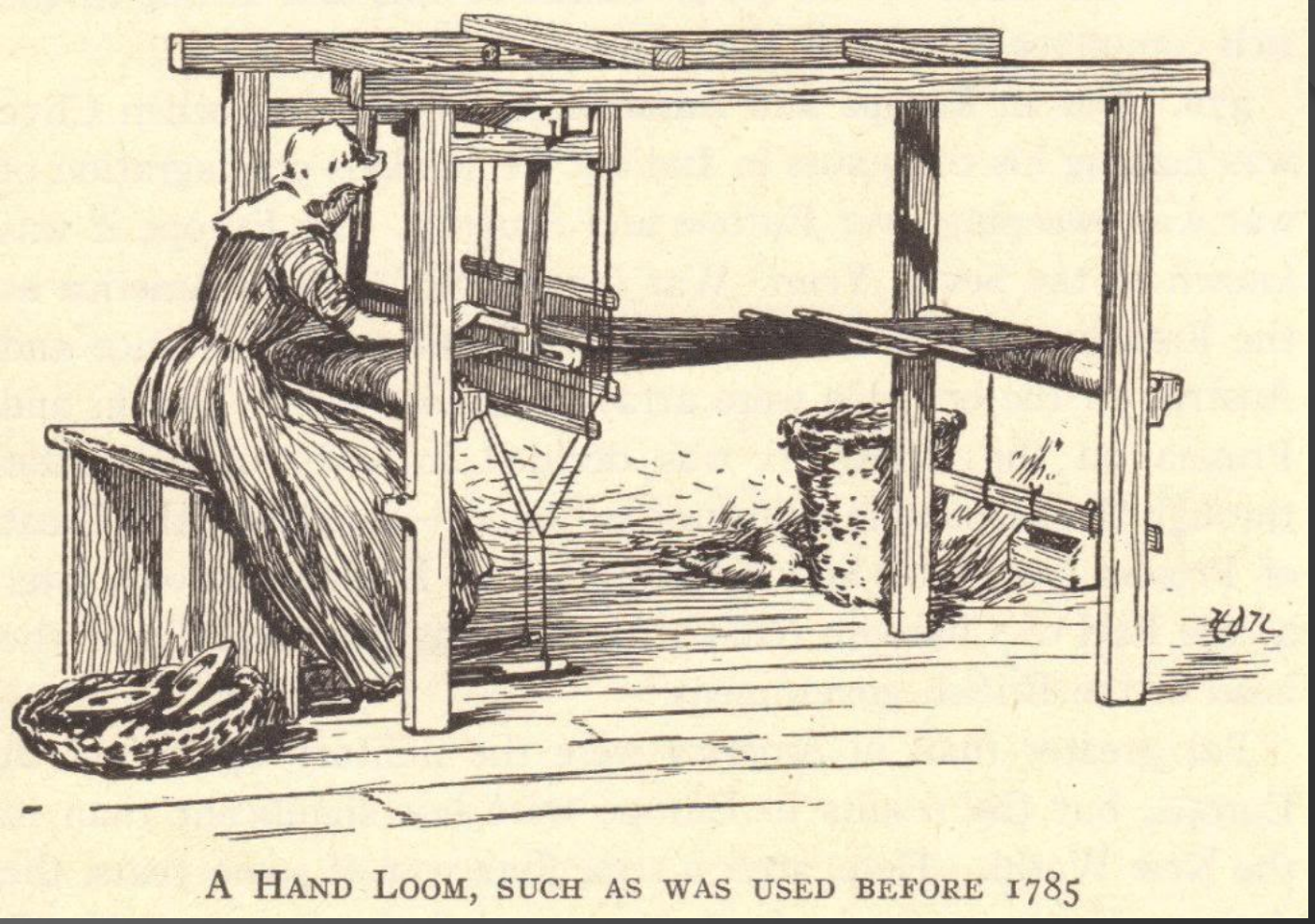
