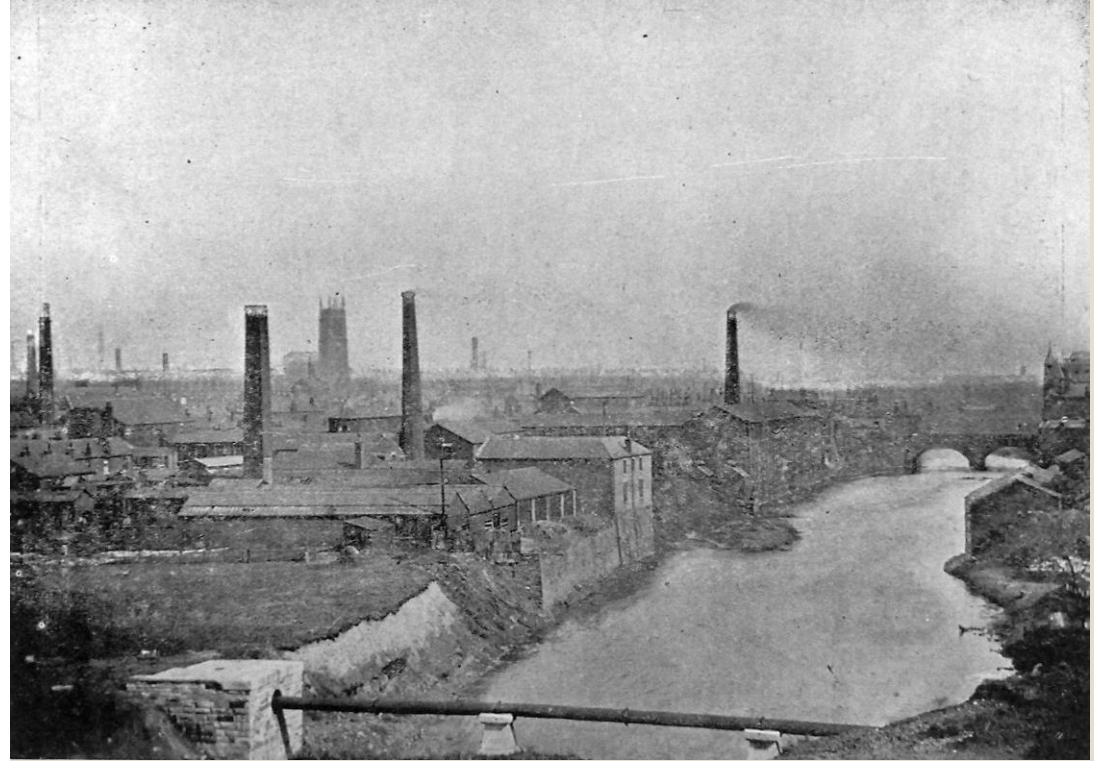


4. Natural resources were abundant

- Rivers run through the country for water power and goods transport
- Abundant supplies of coal and iron ore
 - (both become essential in manufacturing)

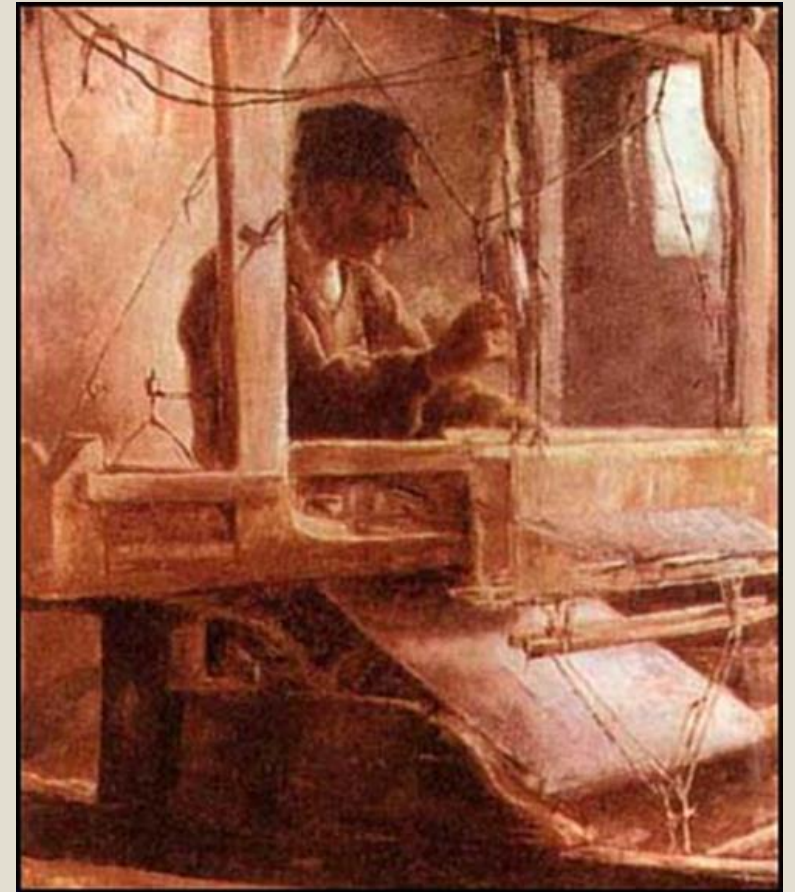
5. Markets to sell to

- Britain had a vast colonial empire to ship to
 - India, the Americas, East Indies, China, Africa, etc. etc.
- They had the ships to back up the production as well,
 - England dominated the oceans



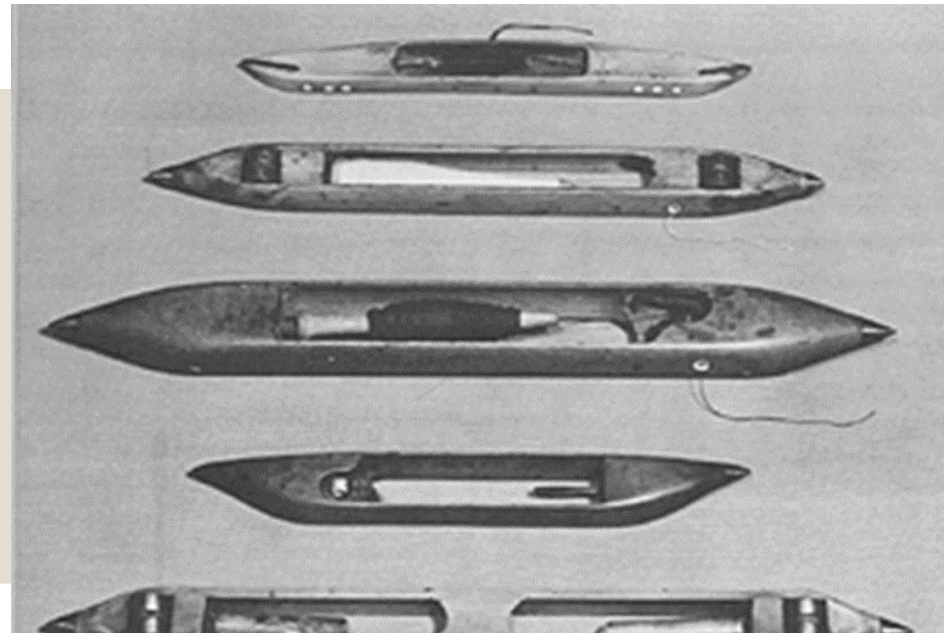
The original form of manufacturing

- Cottage Industry
 - Someone grows the cotton or wool
 - Someone else makes it into thread
 - Someone else makes it into cloth
 - All done in individual homes



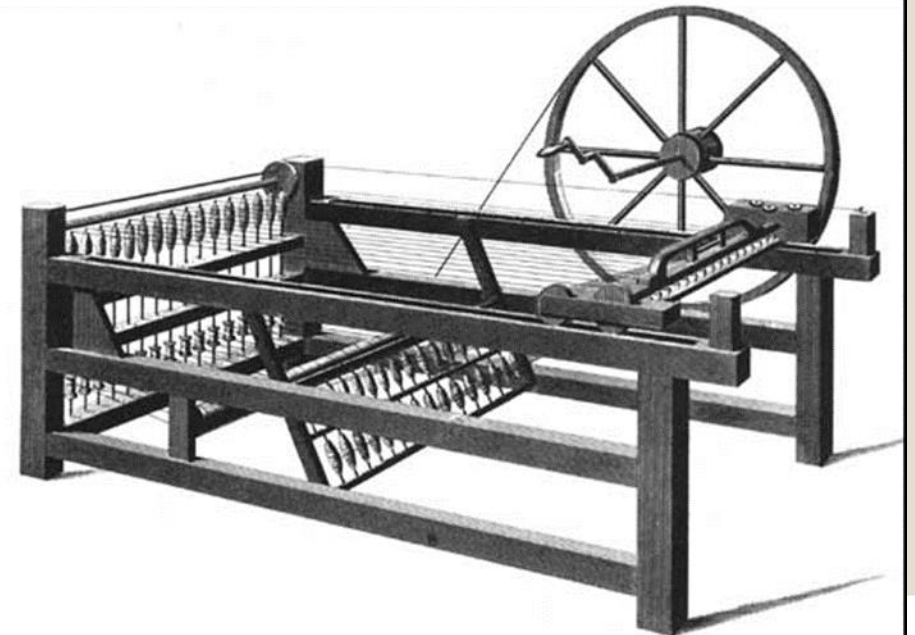
New Manufacturing

- Industrial improvements made the Cottage Industry inefficient
 - Inventions like the "Flying Shuttle" allowed weavers to weave faster, therefore more thread was needed.



