The Industrial Revolution



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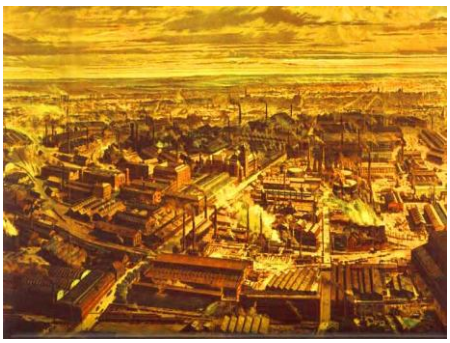
Why the Industrial Revolution Started in Great Britain

1760 AD – 1840 AD in England
1800s-1900s in France and Germany
1840s -1920s in United States

Industrial England: "Workshop of the World"

That Nation of Shopkeepers!
-- Napoleon Bonaparte

How did the world go from this?



The Start of the Industrial Revolution

- By 1750, the Agricultural Revolution had led to a large increase in Europe's population.
- About 93% of the people of Europe lived in rural areas.
- New innovations revolutionized manufacturing.
- People began emigrating from rural to urban areas searching for economic opportunities.
- Advances in medicine, hygiene and agriculture improved the quality and length of people's lives.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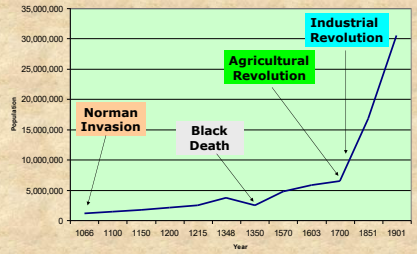
http://www.uncp.edu/home/rwb/agriculture_england2.jpg

Estimated Population of England 1066 to 1900



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London in 1440 and 1840

Urbanization and industrialization changed the architecture and way of life in London.

Right: London 1140 and 1840, from *Pugin's Contrasts*, published 1836.

Urbanization: The process in which more people move to cities.

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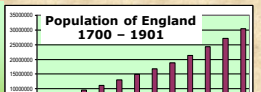
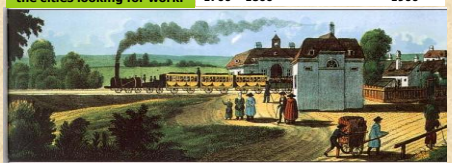
From the Country to the City

- The population of England rose slowly, by less than two million people, during the 100 years from 1700 to 1800.
- The population then increased sharply from 1801 to 1901, increasing by over 22 million.
- Many people moved into the cities looking for work.



1700 – 1800----------1900



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Origins---Why England?

- Agricultural Revolution
  - Horse and steel plow
  - Fertilizer use
  - Yields improved 300% 1700-1850
- Growth of foreign trade for manufactured goods
  - Foreign colonies
  - Increase in ships and size
- Successful wars and foreign conquest

Origins – Why England?

- Factors in England
  - No civil strife
  - Government favored trade
  - *Laissez faire*
  - Large middle class
  - Island geography
  - Mobile population
  - Everyone lived within 20 miles of navigable river
  - Tradition of experimental science
  - Weak guilds

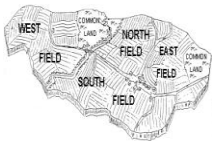
4.) BRITISH EMPIRE

5.) AGRICULTURAL ADVANCEMENTS

- Cooperative plowing
- Conserved the quality of land
- Balanced distribution of good land
- Farmers were part of a "team"
- Gleaning

OPEN FIELD SYSTEM---Old System

ADVANTAGES



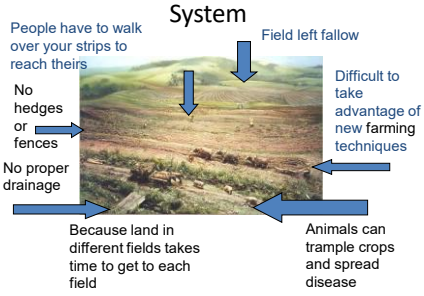
- All villagers worked together
- All the land was shared out
- Everyone helped each other
- Everyone had land to grow food
- For centuries enough food had been grown

OPEN FIELD SYSTEM---Old System

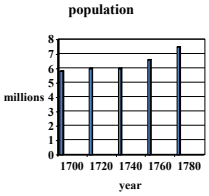
DISADVANTAGES

- Strips in different fields
- Fallow land
- Waste of time
- Waste of land
- Common land

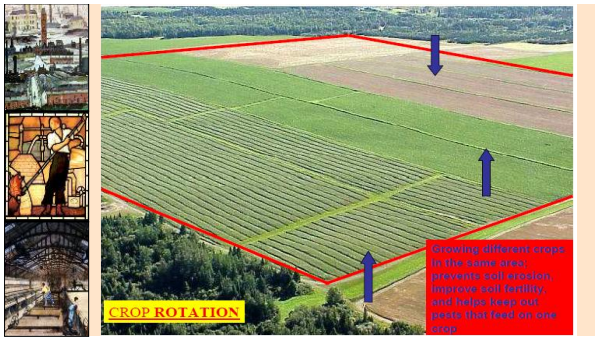
Disadvantages of the Open Field System



Why did the Open Field System change?



What was happening to population?



Enclosure

- Enclosure is when land that was traditionally held and used in common is fenced by private owners.
- Enclosure in England occurred between 1750 and 1860 as a result of parliamentary acts.
- Enclosure resulted in 21% of the land in England being fenced for private use.
- This resulted in larger, more efficient farms that required less labor.
- Many English peasants, who were no longer able to graze sheep and cattle or live off the land, were forced to move to the cities for employment.

A doggerel (rhyme) of the time went:
The law locks up the man or woman who steals the goose from off the common; But leaves the greater villain loose who steals the common from the goose.

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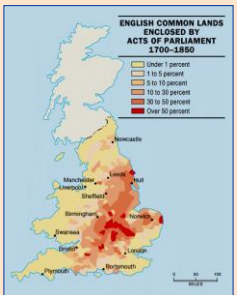
Industrial Revolution Begins in Britain

- The Agricultural Revolution Paves the Way
  - **Enclosures**—large farm fields enclosed by fences or hedges
  - Wealthy landowners buy, enclose land once owned by village farmers.
  - Enclosures allowed experimentation with new agricultural methods

The Enclosure Movement



Turnips, Cattle and Crop Rotation

- Lord Charles Townshend helped develop the four-field crop rotation system using wheat, barley, turnips and clover.
- Four-field crop rotation was a key development in the Agricultural Revolution.
- In 1730 Lord Townshend imported Dutch-grown turnips to feed cattle during the winter.
- Using inexpensive turnips and clover allowed farmers to maintain their livestock year-round.
- Previously, English farmers slaughtered their cattle before winter because the cost of feed was too high.

Right, Clockwise: Clover, Barley, Wheat.
Far Right: Townshend, Turnips, Bull

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The Seed Drill

- How did they plant seeds during ancient/medieval periods?
- Higher productivity of crop yield
- RESULT: Plant seeds quicker + more easily = more food, more money, and less labor costs
- Population continues to increase because food demand is being met – poor people aren't dying and looking for work!!!