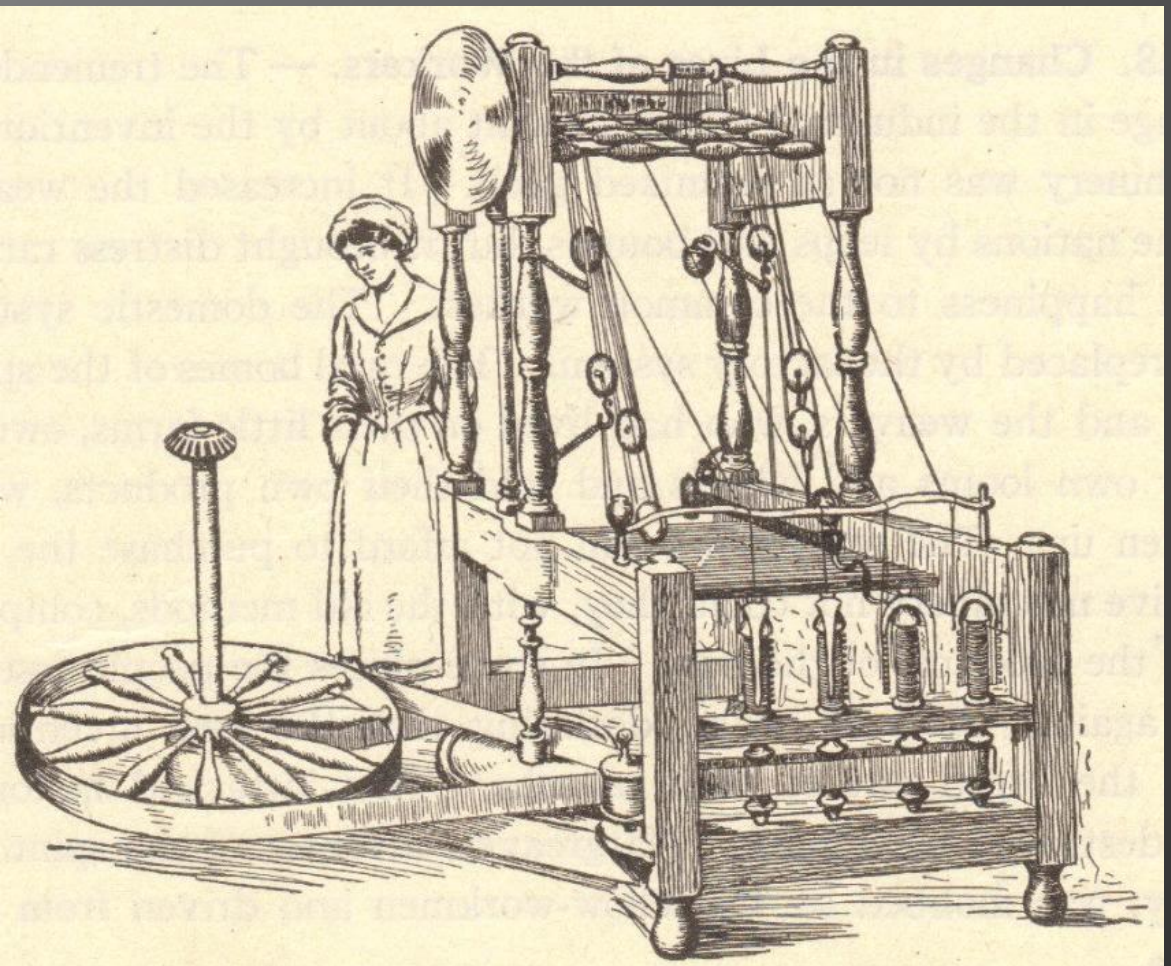