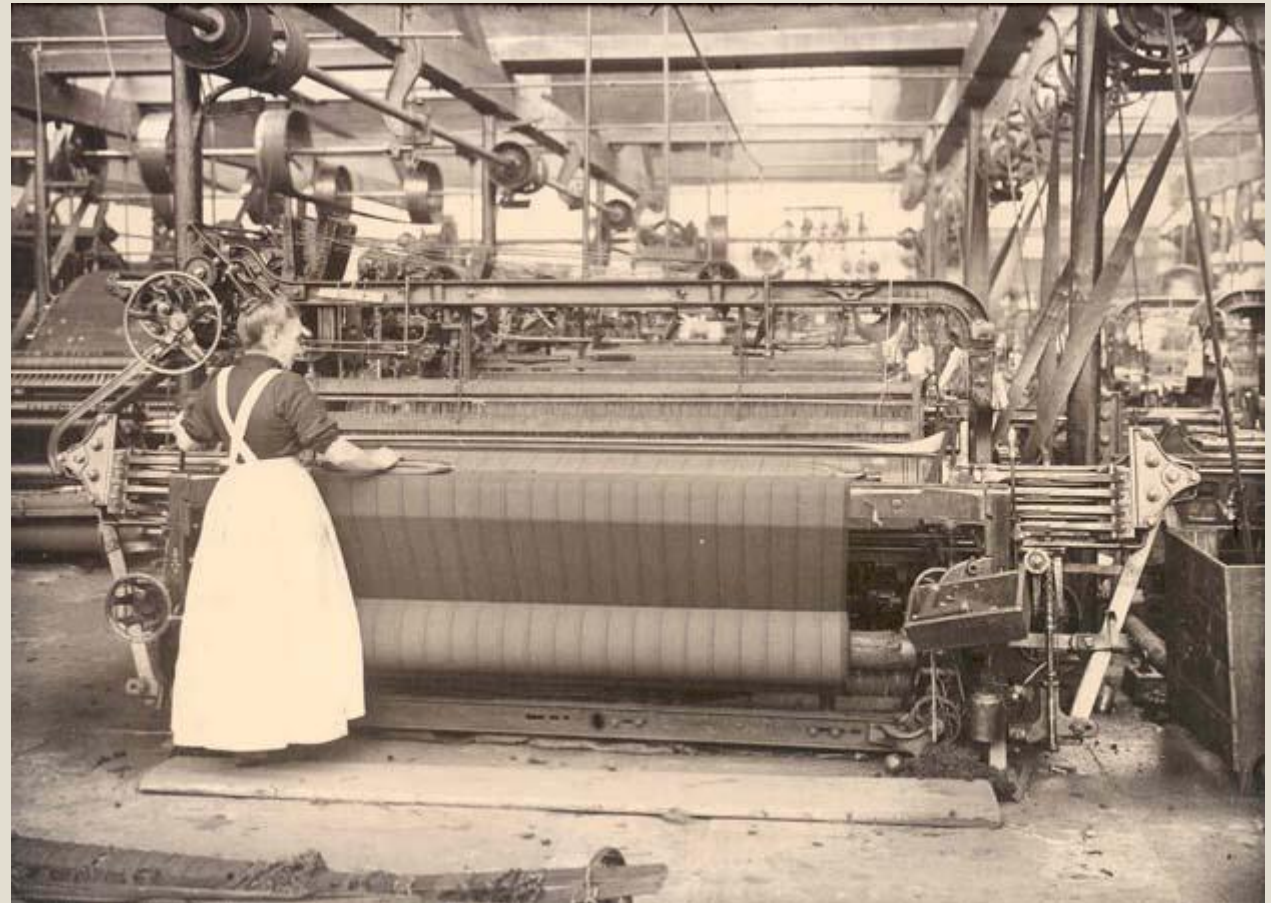
The “Spinning Jenny”

- Invented by James Hargreaves
- 1768
- Made to compensate for the new weaving looms, but was so efficient thread now out produced Cloth
- Spinning Wheel = 1 spool of Thread made
- Original Spinning Jenny = 8 spools
- Later models = 80 spools

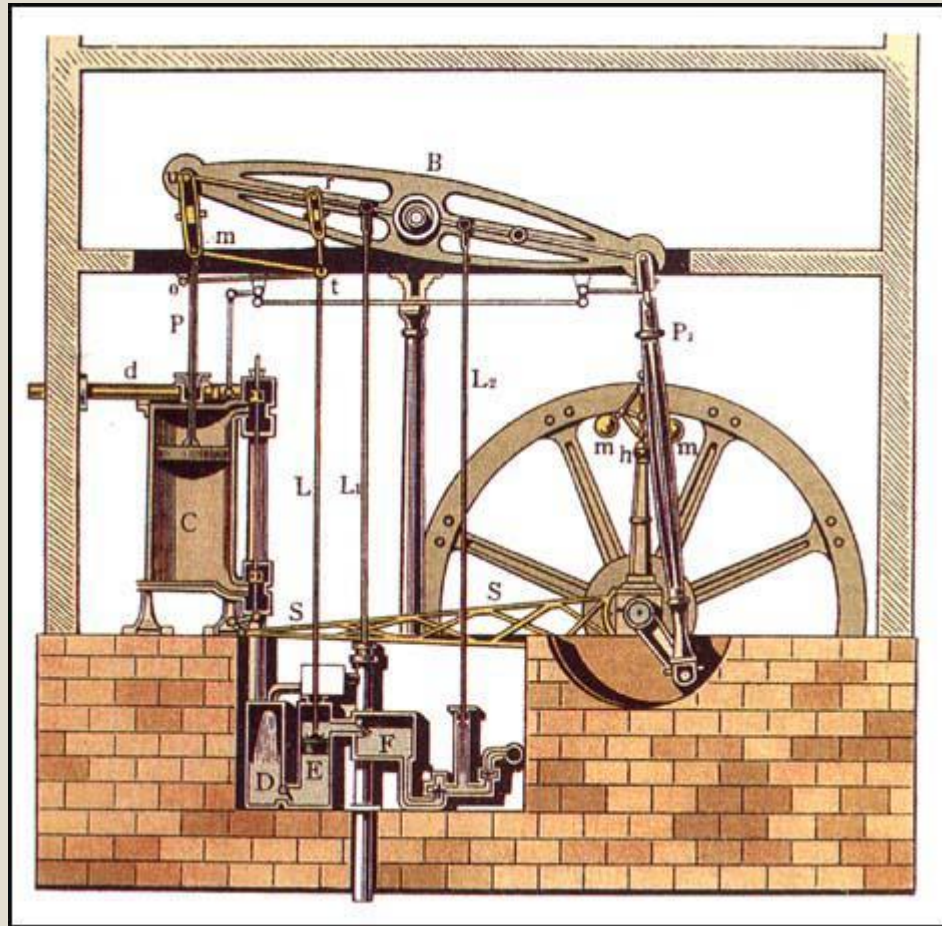


1787 Edmund Cartwright invents the water powered loom

- Intended to catch cloth production back up to thread
- Also made it cheaper to relocate labor instead of machines
 - Move people to factories instead of building machines near pre-existing populations



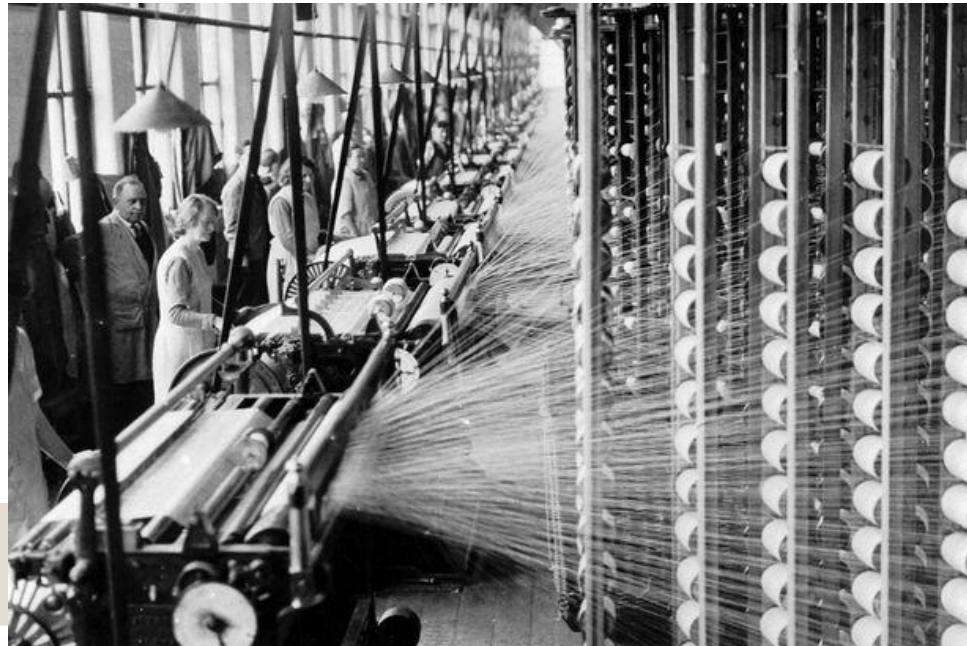
Improvements to the steam engine



- James Watt, a Scottish engineer, made improvements to steam power through 1760s
- In 1782 he found a way to enable the engine to drive machinery
 - Could now be used to spin and weave cotton
 - Also, run by coal, these machines reduced the need for a water source

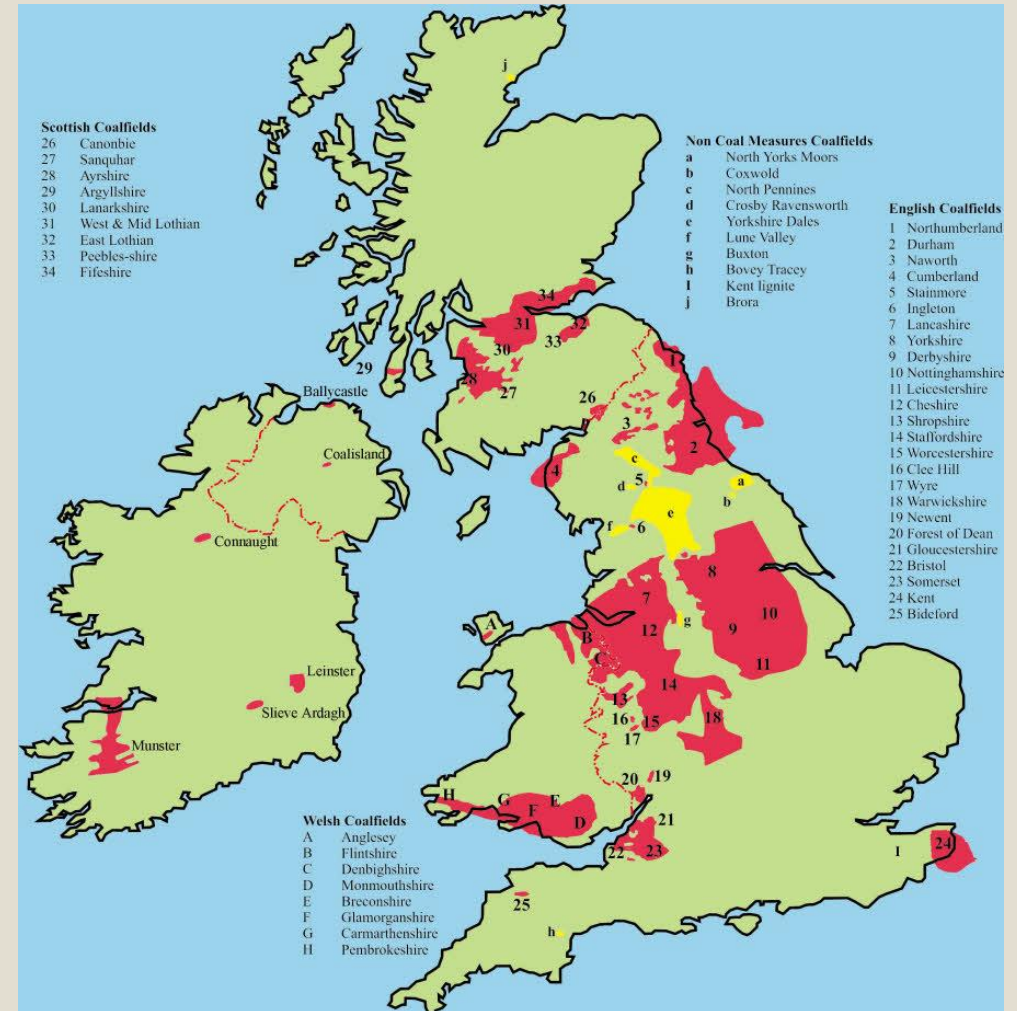
Imports and exports

- 1760 2.5 million pounds of cotton imported to Britain
 - By 1787 22 million pounds were imported to be spun by machines
 - By 1840 366 million pounds were imported
- Cotton cloth became Britain's most valuable export