Agricultural Innovators

Jethro Tull developed the seed drill to make sowing seeds faster and more efficient than planting them by hand. The seed drill makes a small hole and drops the seed into it. **It is estimated that crop yields rose as much as eight times.** Large motor-driven seed drills are used today.

Seed Drill

Jethro Tull

Robert Bakewell developed the use of **selective livestock breeding** in England. He bred Dishley Longhorn cattle for beef, New Leicester sheep for their fine wool and ability to live in the cold English climate, and the Shire horse for its strength.

Clockwise: New Leicester Sheep, Shire Horse, Dishley Longhorn Cow

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King George III

- **King George III was very interested in agriculture and was known as "Farmer George."**
- **He maintained large gardens at his estates at Richmond and Windsor.**
- **The British Agricultural Revolution reached its peak during his reign (1760–1820).**

19th-century plowing with six-oxen team in Sussex, England.

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Definitions of Industrial Revolution and Industrialization

- Industrial Revolution: a period of increased output of goods made by machines and new inventions; a series of dramatic changes in the way work was done
- Industrialization: the process of developing machine production of goods that led to a better quality of life for people and also caused immense suffering

Life in England Before the Industrial Revolution?

- 8 out of 10 worked in countryside
- Subsistence farming
- Cottage industries - factories rarely employed more than 50 people
- Handmade – buttons, needles, cloth, bricks, pottery, bread etc.
- Developing towns – Liverpool, Birmingham, Glasgow

How many objects do you have about you or can you see in the room that are handmade?

Welsh spinsters

Before the Industrial Revolution: Cottage Industry

The Putting-Out System

^The "putting-out system" was a way for 18th-century businesses to contract workers from their homes; an example of cottage industry.
^Different parts of a product were made in the home, collected, and then assembled at a central location.
^The main products of this system were textiles, locks, guns, and iron goods such as pots, pans, and pins.
^In the cottage textile industry, for example, the entire family was involved in cotton yarn production:
- ^Children would sort the cotton fibers in a process called carding.
- ^Women would spin the fibers into threads.
- ^Men would weave the threads into fabric.

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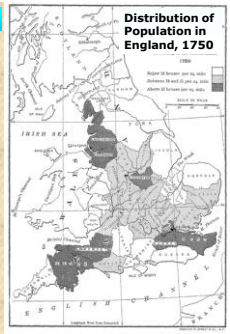
	Domestic System	Factory System
Methods	•Hand tools	•Machines
Location	•Home	•Factory
Ownership and Kinds of Tools	•Small hand tools owned by worker	•Large power-driven machines owned by the capitalist
Production Output	•Small level of production •Sold only to local market •Manufactured on a per-order basis	•Large level of production •Sold to a worldwide market •Manufactured in anticipation of demand
Nature of Work Done by Worker	•Worker manufactured entire item	•Worker typically made one part of the larger whole •Henry Ford's assembly line (early 20th century) kept workers stationary
Hours of Work	•Worker worked as much as he/she would and could, according to demand	•Worker worked set daily hours
Worker Dependence on Employer	•Worker had multiple sources of sustenance–other employers, own garden or farm, and outside farm labor	•Worker relied entirely on capitalist for his/her income–urban living made personal farming and gardening impractical

Urbanization in England

By 1750, large numbers of workers had begun to move into urban areas. This provided a large pool of workers for factory labor.

More factories encouraged more workers to move to the cities, and more workers attracted more industry.



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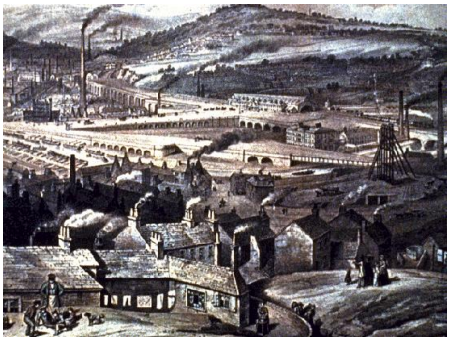


Two great economic "revolutions" occurred in human development

- The *Industrial Revolution,* started in the eighteenth century, is still taking place today
  - Involves a series of inventions leading to the use of machines and inanimate power in the manufacturing process
  - Suddenly whole societies could engage in seemingly limitless multiplication of goods and services
  - Rapid bursts of human inventiveness followed
  - Gigantic population increases

Industrial Revolution

- Began around 1750 in Great Britain
- New machines led to the Industrial Revolution.
- They replaced hand labor and helped workers produce more things faster.
- Moving water power in rivers replaced worker's muscle.
- One water wheel could turn hundreds of machines.

Industrial Revolution

- Machines also started the factory system.
- The new machines were too large and costly to be put into a person's home.
- Large buildings called factories were built to hold many of the machines.
- The workers in one factory manufactured more in a day than one person working in his or her home could manufacture in a lifetime.

Industrial Revolution

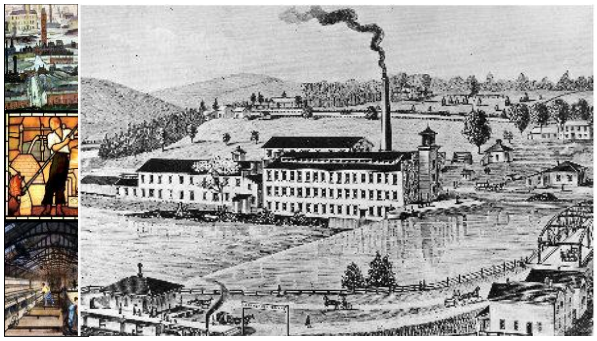
- Steam engines began to appear in the 1700s.
- This important invention used wood or coal as fuel to heat water in a boiler.
- Steam from the hot water powered the engine, which ran the machines.
- Since a steam engine could be placed anywhere, factories no longer had to be built along rivers.
- They could be built near fuel, raw materials, or labor.

Industrial Revolution Included:

- 1) the use of new basic materials, chiefly iron and steel
- (2) the use of new energy sources, including both fuels and motive power, such as coal, the steam engine, electricity, petroleum, and the internal-combustion engine
- (3) the invention of new machines, such as the spinning jenny and the power loom that permitted increased production with smaller expenditure of human energy

Industrial Revolution Included:

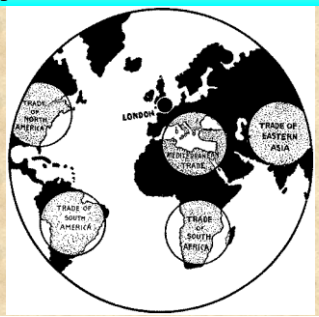
- (4) a new organization of work known as the factory system, which entailed increased division of labor and specialization of function-- the worker acquired new and distinctive skills, and his relation to his task shifted; instead of being a craftsman working with hand tools, he became a machine operator, subject to factory discipline
- (5) important developments in transportation and communication, including the steam locomotive, steamship, automobile, airplane, telegraph, and radio, and
- (6) the increasing application of science to industry



Industrial Revolution

- As factories produced more, better transportation was needed.
- More canals were dug and better roads were built.
- Here again the steam engine was able to help.
- By 1830, steam locomotives began to pull trains.

England saw itself as the center of the world!