A Hand Loom, such as was used before 1785

THE INDUSTRIAL REVOLUTION



ARKWRIGHT'S FIRST SPINNING FRAME

THE FIRST INDUSTRIAL REVOLUTION

What was the Industrial Revolution?

- The Industrial Revolution was a fundamental change in the way goods were produced, from human labor to machines

- The more efficient means of production and subsequent higher levels of production triggered far-reaching changes to industrialized societies

The Industrial Revolution

- Machines were invented which replaced human labor
- New energy sources were developed to power the new machinery – water, steam, electricity, oil (gas, kerosene)
  - Some historians place advances in atomic, solar, and wind energy at the later stages of the Industrial Revolution
- Increased use of metals and minerals
  - Aluminum, coal, copper, iron, etc.

The Industrial Revolution

- Transportation improved
  - Ships
    - Wooden ships → Iron ships → Steel ships
    - Wind-powered sails → Steam-powered boilers
  - Trains
  - Automobiles
- Communication improved
  - Telegraph
  - Telephone
  - Radio

Developments

- Mass production of goods
  - Increased numbers of goods
  - Increased diversity of goods produced
- Development of factory system of production
- Rural-to-urban migration
  - People left farms to work in cities
- Development of capitalism
  - Financial capital for continued industrial growth
- Development and growth of new socio-economic classes
  - Working class, bourgeoisie, and wealthy industrial class
- Commitment to research and development
  - Investments in new technologies
  - Industrial and governmental interest in promoting invention, the sciences, and overall industrial growth

Factory System

- Developed to replace the domestic system of production
- Faster method of production
- Workers concentrated in a set location
- Production anticipated demand
  - For example: Under the domestic system, a woman might select fabric and have a businessperson give it to a home-based worker to make into a dress. Under the factory system, the factory owner bought large lots of popular fabrics and had workers create multiple dresses in common sizes, anticipating that women would buy them.

	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

Why the Industrial Revolution Started in England

Capital for investing in the means of production	Colonies and Markets for manufactured goods	Raw materials for production
Workers	Merchant marine	Geography

England's Resources: Capital

- The Commercial Revolution made many English merchants very wealthy
- These merchants had the capital to invest in the factory system – money to buy buildings, machinery, and raw materials

England's Resources: Colonies and Markets

- Wealth from the Commercial Revolution spread beyond the merchant class
- England had more colonies than any other nation
- Its colonies gave England access to enormous markets and vast amounts of raw materials
- Colonies had rich textile industries for centuries
  - Many of the natural cloths popular today, such as calico and gingham, were originally created in India
  - China had a silk industry

England's Resources: Raw Materials

- England itself possessed the necessary raw materials to create the means of production
- Coal – vast coal reserves powered steam engines
- Iron – basic building block of large machines, railroad tracks, trains, and ships

England's Resources: Workers

- Serfdom and guilds ended earlier in England than other countries
- English people could freely travel from the countryside to the cities
- Enclosure Acts – caused many small farmers to lose their lands, and these former farmers increased the labor supply

England's Resources: Merchant Marine

- World's largest merchant fleet
- Merchant marine built up from the Commercial Revolution
- Vast numbers of ships could bring raw materials and finished goods to and from England's colonies and possessions, as well as to and from other countries

England's Resources: Geography

- England is the political center of Great Britain, an island
- Great Britain (as the entire island was called beginning in 1707) did not suffer fighting on its land during the wars of the 18th century
- Island has excellent harbors and ports
- Damp climate benefited the textile industry (thread did not dry out)
- Government stable
- No internal trade barriers

“Necessity Is the Mother of Invention”

Spinning machine

Need to speed up weaving

Power loom created

“Necessity Is the Mother of Invention”

Power loom

Increased demand for raw cotton

Invention of the cotton gin

“Necessity Is the Mother of Invention”

Cotton gin

Demands for stronger iron

Improvements in iron smelting and the development of steel (Bessemer process)

“Necessity Is the Mother of Invention”

As more steam-powered machines were built, factories needed more coal to create this steam

Mining methods improved to meet the demand for more coal

- The process of inventing never ends
- One invention inevitably leads to improvements upon it and to more inventions

The Textile Industry

- Textiles – cloths or fabrics
- First industry to be industrialized
- Great Britain learned a lot about textiles from India and China

Development of Steam Engines

- Early water power involved mills built over fast-moving streams and rivers
- Early water power had problems
  - Not enough rivers to provide the power needed to meet growing demand
  - Rivers and streams might be far removed from raw materials, workers, and markets
  - Rivers are prone to flooding and drying

Steam Power

- Humans tried harnessing steam power for millennia
  - Hero of Alexandria, Egypt – created a steam-driven device in the 1st century B.C.E.
- Thomas Newcomen, England (1704)
  - Created a steam engine to pump water from mines
- James Watt, Scotland (1769)
  - Improved Newcomen's engine to power machinery