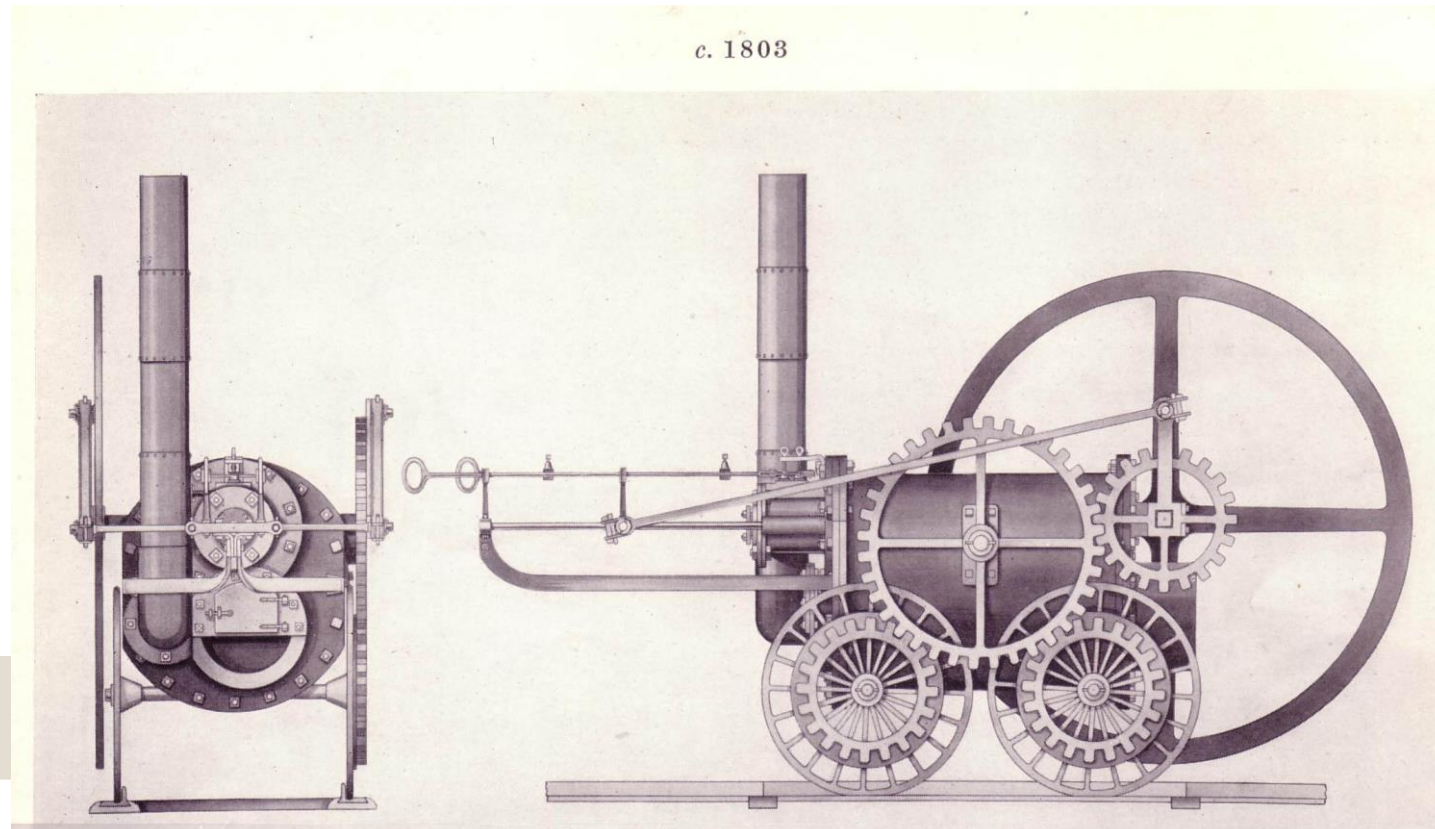
Further consequences of the steam engine

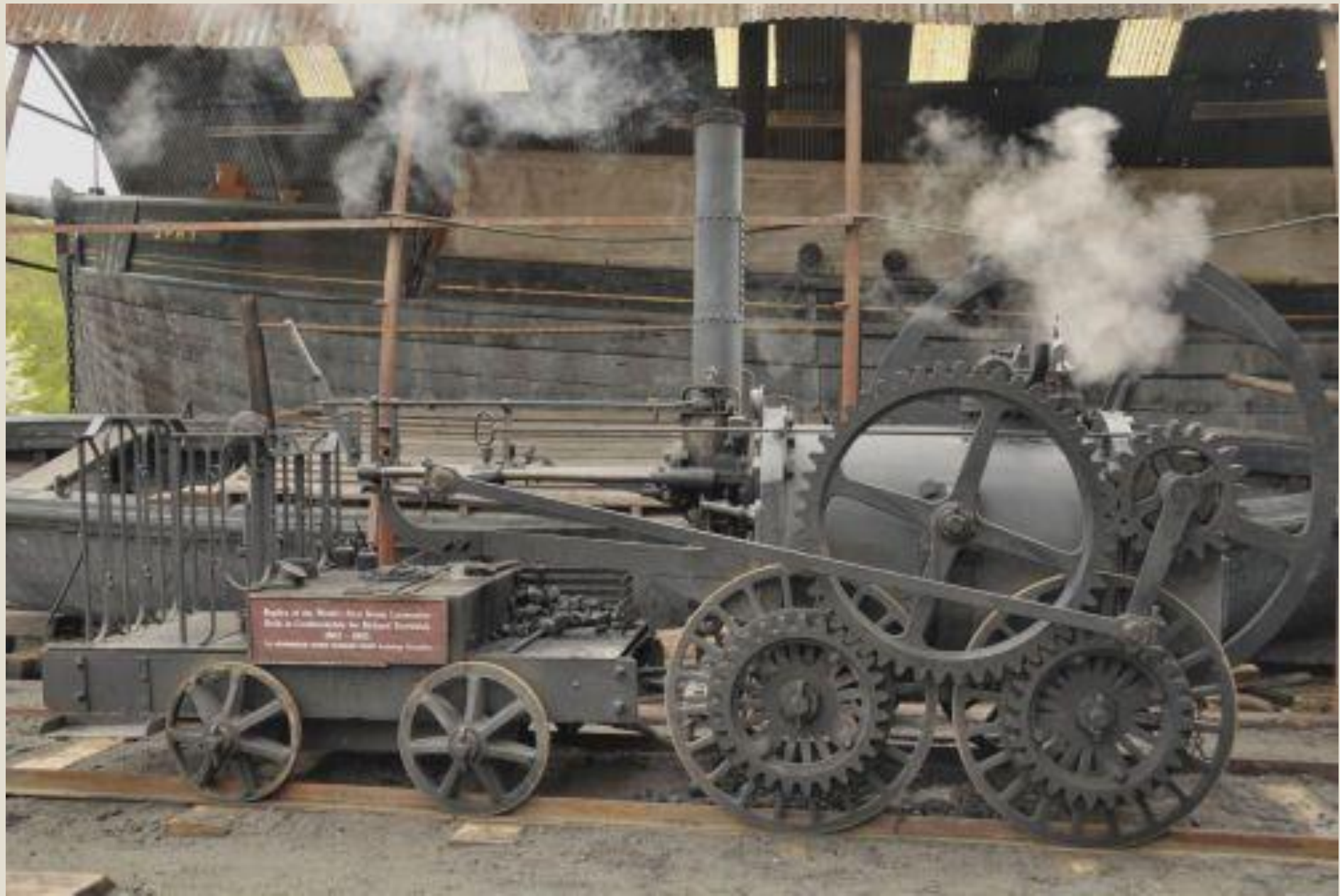
- Industries were interconnected
- Steam engines needed coal
 - England had coal but needed to transport it
- Improvements to coal processing also transformed iron industry
 - By 1852 Britain was producing more iron than the rest of the world combined



Railroads

- Richard Trevithick built the first steam locomotive
 - By 1804 it provided a way of moving industrial goods
 - Pulled 10 tons of ore and 70 people at 5 miles per hour



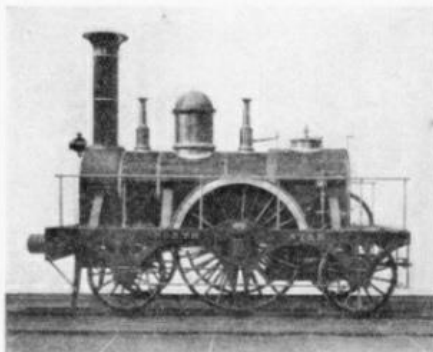


Model of the Steam Traction Engine
Built in Cambridge by Robert Farnham
1867 - 1870
by permission of the National Railway Museum

Improvements soon followed

- Invention of flanged wheels allowed trains to run on top of rails instead of on sunken tracks
- 1829 *The Rocket* changed what was thought possible
 - Designed to connect manufacturing town of Manchester with the port town of Liverpool (32 miles)
 - *The Rocket* could pull 40 tons at 16 mph
- Within 20 years trains could reach 50 mph and England contained over 6,000 miles of train tracks

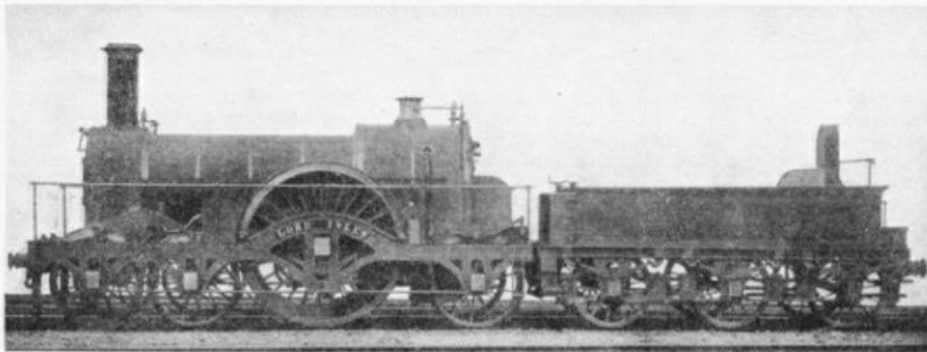
LOCOMOTIVE EVOLUTION ON THE GREAT WESTERN RAILWAY



The "NORTH STAR," shown in the top picture, was built in 1837. There were two cylinders 16 in. diameter with a stroke of 16 in., supplied with steam at a pressure of only 50 lb. per sq. in. The driving wheels were 7 ft. diameter.

The "LORD OF THE ISLES," built in 1851, is illustrated below. This engine had two cylinders 18 in. by 24 in., with 8 ft. driving wheels and a boiler pressure of 140 lb. per sq. in.