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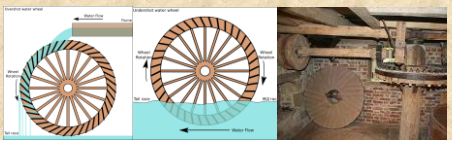
New Inventions of the Industrial Revolution

The Water Wheel Grist Mill Sound

- A water wheel is a means of converting the kinetic energy of flowing water into mechanical energy to operate machines.
- Water wheels were primarily used to power grist mills for making flour.
- During the Industrial Revolution, Richard Arkwright used the water wheel to spin cotton thread.
- Later, water wheels were adapted to run many spinning machines and looms.
- The most powerful water wheel built in the United Kingdom was the 100 hp water wheel at Quarry Bank Mill.



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Water Wheels

Water Wheel on the Orontes River in Syria

Factory Falls in Lowell

Water Wheel in New Lanark, Scotland

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John Kay's Flying Shuttle

- The Flying Shuttle was invented in 1733
- The Flying Shuttle was a piece of wood that held yarn
- The shuttle was woven in and out of the yarn tied to the loom
- It allowed the weaver to work twice as fast

Mechanization of the Textile Industry

The flying shuttle, invented by John Kay in 1733, increased the speed at which cloth could be woven.

The carding machine was developed by Daniel Bourn and Lewis Paul in 1748. It speeded up the process of brushing raw or washed fibers to prepare them for spinning, called carding.

Innovation: The creation, development and implementation of a new product, process or service.

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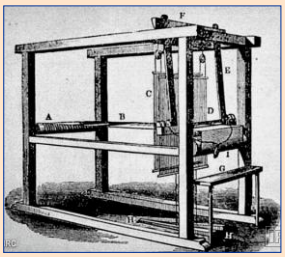
- carding machine- replaces the hand process of combing out the fibers before they can be spun into yarn or thread.
- "Carding" is a mechanical process that breaks up locks and unorganized clumps of fiber and then aligns the individual fibers so that they are more or less parallel with each other. This enabled them to be more easily spun into thread. The old method was done by hand using these tools.

John Kay's "Flying Shuttle"



https://www.youtube.com/watch?v=4nFC0AeEPvc

Inventions Spur Industrialization

Now that you can weave faster, you will need more thread, which means you need more yarn, which means you need more carded wool, which means you need more sheep! What happens if you can't produce more sheep? Is there another fiber from the Americas that might help this?

- Changes in the Textile Industry
  - Weavers work faster with **flying shuttles** and **spinning jennies**
  - **Water frame** uses water power to drive spinning wheels

Inventions

of the Industrial Revolution

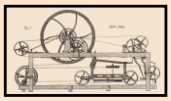
Spinning Jenny

James Hargreaves 1764

Water Frame

Richard Arkwright 1768

Spinning Mule



Samuel Crompton 1779

Spinning Mule Samuel Crompton 1779

So what new skills are going to be required to make the machines for the Industrial Revolution? Where are they coming from and who is doing it?

Who designs the "machines" today that make our lives easier, more efficient, and produce goods more cheaply?

Innovations in Cotton Spinning: Hargreaves and Arkwright

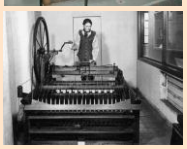
In 1764 James Hargreaves invented the spinning jenny.
It was hand-operated and could spin eight threads at a time.

Richard Arkwright developed an improved spinning machine called a water frame.
Water wheels were used to turn the machine.
In 1771 Arkwright built the world's first water-powered cotton mill at Cromford, Derbyshire, England.

James Hargreaves' Spinning Jenny

- The Spinning Jenny was invented in 1764.
- It was a faster spinning wheel.
- This machine could spin 80 threads at a time.
- Humans could spin only 1 thread at a time.
- This machine was hand operated.

James Hargreaves' Spinning Jenny



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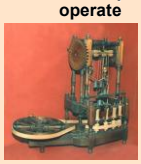
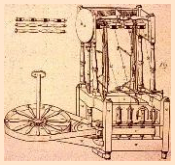
Water Frame

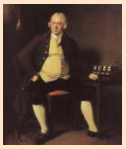
Richard Arkwright - 1768

Held several hundred spindles and required *water power* to operate





Richard Arkwright's Water Frame



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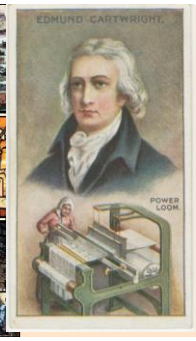


Edmund Cartwright's Power Loom

- The Power Loom was invented in 1785.
- This new loom made weaving much faster.
- It ran on waterpower.
- In 1813, 2000 looms were in use in English factories.
- By 1833, 100,000 looms were in use in England.

The power loom, invented by Edward Cartwright in 1785, used mechanical power from water wheels. It was designed so one person could operate many looms.

The Jacquard loom, a type of punch card loom, was developed by Frenchman Joseph Marie Jacquard around 1804. It automated pattern weaving, using punch cards to control the design.

Cartwright

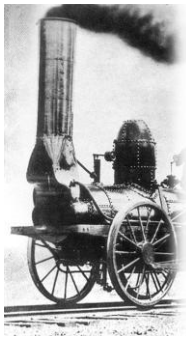
Jacquard

The roller spinning machine was developed in 1839 by Lewis Paul and John Wyatt. It increased the speed of making thread. They powered their machines using a donkey.

Jacquard Loom

Is this the first computer program? It is telling the machine what to do?

https://www.youtube.com/watch?v=OlJns3fPltE



REVOLUTION IN TRANSPORTATION

- TURNPIKE TRUSTS
- CANALS
- RAILROADS
- GEORGE STEPHENSON'S ROCKET
  - 1. 1ST MOD. RR
  - 2. LIVERPOOL TO MANCHESTER
  - 3. SPEED OF 16 MPH

How did people get around before the Industrial Revolution?

- 'We set out at six in the morning and didn't get out of the carriages (except when we overturned or got stuck in the mud) for 14 hours. We had nothing to eat and passed through some of the worst roads I ever saw in my life'

This is a description of a journey by Queen Anne in 1704 from Windsor to Petworth – a journey of 40 miles. What does it tell us about transport at the time?

Early Canals

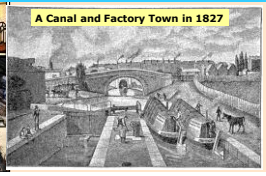
Britain's Earliest Transportation Infrastructure

Canals in England

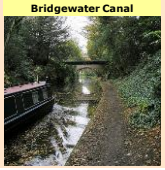
- From 1760 to 1790, over 4,000 miles of canals were built in England.
- The most famous of these was the Bridgewater Canal, built by engineer James Brindley for the Duke of Bridgewater in 1761.
- Barges moved coal from the Duke's mines in Worsley to his factories in Manchester.
- The mines had over 46 miles of underground canals used to transport coal to the surface.

James Brindley

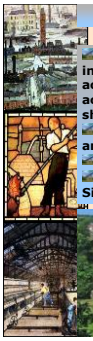
A Canal and Factory Town in 1827



Bridgewater Canal



The Manchester Ship Canal and Railway connected Manchester to the port at Liverpool.