Steam Engines

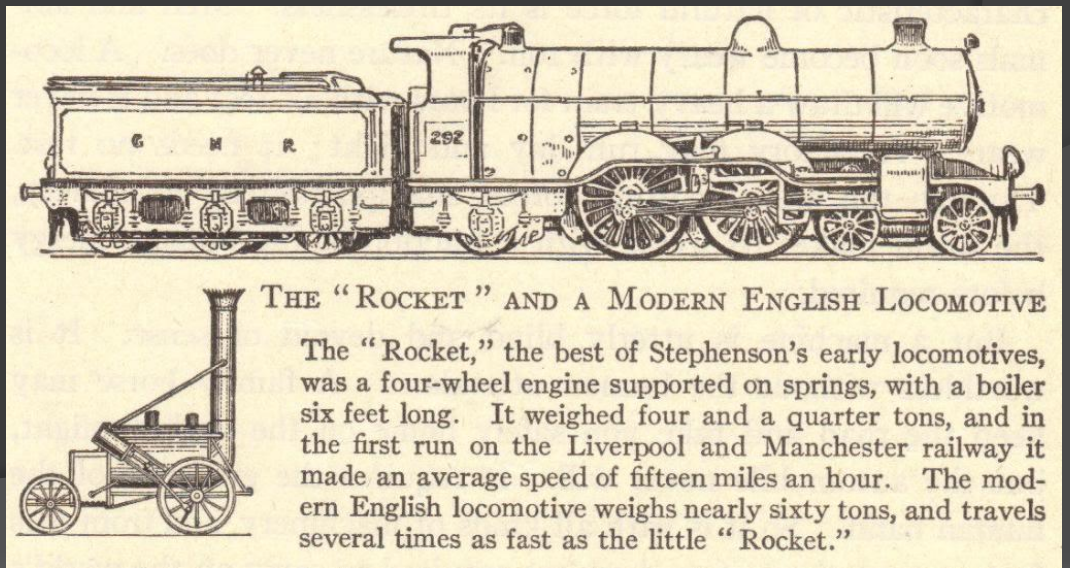
- By 1800, steam engines were replacing water wheels as sources of power for factories
- Factories relocated near raw materials, workers, and ports
- Cities grew around the factories built near central England's coal and iron mines
  - Manchester, Liverpool

Transportation

Increased production → Search for more markets and raw materials → Better and faster means of transportation

Before the Industrial Revolution
- Canal barges pulled by mules
- Ships powered by sails
- Horse-drawn wagons, carts, and carriages

After the Industrial Revolution
- Trains
- Steamships
- Trolleys
- Automobiles



THE "ROCKET" AND A MODERN ENGLISH LOCOMOTIVE

The "Rocket," the best of Stephenson's early locomotives, was a four-wheel engine supported on springs, with a boiler six feet long. It weighed four and a quarter tons, and in the first run on the Liverpool and Manchester railway it made an average speed of fifteen miles an hour. The modern English locomotive weighs nearly sixty tons, and travels several times as fast as the little "Rocket."