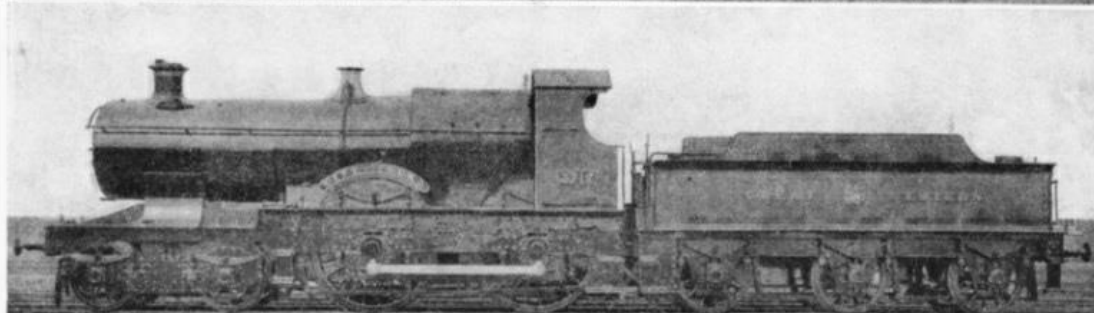
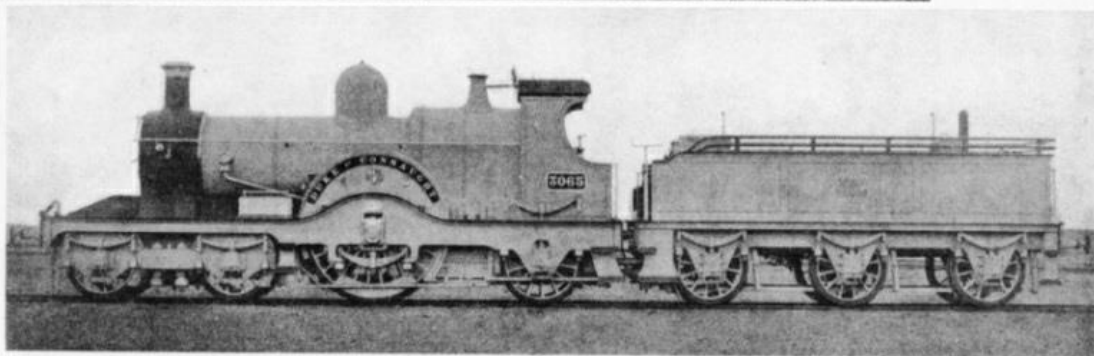
The "DUKE OF CONNAUGHT," in the next photograph, is a fine example of the famous G.W.R. "Single Wheelers." Engines of this class, built in 1891-7, had cylinders 19 in. by 24 in., with 7 ft. 8 in. driving wheels, the boiler pressure being 160 lb. per sq. in. In May, 1904, this locomotive broke all railway records to that date by hauling a mail train the 77½ miles of track from Swindon to London in 59 min. 41 sec.



The "CITY OF TRURO," a locomotive of the "City" class shown at the foot of the page, was built in 1903, and the following year is stated to have attained the highest steam locomotive speed in railway history. The "Cities" were built with cylinders 18 in. by 26 in., 6 ft. 8½ in. driving wheels, the boiler pressure being increased to 165 lb. per sq. in.

This engine is now preserved in the Railway Museum at York.

Photos, Great Western Railway



- Building railroads itself created more jobs
- Cheaper transportation led to lower cost of manufacturing
- Also created larger markets
 - Different types of people, locations to sell to
- Business owners reinvested their profits into new equipment
- Becomes part of the Industrial Economy



Creation of new social classes

- The **Industrial Middle Class**
 - Made up of people who built factories, bought machines, developed markets
 - Term bourgeois expanded to include these new titans of industry and banking.
 - Often associated with qualities of innovation, vision, ambition and greed



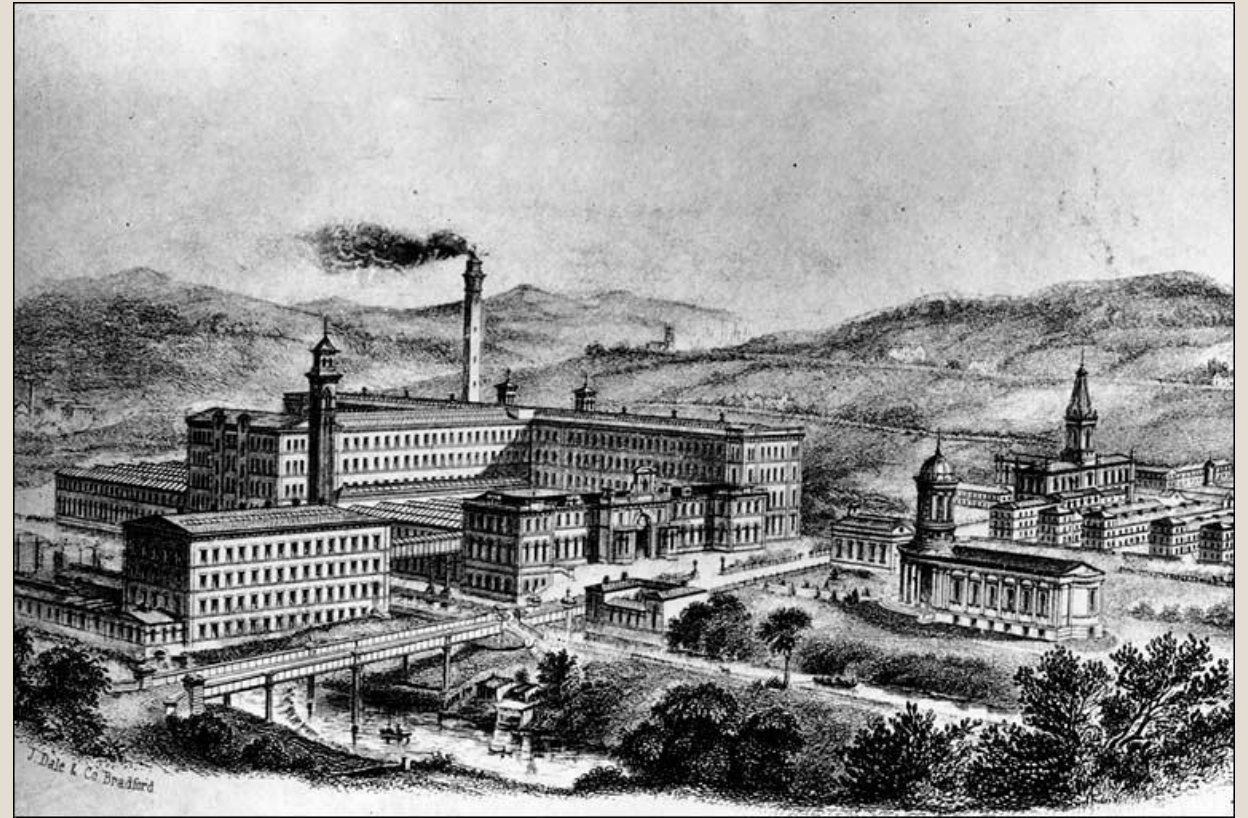


- **Industrial Working Class**

- Employment turned outside the home
- Entire families had to find employment to keep themselves afloat
- Employed by others, often with very little mobility

Factory Life

- Owners wanted their machines in constant use
 - Resulted in shift work
- Early workers came from rural areas
 - Traditionally work had followed cycles of intense activity followed by inactivity
 - Had to be disciplined into a system of regular hours and repetitive tasks
 - “make the men into machines that could not err”



Age Distribution in Cotton Factories

Age Group	Starting Age Percent	Current Age Percent
Under 10	49.9	3.9
10-13	27.9	25.3
14-17	10.3	22.1
18-20	4.1	11.8
21 & Over	7.8	36.9

Table 1: Age Distribution in cotton factories in Manchester and Stockport 1818-1819. [Source: BPP (1818) and BPP (1819)]



- Discipline for children was especially harsh
- “Provided a child should be drowsy the overlooker walks round the room...in the corner of the room there is an iron cistern; it is filled with water; he takes this boy, and takes him up by the legs, and dips him over the head of the cistern and sends him to work for the rest of the day.”
- Beatings and whippings were also used











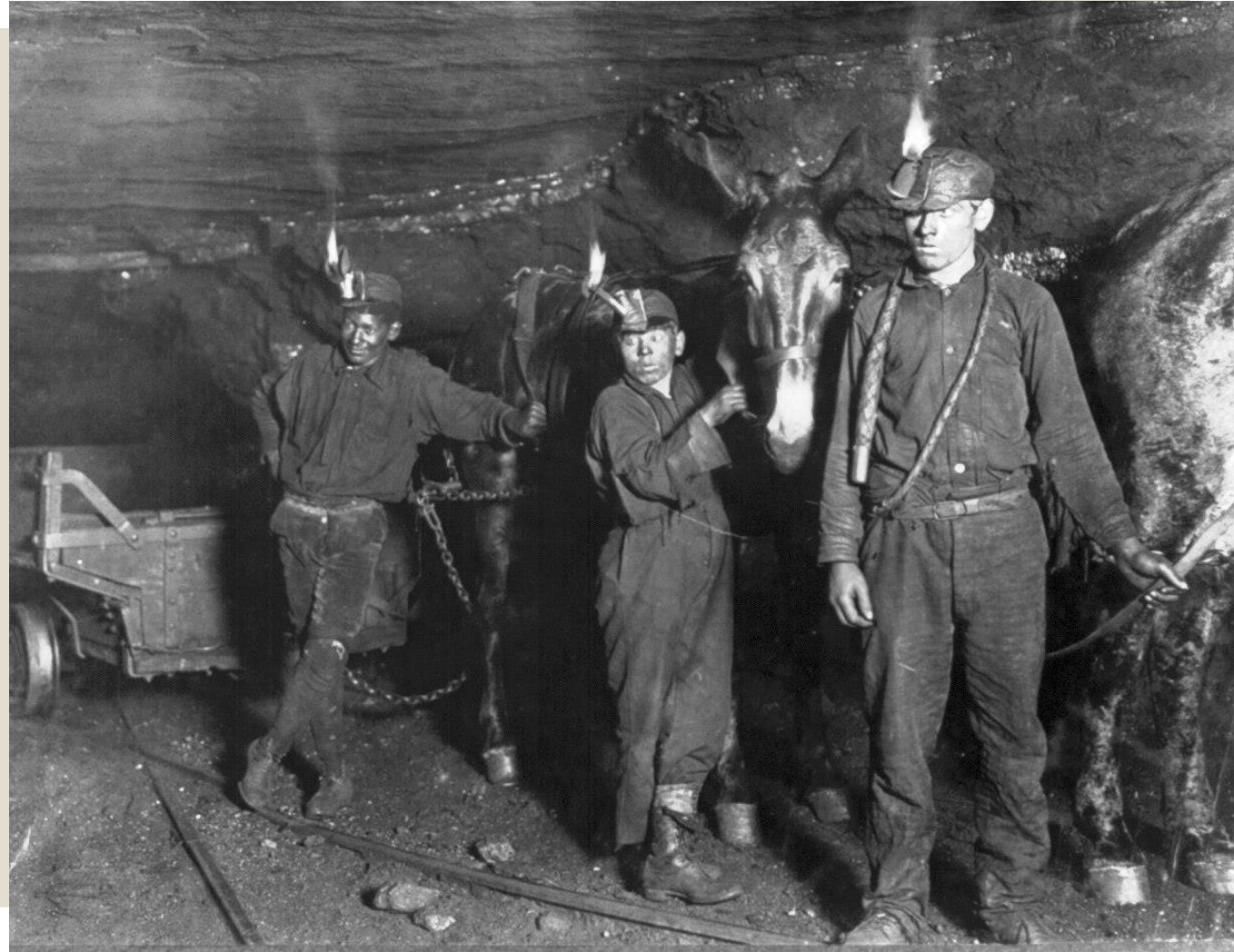


- Work shifts ranged from 12-16 hours, six days a week
- No security of employment, no minimum wage
- Cotton mills had the worst conditions
 - Temperature could rise as high as 84 degrees inside the factories
 - Dirty, dusty, dangerous conditions
 - Fingers and limbs were frequently lost