The Pontcysyllte Aqueduct

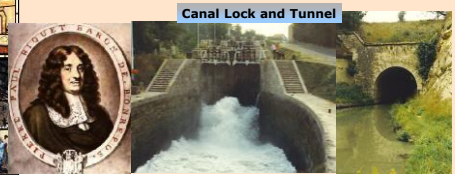
- The Pontcysyllte Aqueduct, completed in 1805, was a technological achievement. Using a cast iron trough, it acts like a bridge to move water and ships over the River Dee in England.
- It was designed by Thomas Telford and William Jessop.
- The aqueduct is 1,007 feet long.
- Today it is a UNESCO World Heritage Site.

Thomas Telford

Canal du Midi in France

- The Canal du Midi in France was completed in 1681, connecting the Atlantic Ocean to the Mediterranean Sea.
- Construction of the canal was overseen by Pierre-Paul Riquet.
- The canal allowed commercial traffic to bypass the warships of Spain and the pirates of the Barbary Coast.
- The Canal du Midi was the first canal ever built using a tunnel through a mountain.
- The canal was also the first to use its own reservoir to provide water for the 103 locks used to climb 109 meters.

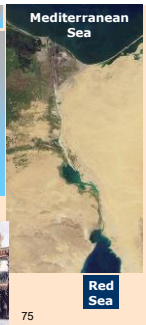
Canal Lock and Tunnel



The Suez Canal

- The original Suez Canal existed as far back as the 13th century BCE, during the time of Ramesses II.
- The 101-mile canal connects the Mediterranean Sea to the Red Sea.
- The canal allows ships to travel from Europe to Asia without going around Africa.
- The Suez Canal was rebuilt by the French Suez Canal Company in 1869.
- In 1888 the canal was declared a neutral zone for all nations of the world and was placed under the protection of the British.

Canal Construction, 1869



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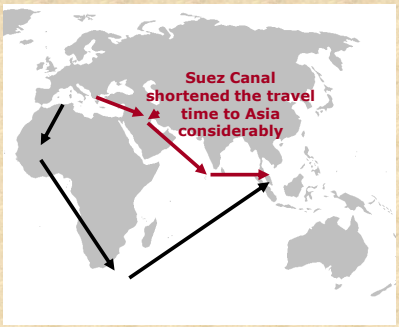

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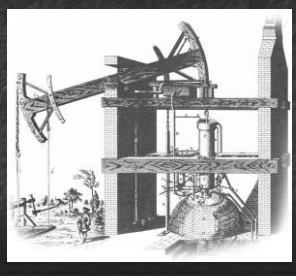
Coal

The British had access to **coal**, which provided massive amounts of energy in comparison to water, but it was still *finite*.

Photo by pxhere

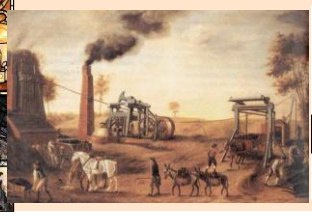
THE STEAM ENGINE

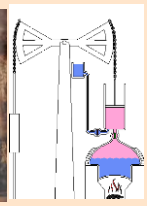
- 1ST USED TO PUMP WATER OUT OF COAL MINES
- COAL REPLACES WOOD
- COAL USED TO SMELT IRON ORE
- THOMAS NEWCOMEN – 1ST STEAM ENG. = INEFFICIENT
- JAMES WATT – 1ST EFFICIENT STEAM ENG. 1760'S
- STEAM ENG. = POWERS SPINNING AND WEAVING = COTTON MILLS



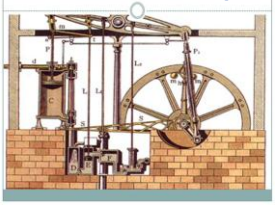
Thomas Newcomen

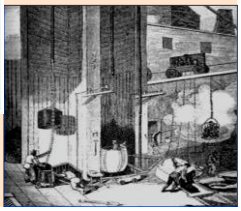
- Thomas Newcomen built the first practical steam engine. It was used for pumping water out of mines in the first decade of the 18th century.
- His engine converted steam power into mechanical energy.
- It used reciprocal (back and forth) motion.
- It was called the *atmospheric* or *Newcomen* steam engine.





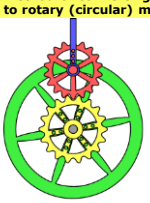
James Watt's Steam Engine





James Watt and Practical Steam Power

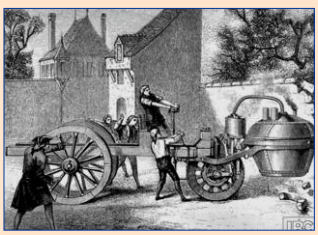
- James Watt was a Scottish engineer who, in 1775, modified the steam engine and made it practical for industrial use.
- He is credited with the invention of the sun and planet gear, a method of converting reciprocal (back and forth) motion to rotary (circular) motion.



Sun and Planet Gear

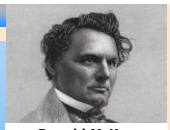
James Watt

Steam Tractor



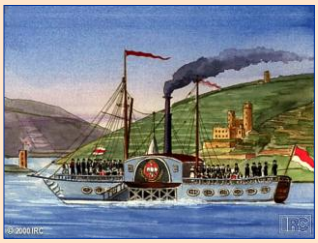
Clipper Ships

- Clipper ships were small, fast cargo sailing ships used in the first half of the 19th century.
- Their speed was two to three times faster than that of larger traditional merchant sailing vessels.
- They were built to carry high-value, low-volume cargo such as tea, coffee and spices, as well as passengers and mail.
- Donald McKay was the most successful clipper ship builder.
- One of his ships, the *Flying Cloud*, sailed from New York to San Francisco, around South America, in 89 days.
- Clipper ship construction declined rapidly after 1860 due to competition from steam-powered vessels.



Donald McKay

Steam Ship



Openness to New Ideas: Inventions

Steamboat

- Invented to improve transportation of people and goods
- Some ships were also used as party ships up and down rivers in the 19th and early 20th centuries

Steamships Cross the Atlantic

- The first steam-powered ship to cross the Atlantic Ocean was the paddle-steamer SS *Savannah* in 1819.
- The Savannah traveled from Savannah, Georgia, to Liverpool, England, in 29 days.
- The Savannah also had sails to use on windy days. The paddle wheels could collapse when the ship was under sail.
- The SS *Great Western* was built in 1837 for Atlantic voyages.
- It was built of steel-strapped oak planks and had four auxiliary masts for wind power.
- In 1838 the *Great Western* crossed the Atlantic under sustained steam power in 15 days.

SS *Great Western*

SS *Savannah*

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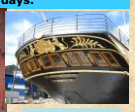
Iron Ships

- The first iron steamship, the SS *Aaron Manby*, was built in England in 1822 by Admiral Charles Napier.
- It crossed the English Channel from London to Paris and was then put into service on the River Seine.
- The SS *Great Britain*, built in 1843, was an iron steamship built to cross the Atlantic. It was the largest ship of its time.
- The SS *Great Britain* used a propeller for propulsion, but was also equipped with sails.
- The SS *Great Britain* crossed the Atlantic in 14 days.