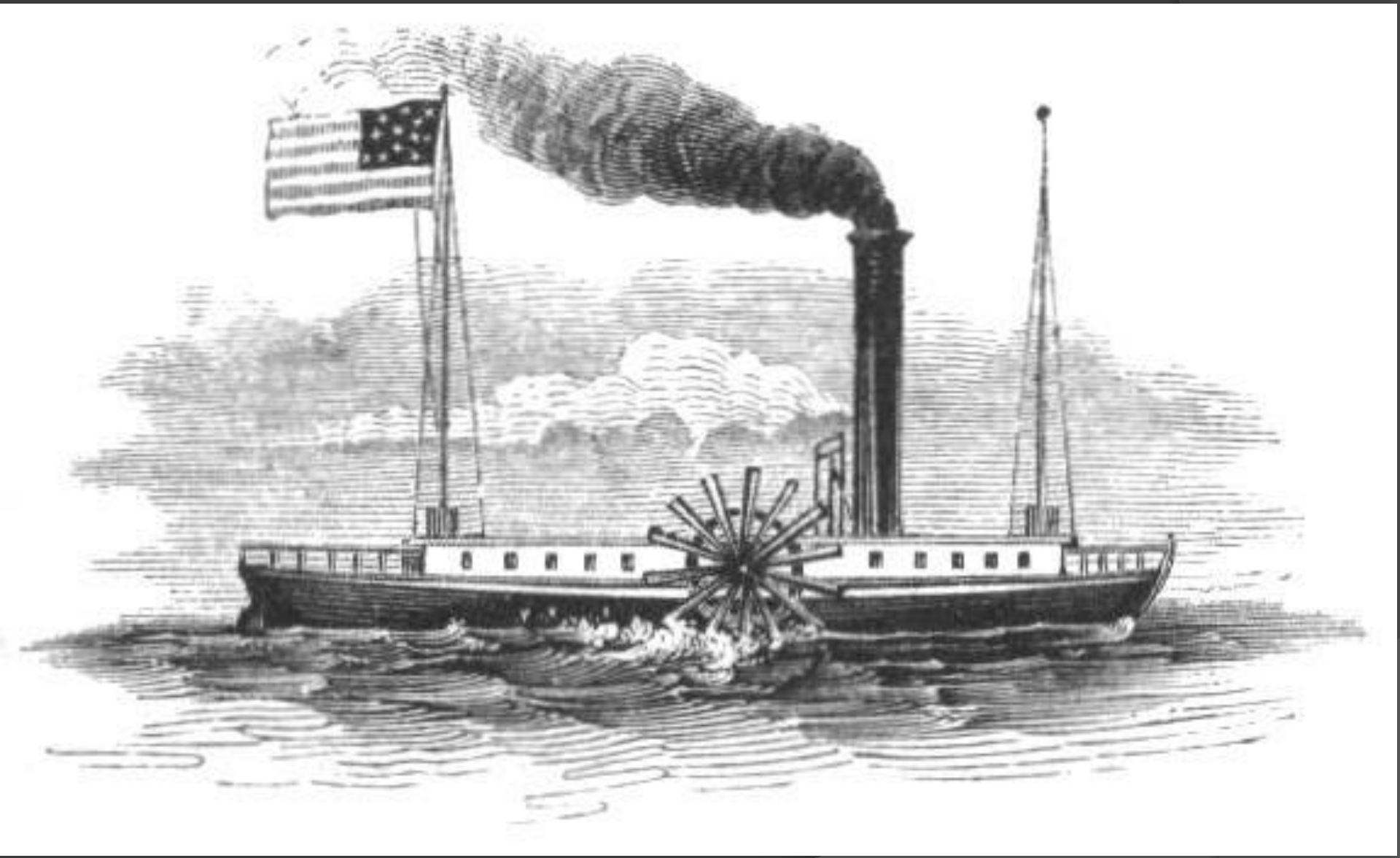
Transportation Revolution

Robert Fulton (American)	Thomas Telford and John McAdam (British)	George Stephenson (English)
• Steamboat (1807) • Sped water transportation	• Macadamized roads (1810-1830) • Improved roads	• Locomotive (1825) • Fast land transport of people and goods

Gottlieb Daimler (German)	Rudolf Diesel (German)	Orville and Wilbur Wright (American)
• Gasoline engine (1885) • Led to the invention of the automobile	• Diesel engine (1892) • Cheaper fuel	• Airplane (1903) • Air transport