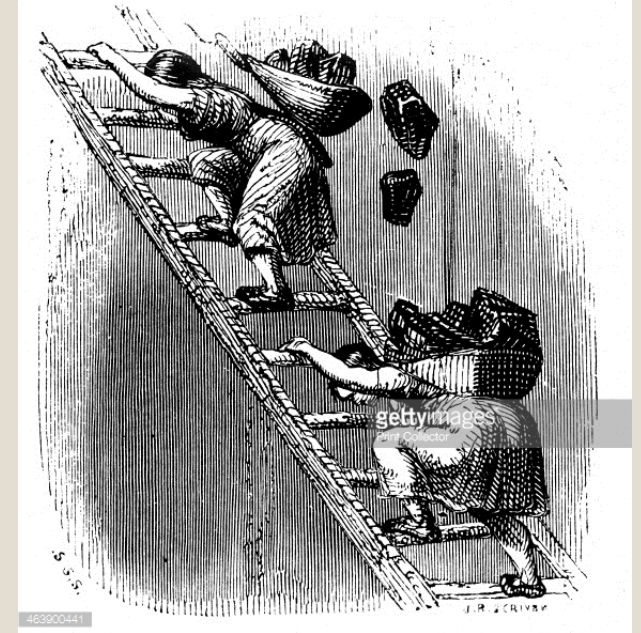


Coal mines were another difficult environment

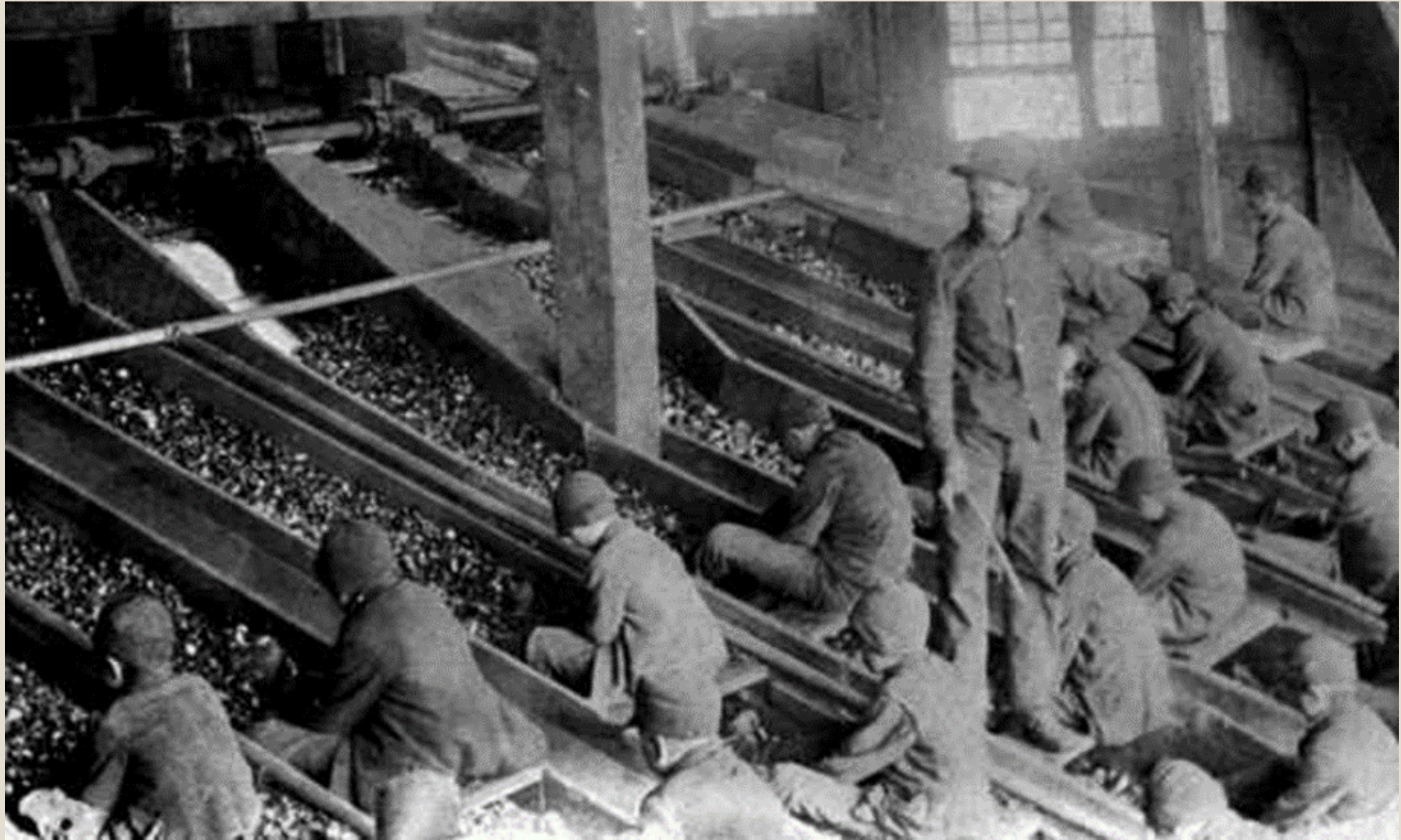
- Coal production in England
 - 1700 : 2.7 million tonnes
 - 1750 : 4.7 million tonnes
 - 1800 : 10 million tonnes
 - 1850 : 50 million tonnes
 - 1900 : 250 million tonnes



- Teams of women were employed to use a windlass to lift coal and workers.
 - Men refused to do such work.
- Children were also used to help remove and sort coal
- Dangerous working conditions
 - Cave-ins, explosions, gas fumes (“bad air”)
 - Cramped conditions led to led to deformed bodies and damaged lungs









Factory act of 1833

- Minimum age of employment set at 9 years old
- Set maximum shift times for age groups
 - From 9-13 8 hours
 - 13-18 12 hours
- Resulted in fewer children being employed
 - Women took their place, making up 50% of textile workforce
 - Paid half of men's wages

Rise of Socialism

- Society (usually the Government) owns, controls, regulates production
 - Ideally would allow for wealth to be equitably distributed
 - Early idealists wrote about everyone using their skills to the betterment of society as a whole
 - Marx would dub them “Utopian Socialists”



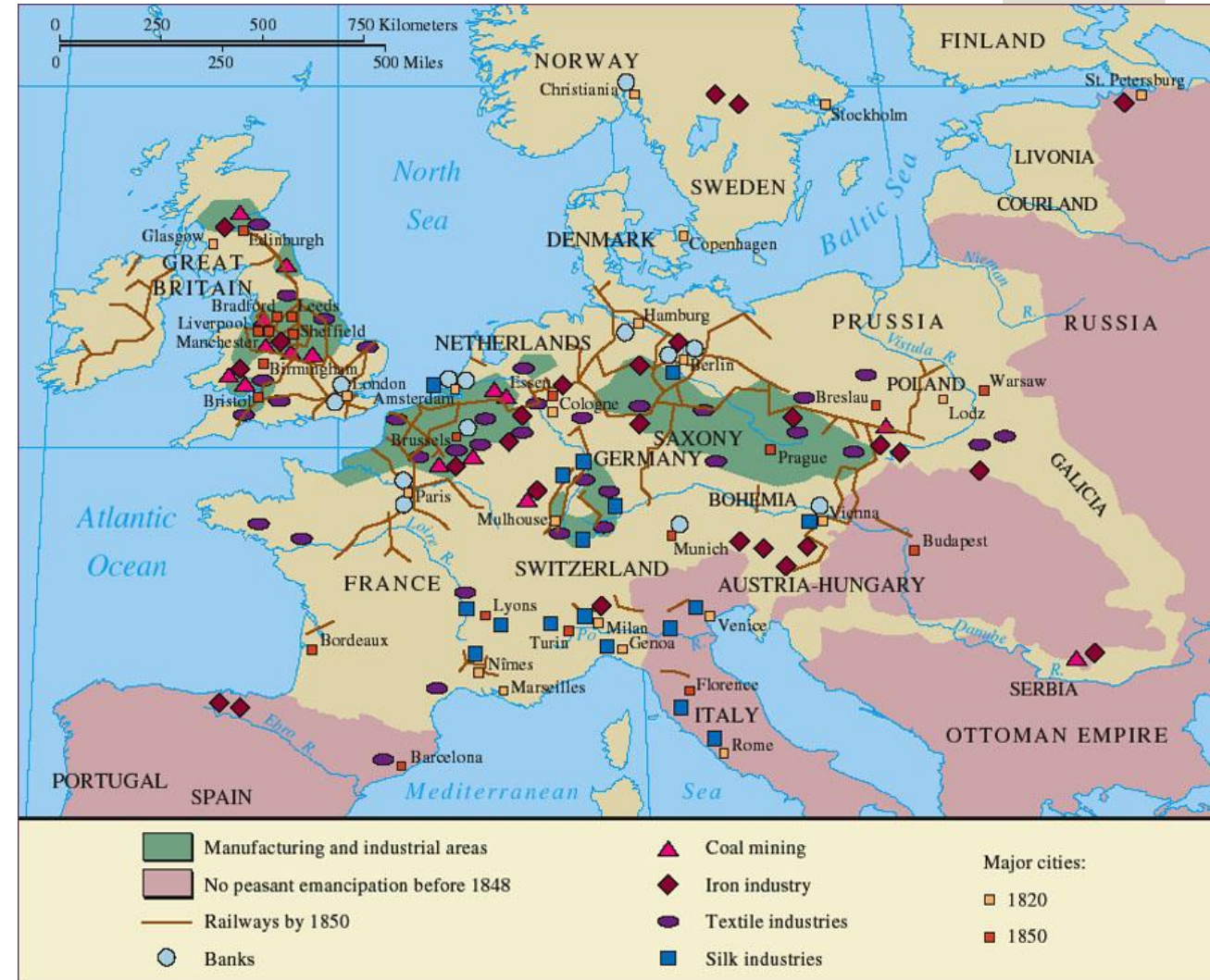
Robert Owen's Utopias



- Believed humans would show their best selves if they lived in cooperation
- Used considerable wealth to buy squalid factory towns
 - Turned New Lanark, Scotland into a flourishing community
 - But New Harmony, Indiana fell apart
 - Were some successes: established the first free library, a civic drama club, and a public school system open to men and women