Admiral Charles Napier

Launching of the SS *Great Britain*

Propeller



Stern of the SS *Great Britain*

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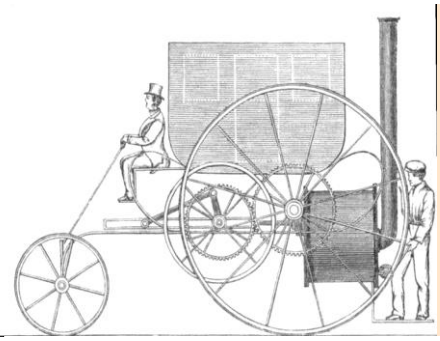
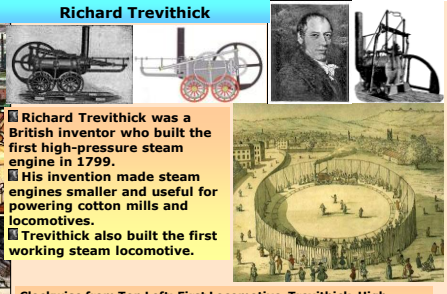
The Iron Horse

- First stage of the Industrial Revolution in England was driven by a demand for consumer goods in textiles. The second by transportation—the rail.
- Canals were effective…but inefficient.
- Coal was the primary item in need of movement. It was done by pulling it with horses on temporary tracks.



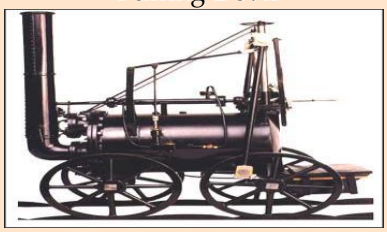
Richard Trevithick



- Richard Trevithick was a British inventor who built the first high-pressure steam engine in 1799.
- His invention made steam engines smaller and useful for powering cotton mills and locomotives.
- Trevithick also built the first working steam locomotive.

Clockwise from Top Left: First Locomotive, Trevithick, High-Pressure Steam Engine, "Catch Me If You Can" Locomotive Circus

Richard Trevithick's "Puffing Devil"

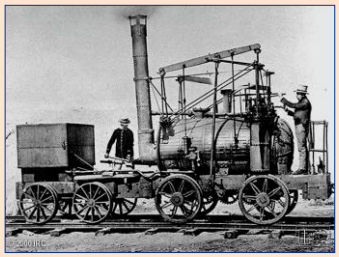


It could pull 10 tons of ore and 70 people and reach speeds of around 5 mph

- George Stephenson changed the world with his prize winning invention: the Rocket. A locomotive that pulled 3x its weight at 30 mph!

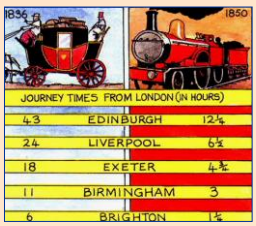
"Catch me if you can"

An Early Steam Locomotive



Later Locomotives

The Impact of the Railroad



"The Great Land Serpent"

Railroads on the Continent

The Industrial Revolution

The Spinning Mill

In the 18th century, English merchants were leaders in world commerce. It created a demand for more goods and a cheaper system of production. Besides, there were new ideas in England : an interest in scientific investigation and invention, and the doctrine of "laissez-faire" : letting business be regulated by supply and demand rather than by laws. Most important of all, new machines and techniques were developed by British inventors (for example : James Hargreaves, James Watt, John Blenkinsop…)

Stephenson's Rocket

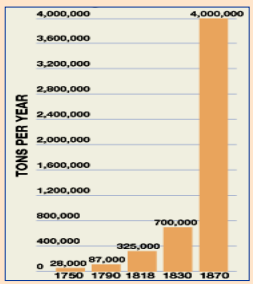
Consequences on society

EFFECTS OF THE RR

- 1. GROWTH OF COAL AND IRON INDUSTRIES
- 2. SUPREMACY IN CIVIL AND MECH. ENGINEERING
- 3. NEW JOINT-STOCK COMPANIES – MIDDLE CLASS INVESTORS
- 4. INCREASED EMPLOYMENT
- 5. LOWER PRICES – INCREASED SALES – INCREASED EMPLOYMENT – INCREASED SALES
- *GREATER ECON. GROWTH = GREATER INVESTMENT CAPITAL = GREATER GROWTH

British Pig Iron Production

Henry Cort



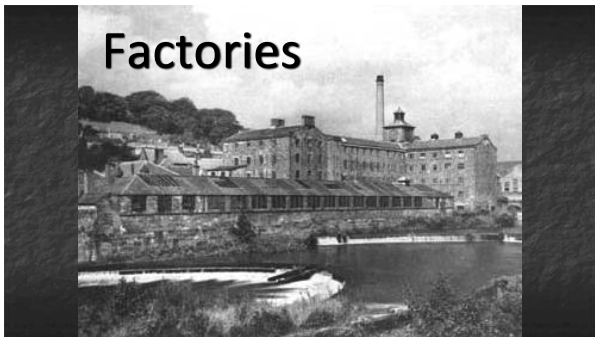
A technological revolution

A series of inventions that built on principles of mass production, mechanization and interchangeable parts

Josiah Wedgwood developed a mold for pottery that replaced the potters wheel, making mass production possible

Richard Arkwright: "Pioneer of the Factory System"

The "Water Frame"



Factory Production

- Concentrates production in one place [materials, labor].
- Located near sources of power [rather than labor or markets].
- Requires a lot of capital investment [factory, machines, etc.] more than skilled labor.
- Only 10% of English industry in 1850.

THE INDUSTRIAL FACTORY

- 1. 1ST USED TO PRODUCE COTTON
- 2. NEW WAY TO ORGANIZE LABOR
- 3. SHIFT FROM SHOPS & COTTAGES
- 4. WORKERS DIDN'T OWN MACHINES -> JUST PROVIDED THE LABOR

THE FACTORY SYSTEM

- ❑NEW TYPE OF WORK DISCIPLINE
- ❑REGULAR WORK HOURS
- ❑TIME-WORK DISCIPLINE
- ❑WORK WAS REPETITIVE AND BORING
- ❑STRICT WORK RULES
- ❑FINES AND DISMISSAL FOR ADULTS
- ❑BEATINGS FOR CHILDREN

Textile Factory Workers in England

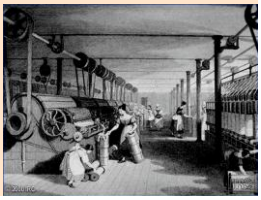
1813	2400 looms	150, 000 workers
1833	85, 000 looms	200, 000 workers
1850	224, 000 looms	>1 million workers

The Factory System

- Rigid schedule.
- 12-14 hour day.
- Dangerous conditions.
- Mind-numbing monotony.