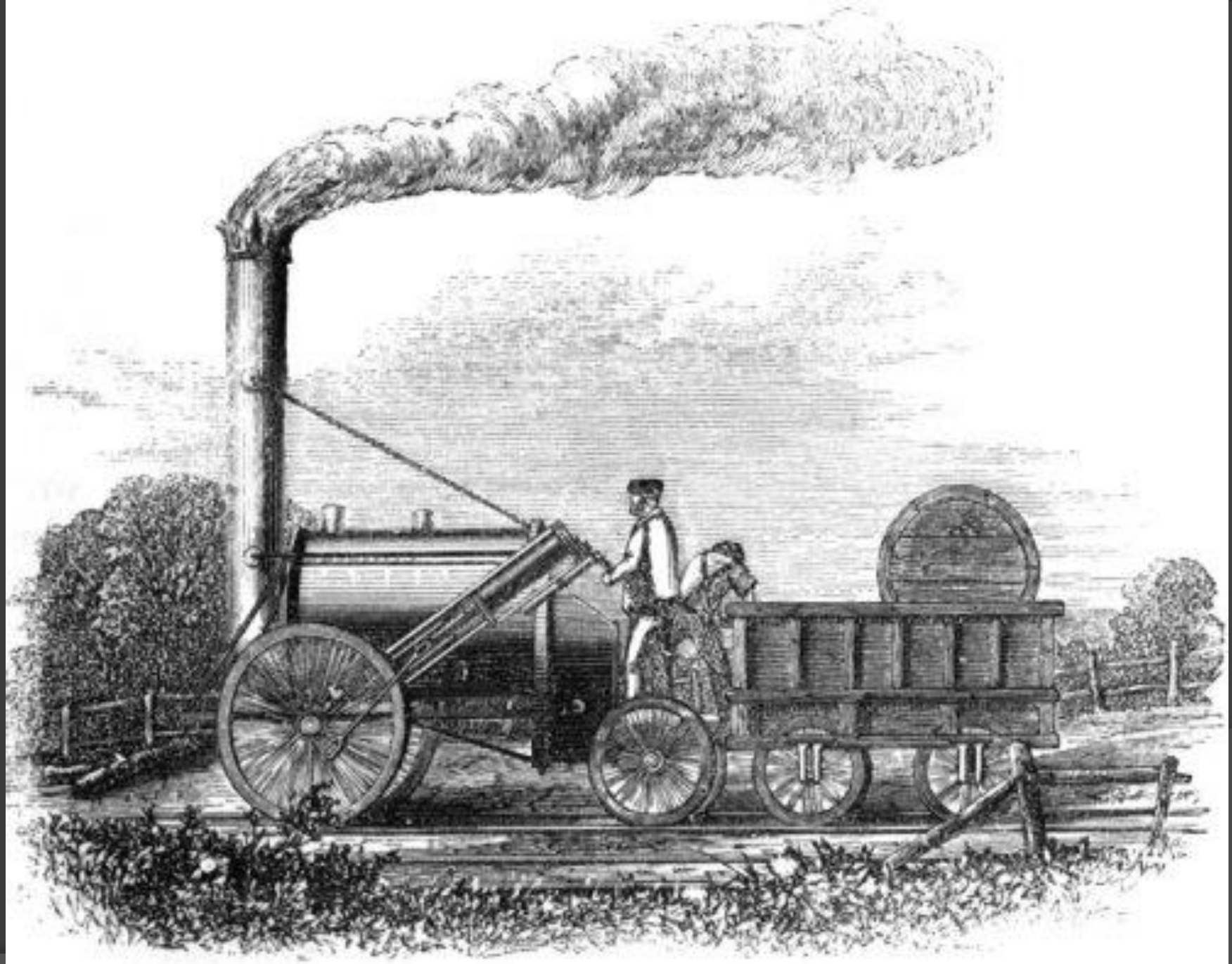
Steamboats

- Robert Fulton invented the steamboat in 1807
- The *Clermont* operated the first regular steamboat route, running between Albany and New York City
- 1819 – the *Savannah* used a steam engine as auxiliary power for the first time when it sailed across the Atlantic Ocean
- 1836 – John Ericsson invented a screw propeller to replace paddle wheels
- 1838 – the *Great* Western first ship to sail across the Atlantic on steam power alone, completing the trip in 15 days



Railroads

- 1830 – Stephenson's "Rocket" train traveled the 40 miles between Liverpool and Manchester in 1 ½ hours
- 1830-1870 – railroad tracks went from 49 miles to over 15,000 miles
- Steel rails replaced iron rails
- 1869 – Westinghouse's air brake made train travel safer
- Greater train traveling comfort – heavier train cars, improved road beds, and sleeping cars



The "Rocket."

Communications Revolution

Samuel F.B. Morse (American)

- Telegraph (1844)
- Rapid communication across continents

Alexander Graham Bell (American)

- Telephone (1876)
- Human speech heard across continents

Cyrus W. Field (American)

- Atlantic cable (1866)
- United States and Europe connected by cable

Guglielmo Marconi (Italian)

- Wireless telegraph, an early form of the radio (1895)
- No wires needed for sending messages

Lee de Forest (American)

- Radio tube (1907)
- Radio broadcasts could be sent around the world

Vladimir Zworykin (American)

- Television (1925)
- Simultaneous audio and visual broadcast

THE LABOR MOVEMENT

Changing Employee-Employer Relationships

- Domestic system
  - Workers and employers knew each other personally
  - Workers could aspire to become employers
- Factory system
  - Workers no longer owned the means of production (machinery)
  - Employers no longer knew workers personally
    - Factories often run by managers paid by the corporation
  - Relationships between employers and employees grew strained

Problems of the Factory System

- Factories were crowded, dark, and dirty
- Workers toiled from dawn to dusk
- Young children worked with dangerous machinery
- Employment of women and children put men out of work
  - Women and children were paid less for the same work
- Technological unemployment – workers lost their jobs as their labor was replaced by machines