The Spread of Industrialization

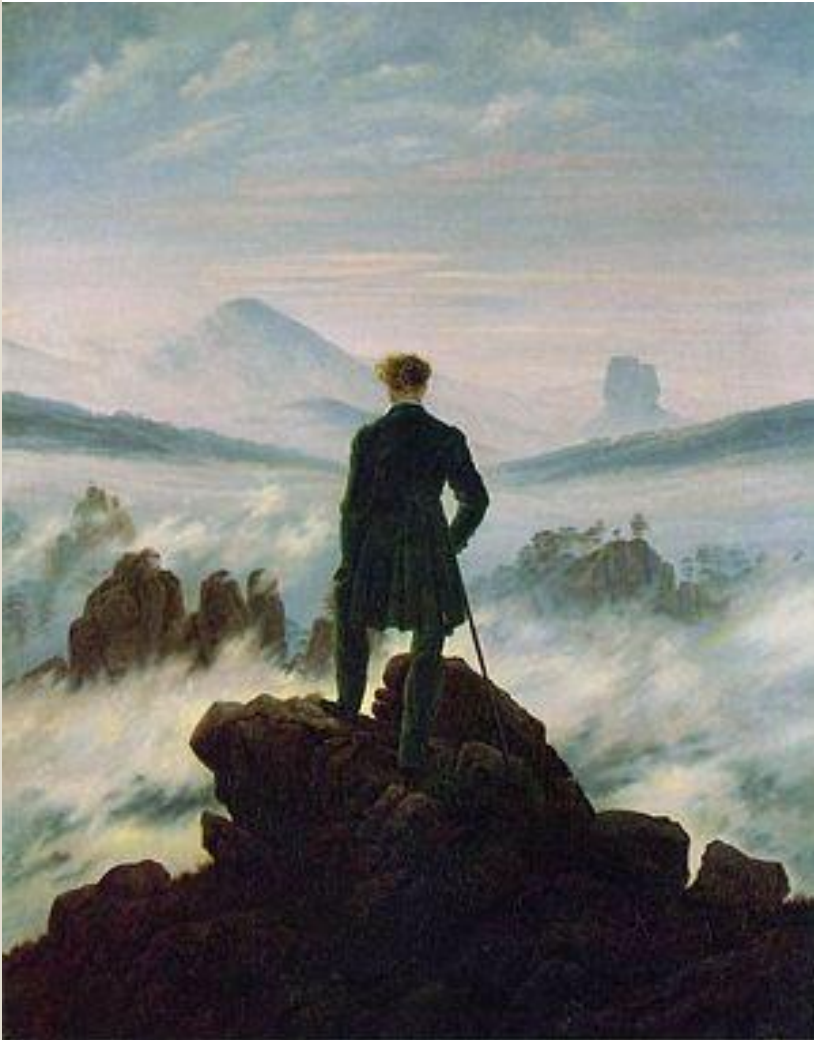
- By the 1850s Great Britain was the richest nation in the world
- Belgium, France, and Germany were the first industrialize on the continent
 - Government actively encouraged it, providing money for the rail systems, canals and roads
- Led to rail lines connecting all of Europe by 1850





ART IN THE INDUSTRIAL ERA

Romanticism



- Counteracted against the Enlightenment's obsession with Reason
 - Stresses feelings, emotions, imagination as sources of knowledge and understanding.
 - Can also be seen as a reaction against an increasingly mechanical world.
 - Believed in individualism, the uniqueness of each individual

Many rebelled against traditional values and customs

- Male romantics grew beards and long hair, both men and women wore outrageous clothing
- Formed early communes and new religions



- 1. Art was a reflection of an artists inner feelings, should reflect an artists vision of the world
- 2. Abandon classical reason for emotion and warmth





J. L. David



Eugene
Delacroix





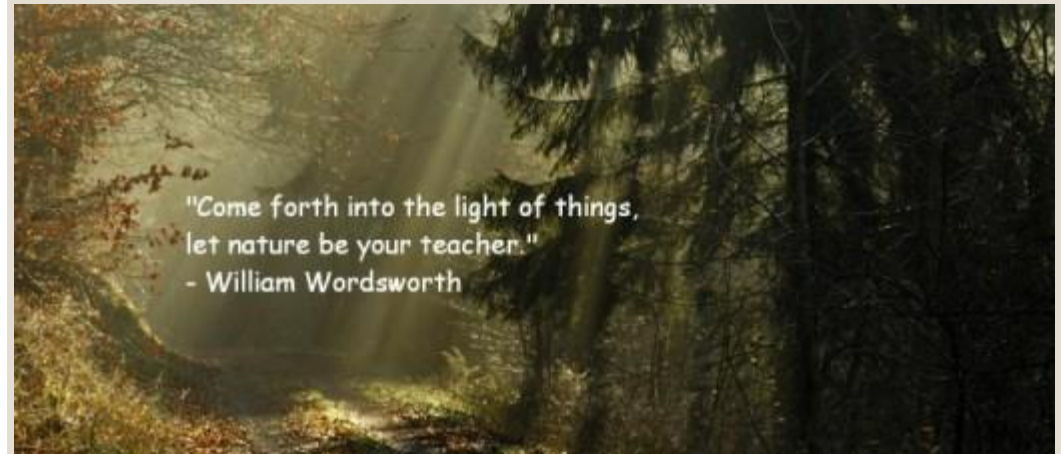


Literature

- Often reflected nationalistic themes
 - Romanticizing national pasts
- Gothic Literature created chilling, exotic atmospheres
 - Ex: *Frankenstein*, *Wuthering Heights*, Edger Allen Poe



- Poetry in particular was valued
 - Viewed as a direct expression of the soul
 - Gave expression to a love of nature
 - “One impulse from a vernal wood may teach you more of man, Of moral evil and of good, Than all the sages can.”
- Critical of 18th century science
 - Frankenstein: when science tries to conquer nature a monster is created



Realism

- Belief that the world should be viewed realistically
- Realists rejected Romantics
 - They wrote about realistic characters with real life situations
 - not romantic heroes in exotic settings





“I have never seen angels or goddesses, so I am not interested in painting either of them.”

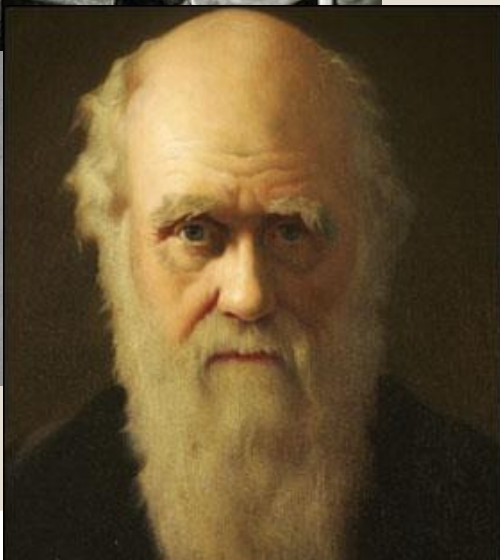
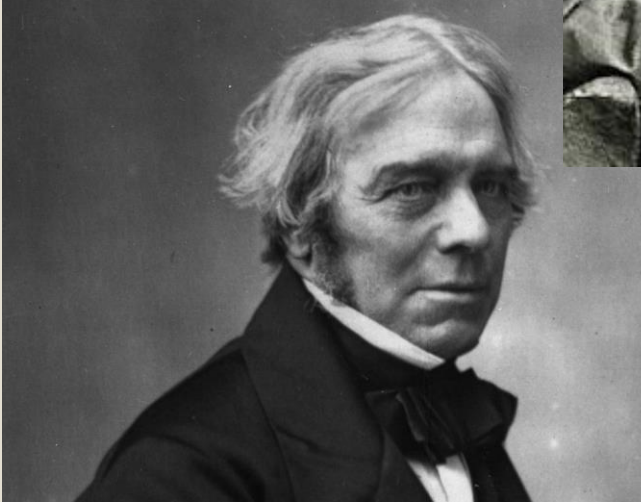
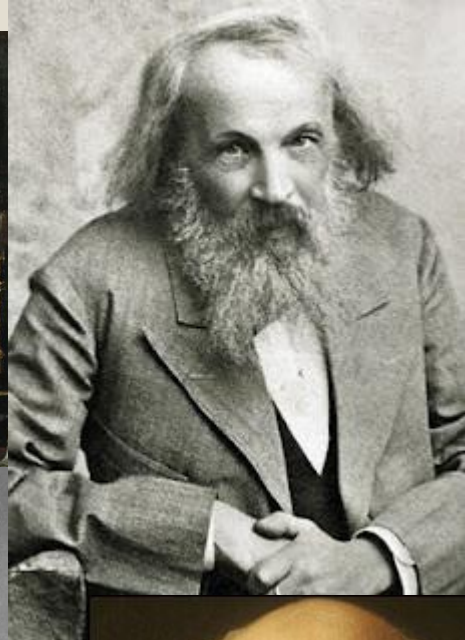
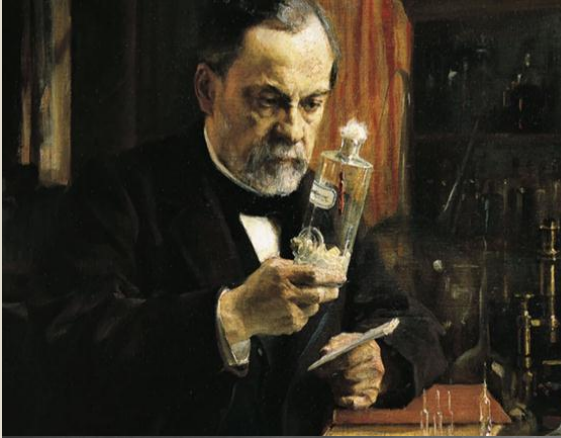
-Gustave Courbet

Realism and Literature

- Preferred novels to poems
 - Focusing on social views and problems
- Charles Dickens
 - *Oliver Twist*
 - *David Copperfield*
 - Focused on the lower and middle class of Britain's Industrial Age



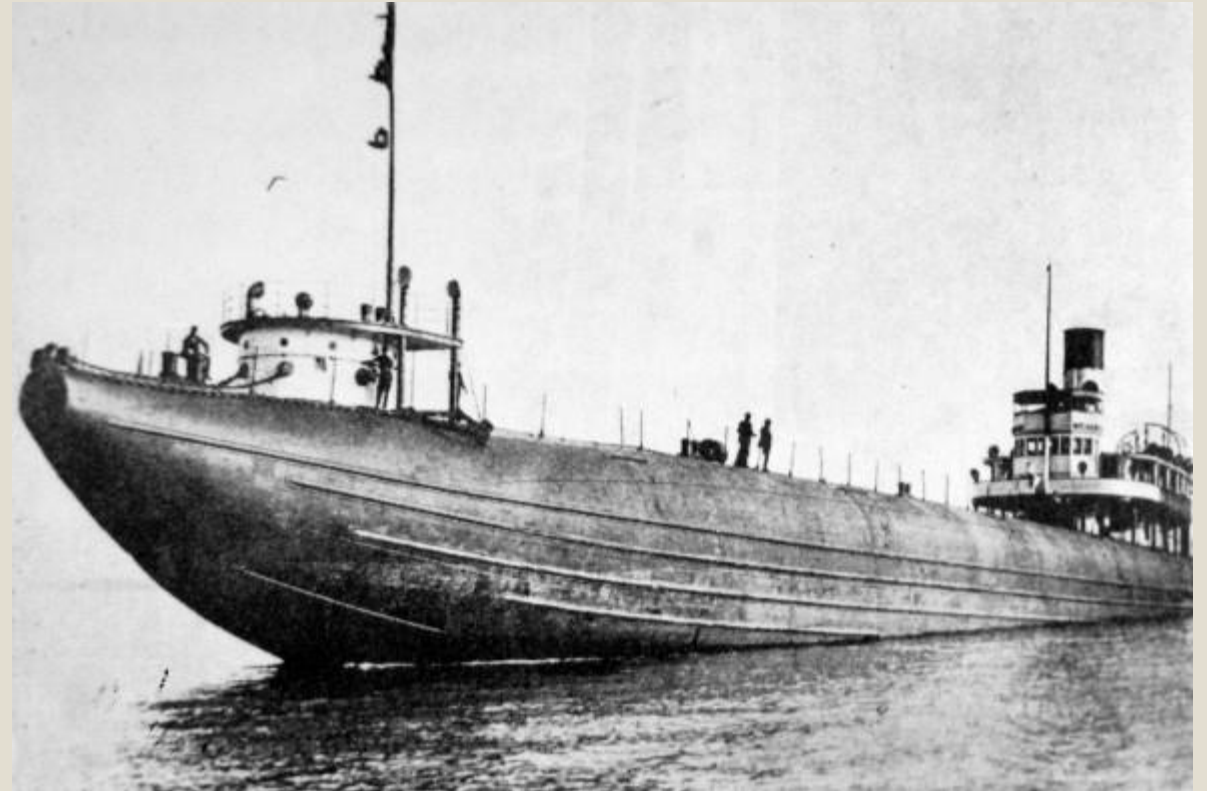
Realism was influenced by scientific innovations