Textile Factory Workers in England

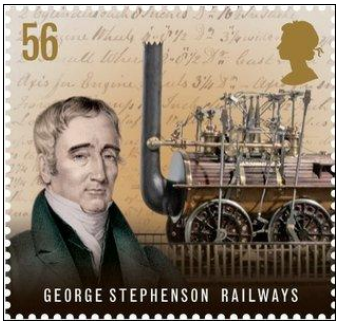
Young "Bobbin-Doffers"



British Coin Portraying a Factory, 1812

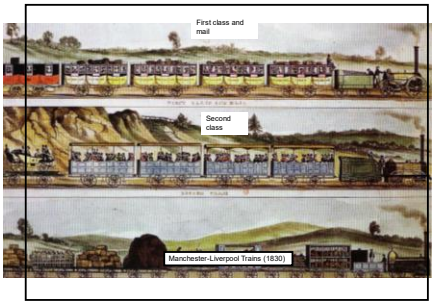
Man of Steel: Henry Bessemer

- Before 1850, railroads and trains were made of iron
- Iron is brittle
- Railroads were unsafe
- 1850 Henry Bessemer (England) invents a way to turn iron ore into steel

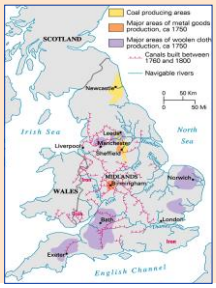


The Role of the Railroads

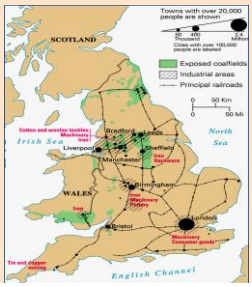
- The railroads, built during the 1830s and 1840s:
  - Enabled people to leave the place of their birth and migrate easily to the cities.
  - Allowed cheaper and more rapid transport of raw materials and finished products.
  - Created an increased demand for iron and steel and a skilled labor force.



Metals, Woolens, & Canals



Coalfields & Industrial Areas



Mine & Forge [1840-1880]

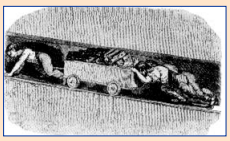
- ù More powerful than water is coal.
- ù More powerful than wood is iron.
- ù Innovations make steel feasible.
  - "Puddling" [1820] – "pig iron."
  - "Hot blast" [1829] – cheaper, purer steel.
  - Bessemer process [1856] – strong, flexible steel.

Coal Mining in Britain: 1800-1914

1800	1 ton of coal	50, 000 miners
1850	30 tons	200, 000 miners
1880	300 million tons	500, 000 miners
1914	250 million tons	1, 200, 000 miners

Child Labor in the Mines

Young Coal Miners



Child "hurriers"

Testimony of Sarah Gooder, Age 8

"I'm a trapper in the Gawber pit. It does not tire me, but I have to trap without a light and I'm scared. I go at four and sometimes half past three in the morning, and come out at five and half past. I never go to sleep. Sometimes I sing when I've light, but not in the dark; I dare not sing then. I don't like being in the pit. I am very sleepy when I go sometimes in the morning. I go to Sunday-schools and read *Reading made Easy*. [She knows her letters, and can read little words.] They teach me to pray. [She repeated the Lord's Prayer, not very perfectly, and ran on with the following addition:] 'God bless my father and mother, and sister and brother, uncles and aunts and cousins, and everybody else, and God bless me and make me a good servant. Amen.' I have heard tell of Jesus many a time. I don't know why he came on earth, I'm sure, and I don't know why he died, but he had stones for his head to rest on. I would like to be at school far better than in the pit."

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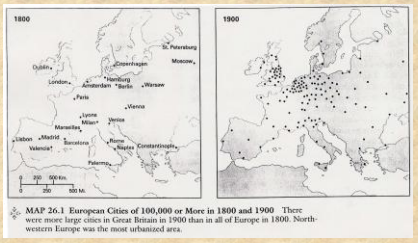
http://www.victorianweb.org/history/ashley.html

The Results of Industrialization at the end of the 19c

Effects of the Industrial Revolution

- What was the industrial revolution?
  - Machines coordinated to make goods
  - Energy from non-animal sources
  - Industry grew 4 times faster
- Changed all aspects of society
  - Most profound effect since agriculture
  - Government change
    - Political and military balance
    - Europe as dominant power
  - Transformed social classes
  - Higher standard of living for most

Effects of the Industrial Revolution



MAP 26.1 European Cities of 100,000 or More in 1800 and 1900 There were more large cities in Great Britain in 1900 than in all of Europe in 1800. Northwestern Europe was the most urbanized area.

Effects of the Industrial Revolution

England vs. Continental Europe

TABLE 24.1 PER CAPITA LEVELS OF INDUSTRIALIZATION, 1750–1913

	1750	1800	1830	1860	1880	1900	1913
Great Britain	10	16	25	64	87	100	115
Belgium	9	10	14	28	43	56	88
United States	4	9	14	21	38	69	126
France	9	9	12	20	28	39	59
Germany	8	8	9	15	25	52	85
Austria-Hungary	7	7	8	11	15	23	32
Italy	8	8	8	10	12	17	26
Russia	6	6	7	8	10	15	20
China	8	6	6	4	4	3	3
India	7	6	6	3	2	1	2

Note: All entries are based on an index value of 100, equal to the per capita level of industrialization in Great Britain in 1900.
Source: P. Bairoch, "International Industrialization Levels from 1750 to 1980," Journal of European Economic History 11 (Fall 1982): 294. Data for Great Britain are actually for the United Kingdom, thereby including Ireland with England, Wales, and Scotland.

England vs. Continental Europe

- Produced 20% of industrial goods
- Gross national product rose 4x
- Population increase
- Inventors took inventions abroad
- Belgium's coal and iron resources
- Germany iron and wool factories
- France slow to industrialize
- Mechanization came but late

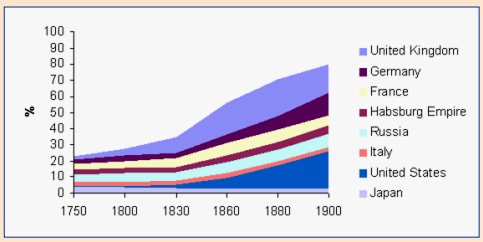
Railroads on the Continent

By 1850:
Zones of Industrialization on the European Continent

- Northeast France.
- Belgium.
- The Netherlands.
- Western German states.
- Northern Italy
- East Germany → Saxony

Industrialization By 1850

Share in World Manufacturing Output: 1750-1900



The Politics of Industrialization

- State ownership of some industries.
  - RRs → Belgium & most of Germany.
- Tariffs → British Corn Laws.
- National Banks granted a monopoly on issuing bank notes.
  - Bank of England.
  - Bank of France.
- Companies required to register with the government & publish annual budgets.
- New legislation to:
  - Establish limited liability.
  - Create rules for the formation of corporations.
- Postal system.
- Free trade zones → Ger. *Zollverein*

The Great Exhibition at the Crystal Palace

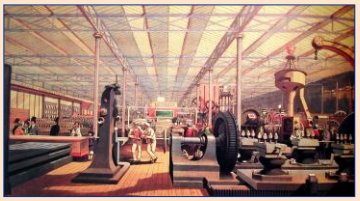
The Great Exhibition of 1851 in London was mounted to symbolize Great Britain's economic, industrial, and military superiority.

Crystal Palace Exhibition: 1851

Exhibitions of the new industrial utopia.