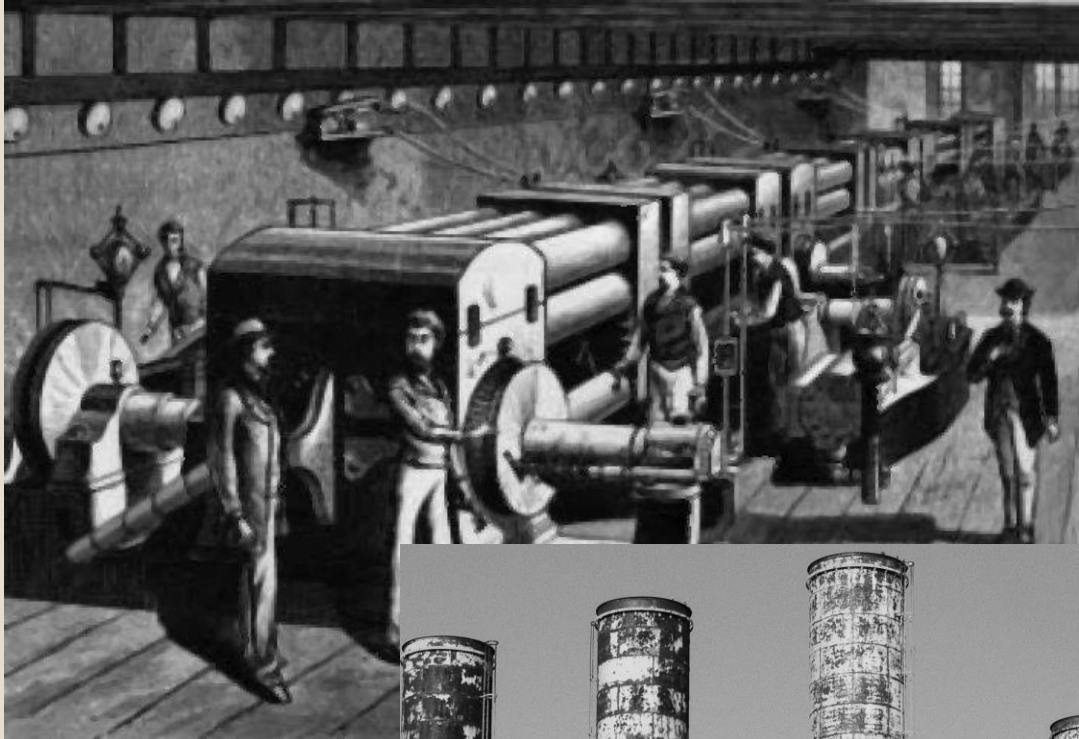
- Louis Pasteur
 - Germ Theory
 - Theorized that there were little life forms in everything that we can't see
 - Pushed for sterilization in hospitals, "pasteurization" of milk
- Dmitri Mendeleev
 - Classified the elements by Atomic Weight
- Michael Faraday
 - Primitive generator laying the foundation for use of electric current
- Charles Darwin
 - *On the Origin of Species by Means of Natural Selection*
 - *The Descent of Man* – this is the book that Darwin used to expand his theory that Man was not separate from his previous book on the evolution of animals

New Materials

- From 1870-1914 steel began to replace iron
 - Iron is malleable, and easily corroded
 - Steel is an alloy of iron combined with carbon and small amounts of other elements.
 - These elements can be changed and manipulated to alter the type of steel and address different needs



New Power



- 1870s
 - First practical generators went online
 - created easy/cheap source of heat, light, motion
- 1910
 - Hydroelectric power stations and coal fired steam-generating plants enabled homes and factories to be tied to a single power source
 - Thus, individual families no longer needing their own

The Rise of Electricity

- Thomas Edison (in the U.S.)
Joseph Swan (in Great Britain)
 - light bulb
- Alexander Graham Bell
 - 1876 – Telephone
- Guglielmo Marconi
 - 1901 – first radio waves across the Atlantic



By 1880

- Streetcars and Subways now powered by electricity
- Conveyer belts and cranes speed manufacturing
- Light bulbs allow for easy 24hr work shifts
- Internal Combustions engines are invented
- Powered ocean liners, airplanes, and eventually automobiles

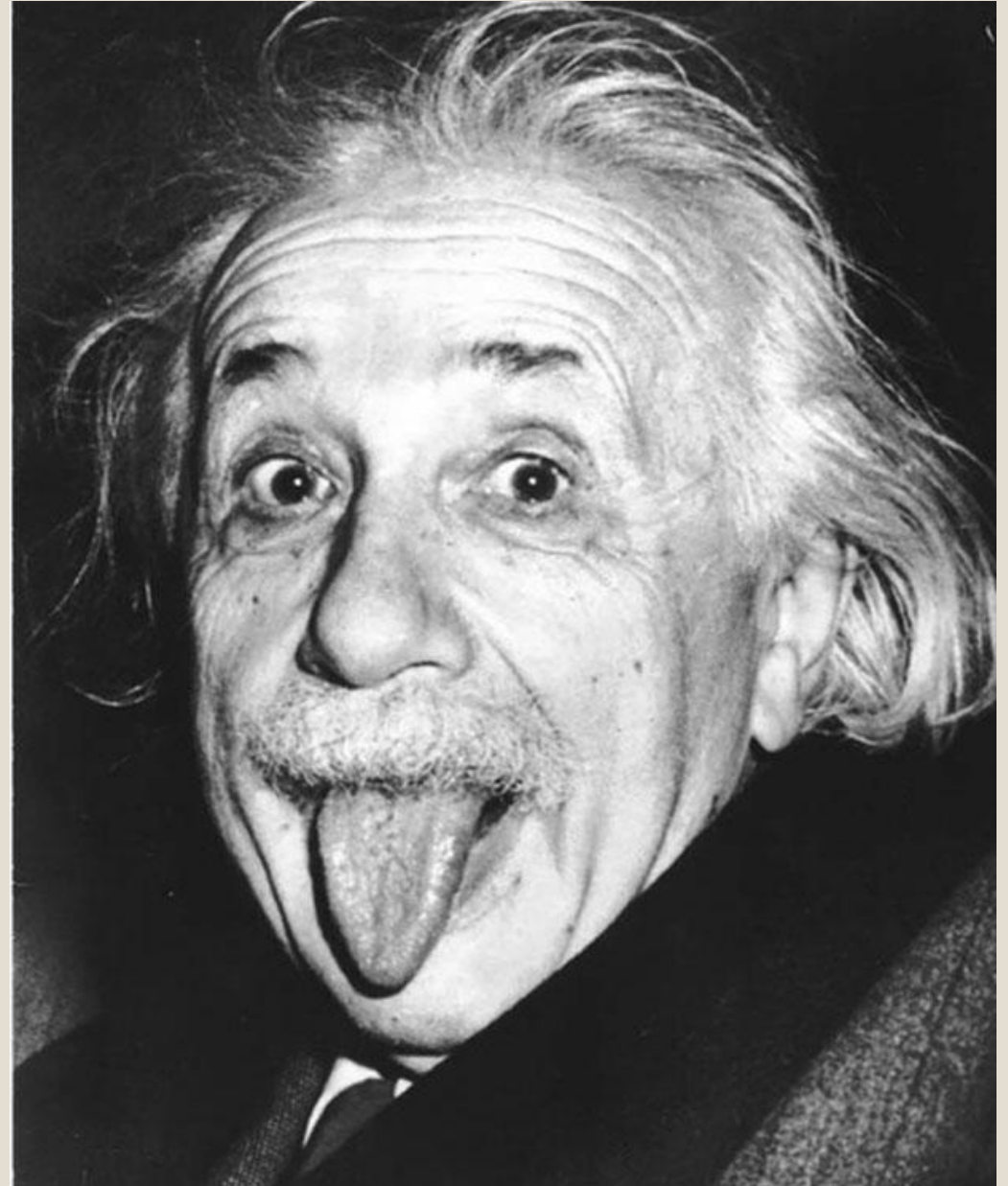




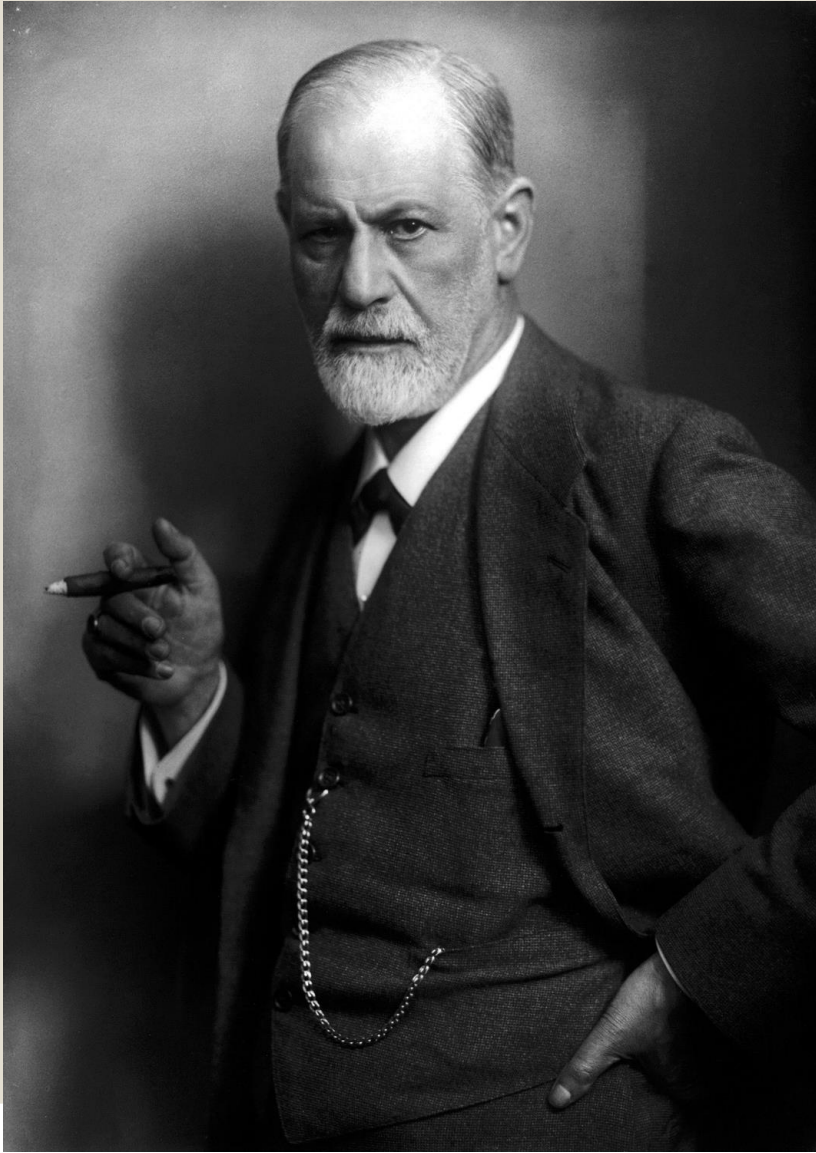
- 1885
 - Gottlieb Daimler invented a light Internal Combustion Engine
- 1903
 - Orville and Wilbur Wright – Kitty Hawk
- 1909
 - Igor Sikorsky invents the helicopter, which won't fly
 - 1938-his 3rd attempt does
- 1919
 - The first regular passenger air service was established

◦ Einstein

- Published his “Special Theory of Relativity” in 1905
 - Speed isn’t relative just to the person or object traveling, but also to the observer
 - Movement causes a slowing down of time
 - Changed Newtonian Physics
- Also, he concluded
 - Matter is nothing but another form of energy
 - Which lead to research into the vast energy stored with the atom, giving birth to the atomic age.