Crystal Palace: Interior Exhibits

Crystal Palace: British Ingenuity on Display



Crystal Palace: American Pavilion

The "Haves": Bourgeois Life Thrived on the Luxuries of the Industrial Revolution

THE INDUSTRIAL MIDDLE CLASS

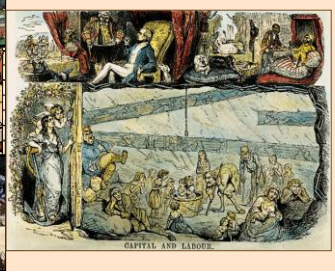
- IR creates new middle class group
- **BOURGEOISIE** = the middle class = people involved in commerce, industry, banking, and professionals
- New industrial businesses = intense competition/frequent bankruptcy
- Indust. Entrepreneurs = very resourceful/came from diverse backgrounds
- By 1850:
  - 1. dev. of a new "business aristocracy"
  - 2. mass fortunes, passed down to children
  - 3. begin to acquire social respectability and political power

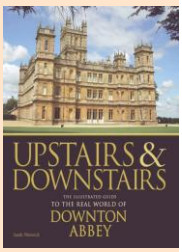
19ᶜ Bourgeoisie: The Industrial *Nouveau Riche*

Criticism of the New Bourgeoisie

Stereotype of the Factory Owner

"Upstairs"/"Downstairs" Life





The "Have-Nots": The Poor, The Over-Worked, & the Destitute

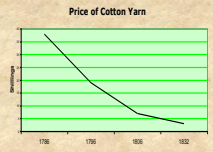
STANDARDS OF LIVING

- Big historical debate = how did the Ind. Rev. affect the standard of living

1. Standard of living involved wages, prices, consumption
2. 1st half of 19th cent. -> widening gap between rich and poor
3. Wages + prices 1780-1850 -> fluctuate widely
4. Middle class benefit most from early Ind. Rev.
5. After 1850 -> wages and standard of living improved for the workers

Falling Prices and Wages

- The introduction of factory-based cotton thread production led to falling cotton thread prices.
- From 1786 to 1832 the price of cotton yarn fell 90%.
- Wages fell for cotton hand weavers.
- Hand loom weavers making 25 shillings a week in 1786 were only able to make 9 shillings and 6 pence by 1830.
- Craftsmen left the putting-out system to work in factories.



A shilling was worth 1/20 of a pound, or 12 pence.

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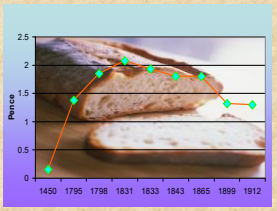
The Speenhamland Allowance Scale

- The Speenhamland Allowance Scale of 1795 in England tied the minimum wage of workers to the price of bread.
- Every worker was to receive a minimum wage equivalent to about 12.5 pounds of bread per day.
- It was estimated that 1/3 of a worker's wage went to food.

Price of Bread (Per Pound)



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Source: http://www.victorianweb.org/

Factory Wages in Lancashire, 1830

Age of Worker	Male Wages	Female Wages
under 11	2s 3d.	2s. 4d.
11 - 16	4s. 1d.	4s. 3d.
17 - 21	10s. 2d.	7s. 3d.
22 - 26	17s. 2d.	8s. 5d.
27 - 31	20s. 4d.	8s. 7d.
32 - 36	22s. 8d.	8s. 9d.
37 - 41	21s. 7d.	9s. 8d.
42 - 46	20s. 3d.	9s. 3d.
47 - 51	16s. 7d.	8s. 10d.
52 - 56	16s. 4d.	8s. 4d.
57 - 61	13s. 6d.	6s. 4d.

Industrial Staffordshire

Problems of Polution

The Silent Highwayman - 1858

The New Industrial City

Early-19c London
by Gustave Dore

Worker Housing in Manchester

Factory Workers at Home

Workers Housing in Newcastle Today

The Life of the New Urban Poor: A Dickensian Nightmare!

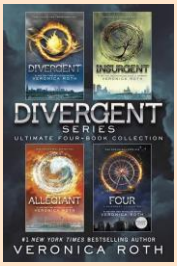
Charles Dickens: From Poorhouse to Mansion

- English author Charles Dickens (1812-1870)

➢ Front piece of the first edition of *Oliver Twist* (1838).

➢ First edition front piece of *A Christmas Carol* (1843)

Are these Modern Day Dickensian Tales



Private Charities: Soup Kitchens

Private Charities: The "Lady Bountifuls"

Labor Conditions

Laborers often worked in dangerous and hazardous conditions

Women: The Labor Behind the Industry

19th-century women at work

Child Labor: Unlimited Hours

Factory children attend a Sunday school

Child Labor: Dangers

"Scavengers" and "piecers"

Child Labor: Punishment

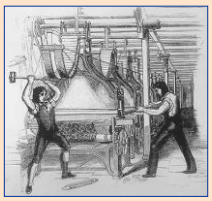
- Malnourishment
- Beatings
- Runaways sent to prison

Child Labor: Movements to Regulate

- Factory owners argued that child labor was good for the economy and helped build children's characters
- Factory Act of 1833: limited child labor and the number of hours children could work in textile mills

Protests / Reformers

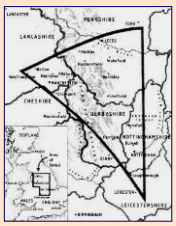
The Luddites: 1811-1816

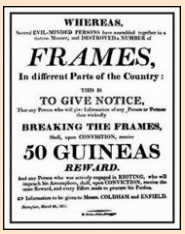


Attacks on the "frames" [power looms].

Ned Ludd [a mythical figure supposed to live in Sherwood Forest]

The Luddite Triangle





WHEREAS,

FRAMES,

In different Parts of the Country:

TO GIVE NOTICE,

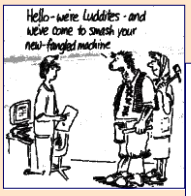
BREAKING THE FRAMES,

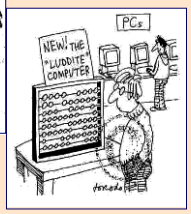
50 GUINEAS

REWARD.

The Luddites

The Neo-Luddites Today

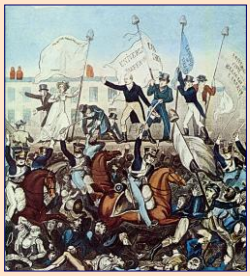




Peterloo Massacre, 1819

British Soldiers Fire on British Workers:

Let us die like men, and not be sold like slaves!



The Chartists

Key	
Snig's End	Chartist settlements
Swansea	Centres of Chartism
	Area of plug riots, 1842

The "Peoples' Charter"

- Drafted in 1838 by **William Lovett**.
- Radical campaign for Parliamentary reform of the inequalities created by the Reform Bill of 1832.
  - Votes for all men.
  - Equal electoral districts.
  - Abolition of the requirement that Members of Parliament [MPs] be property owners.
  - Payment for Members of Parliament.
  - Annual general elections.
  - The secret ballot.

The Chartists

A physical force—Chartists arming for the fight.

A female Chartist

The Utilitarians:
Jeremy Bentham & John Stuart Mill

- The goal of society is *the greatest good for the greatest number.*
- There is a role to play for government intervention to provide some social safety net.

Jeremy Bentham

- Jeremy Bentham (1748–1832) was an English philosopher and social reformer.
- He is known for his concept of utilitarianism, the belief that a person's actions have moral value (utility).
- The utility of a person's actions should bring happiness and pleasure to society.
- Bentham supported animal rights, the separation of church and state, freedom of expression, the abolition of slavery, equality for women, and free trade.