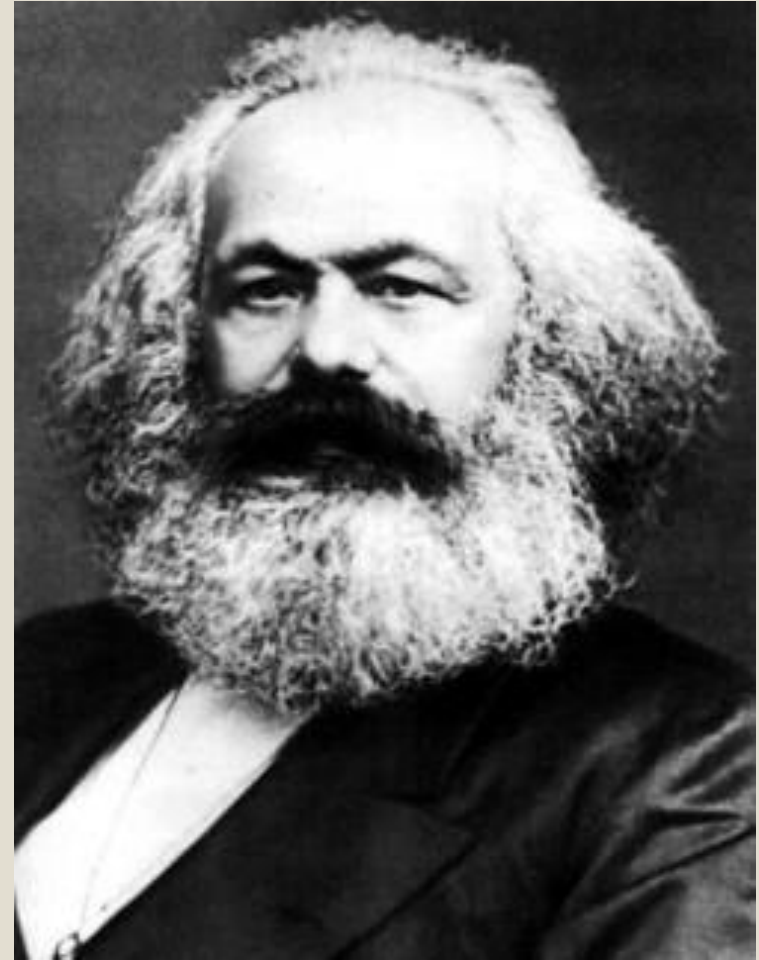
Changes in Psychology



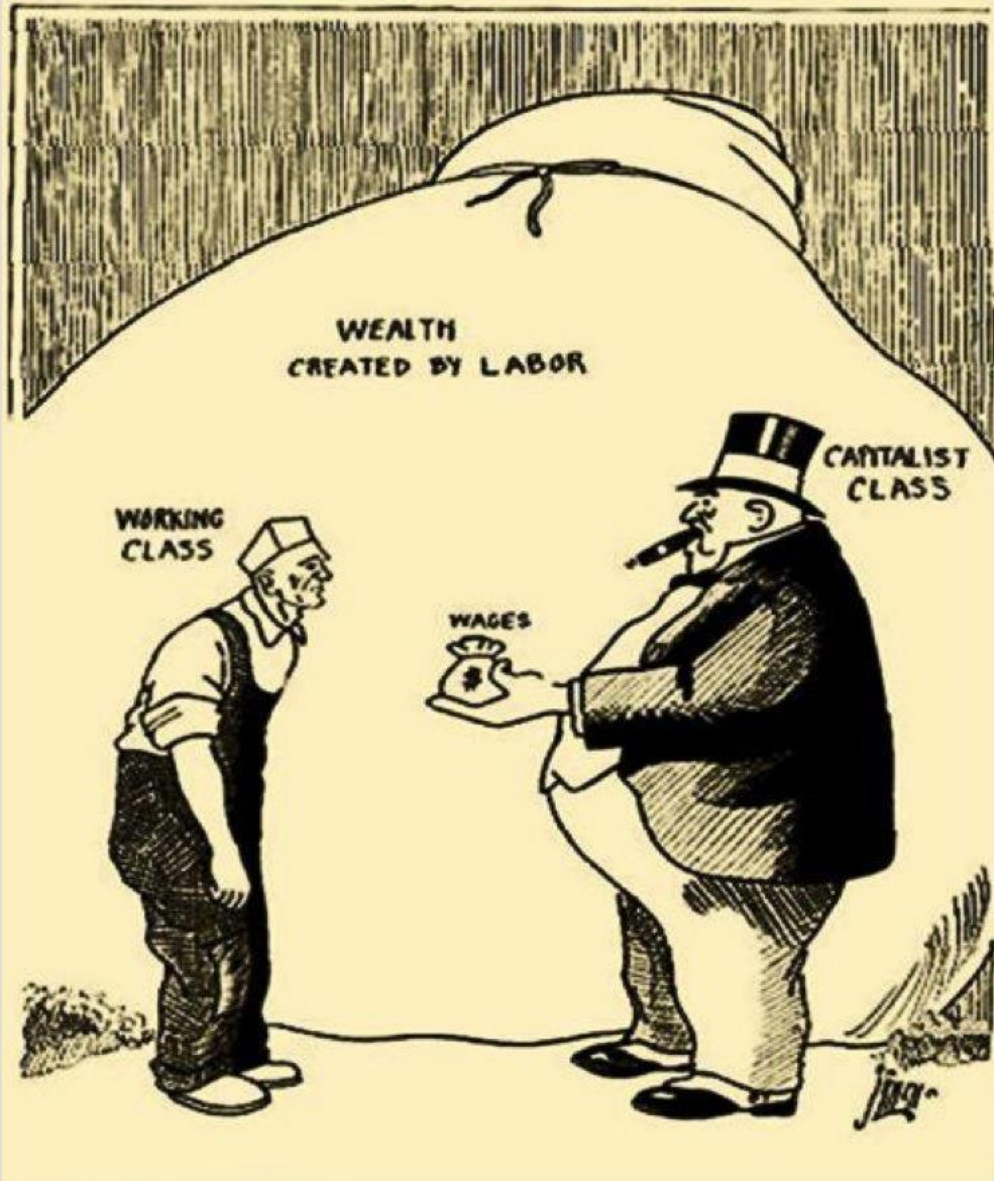
- Freud thought that painful memories were repressed, but still influenced people subconsciously
 - Therefore, he devised psychoanalysis to probe repressed memories to bring them to the conscious mind, thereby curing the patient

Economic Theories

- 1848 – *The Communist Manifesto* by Karl Marx and Friedrich Engels is published
 - They were appalled by the horrible conditions in factories
 - they blamed the Industrial Capitalist System
 - basically, that competition keeps workers poor and in cheap/unsafe conditions



Organize and Take the Big Bag!

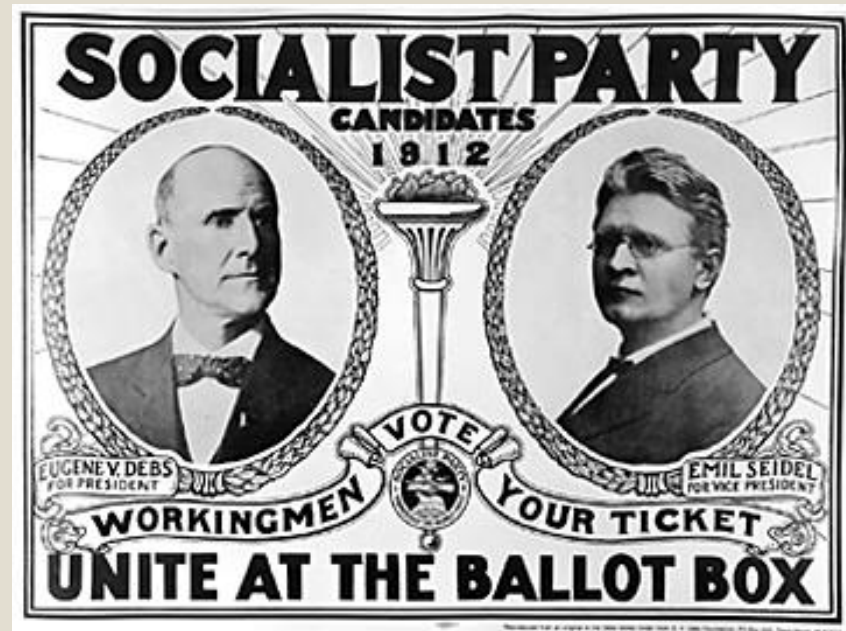


- Marx believed that all world history is a struggle between the oppressors and the oppressed
 - Oppressors (bourgeois) = control production, raw materials, land, money, etc.
 - Oppressed (proletariat) = dependent on the production of the oppressors
- Marx believed that the working class would eventually rise up in a bloody revolution and destroy the middle/upper class.
 - therefore creating a classes society on equal footing, destroying the need for a "state"



- Pure Marxists
 - Advocated for the violent overthrow approach
- Revisionist Marxists
 - workers must continue to form Political parties and action groups, and even join with other groups (i.e. UNIONS)

- 1875
 - German Social Democratic Party formed
 - start running candidate for offices
 - 1889
 - Socialist parties form all over Europe to fight the spread of Capitalism
- 1912
 - German candidates receive over 4 million votes, making them the biggest party in Germany



Rise of Unions

- 1870 – England
 - Unions win the right to strike to pressure employer to meet demands
- 1900
 - 2 million workers had joined unions
- 1914
 - 4 million
 - making huge improvements in living and working condition



- Public Schools
 - most western nations established “state-financed” primary schools
 - boys and girls age 6-12 were required to attend in most cases
- The Start of Mandatory education
 - at the beginning of the Ind. Rev. unskilled workers were fine for factory work
 - as industry grew...skilled, educated, trained workers were needed
- **The Right to Vote expanded**
 - With the right to vote came the need for an educated population