"Nature has placed mankind under the governance of two sovereign masters, pain and pleasure. It is for them alone to point out what we ought to do, as well as to determine what we shall do. On the one hand the standard of right and wrong, on the other the chain of causes and effects, are fastened to their throne. They govern us in all we do, in all we say, in all we think..."
From The Principles of Morals and Legislation (1789)

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Jeremy Bentham

Quarry Bank Mill

- Quarry Bank Mill was built by Samuel Greg in Cheshire, England, in 1784.
- Greg used unpaid child apprentices from workhouses as his labor.

Above: Apprentice House, Workhouse Children
Below: Samuel Greg, Power Loom

- Greg, like many other industrialists in Manchester, England, was a Utilitarian.
- The children were provided with education and medical treatment.
- Greg hired Dr. Peter Holland, the first doctor to be employed by a mill in England.
- The mill still operates today.

Utilitarianism: The belief that one's actions should bring happiness or pleasure to society

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The Workhouse

- The workhouse was a place where people went who could not support themselves.
- Homeless people and the insane were sent to workhouses by local authorities.
- Orphans, as in Charles Dickens' novel *Oliver Twist*, were also sent to workhouses.
- Conditions in the workhouses were purposely harsh, in order to encourage people to leave and find work.
- Little money was provided to maintain workhouses.
- People did unpaid work in exchange for food and shelter. People were fed gruel, soup, bread and cheese.
- Many children from workhouses were apprenticed to mine owners and textile mills, where they worked for no wages.

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John Stuart Mill

- John Stuart Mill (1806–1873) was a British philosopher and political economist.
- He built on Jeremy Bentham's concept of utilitarianism by arguing that some forms of happiness are more valuable than others.
- Mill is known for his ideas about liberty and the power of the society over the individual.
- He developed the "harm" principle, which states that each individual has the right to act as he wishes, so long as these actions do not harm others.
- Mill supported abolitionism, women's rights and suffrage, compulsory education, the public ownership of natural resources, and equal taxation.

Women could not vote in England until 1928

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ROBERT OWEN

1. Rich wealthy cotton entrepreneur
2. Social reformer
3. Cooperation is better than competition
4. Helps form the Grand National Consolidated Trades Union 1834
5. GNCTU worked/planned strikes to demand 8 hour day
6. Effort failed → GNCTU collapses

Robert Owen and Socialism

- Robert Owen (1771–1858) was a Welsh social reformer.
- He was one of the founders of socialism and the cooperative movement.
- Owen based his philosophy on three fundamental ideas:
  1. He believed that society is responsible for human development.
  2. He was firmly against religion because it made men weak-minded.
  3. He was against the factory system of production.
- In 1825 Owen put his socialist ideas to work by creating two cooperative societies: one at Orbston, near Glasgow, England, and one at New Harmony, Indiana, which was known as the New Harmony Society.
- Within two years both communities failed.

New Harmony, as Envisioned by Owen

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Robert Owen (1771-1858)

Utopian Socialist

"Village of Cooperation"

Original Plans for New Harmony, IN

New Harmony in 1832

New Harmony, IN

David Lenz House, with Bake Oven
(photo by Ruth Reichmann)

New Harmony Inn
(photo by Ruth Reichmann)

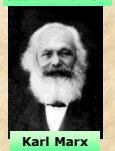
Labyrinth
(History, New Harmony photo)

Utopian Socialism and Anarchism

- The word "socialism" was first used in discussions of the Association of All Classes of All Nations, formed by Robert Owen in 1835.
- Owen believed that the state could develop good conduct in individuals.
- Karl Marx referred to Owen's ideals as "utopian socialism."
- Josiah Warren, a member of the New Harmony Society, wrote that the community did not work because its members lacked personal freedom and private property.
- Warren helped to develop the concept of American individualist anarchism.

Socialism: The state is responsible for production and the welfare of the people.

Josiah Warren



Karl Marx

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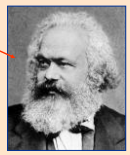
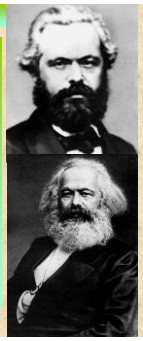
The Socialists:
Utopians & Marxists



- People as a society would operate and own the means of production, not individuals.
- Their goal was a society that benefited everyone, not just a rich, well-connected few.
- Tried to build perfect communities [utopias].

Karl Marx

- Karl Heinrich Marx (1818–1883) was philosopher and political economist.
- Marx introduced the world to the ideas of communism.
- He believed that capitalism, filled with social turmoil and injustice, would naturally fail, and would be replaced by a classless society called communism.
- In 1848 he and Friedrich Engels wrote the *Communist Manifesto,* stating, "The history of all hitherto existing society is the history of class struggles."
- According to Marx, communism would develop after the impoverished workers of world, called the proletariat, came together and revolted against the ruling bourgeoisie (wealthy merchants and industrialists).



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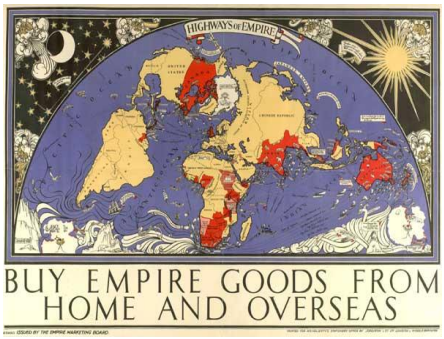

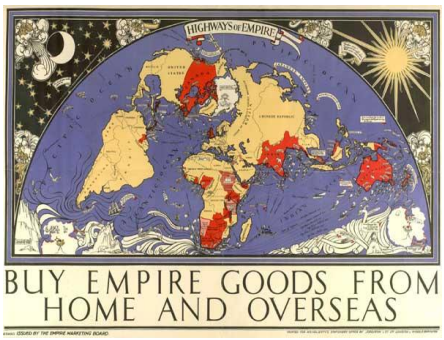

Industrialization Spreads

Industrialization soon spread to western Europe and the United States. Other regions did not industrialize in the 1800s. What was it about Western countries that encouraged them to embrace industry?

Why Western Countries?	*America*	*Europe*
• Political liberty	• British restrictions	• Belgium, 1807
• Freedom to compete	• Hamilton, 1791	• France, 1815
• Rewards reaped	• Samuel Slater	• Germany, 1850
• Exploitation and improvements	– Water frame	– Railroads
	– Slater's Mill	– Treaties
	• Lowell's Mill	

Results of the Industrial Revolution

Economic Changes
- Expansion of world trade
- Factory system
- Mass production of goods
- Industrial capitalism
- Increased standard of living
- Unemployment

Political Changes
- Decline of landed aristocracy
- Growth and expansion of democracy
- Increased government involvement in society
- Increased power of industrialized nations
- Nationalism and imperialism stimulated
- Rise to power of businesspeople

Social Changes
- Development and growth of cities
- Improved status and earning power of women
- Increase in leisure time
- Population increases
- Problems – economic insecurity, increased deadliness of war, urban slums, etc.
- Science and research stimulated