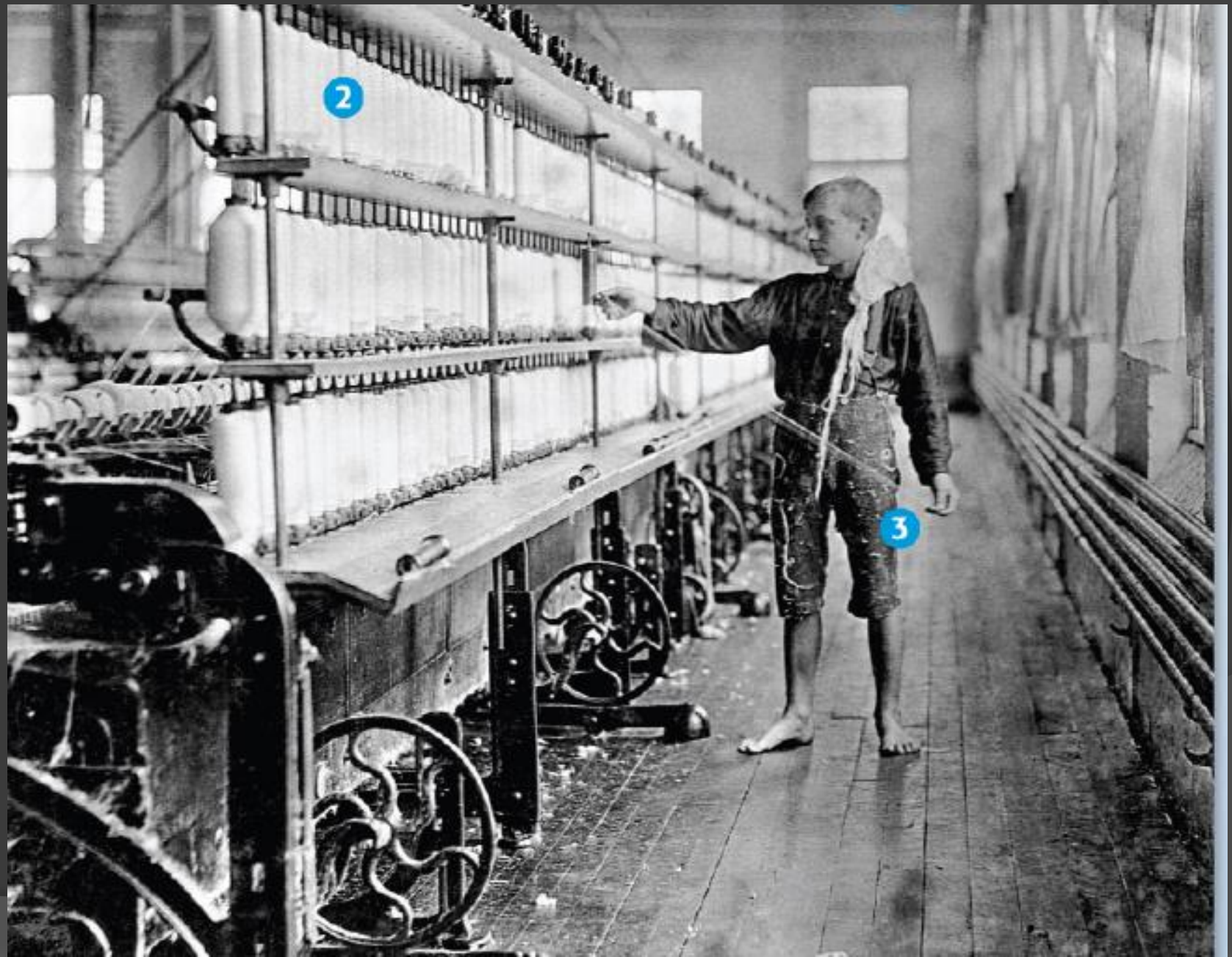
Poor Living Conditions

- Factories driven solely by profit
  - Businesses largely immune to problems of workers
- Factory (also company or mill) towns
  - Towns built by employers around factories to house workers
  - Workers charged higher prices than normal for rent, groceries, etc.
    - Workers often became indebted to their employers
    - Created a type of forced servitude as workers had to stay on at their jobs to pay their debts
  - Considered paternalistic by workers
    - Some employers had workers' interests at heart
    - But workers wanted to control their own lives

Slum Living Conditions

- Factory towns – often built and owned by factories
  - Not a strange concept to rural-to-urban migrants who were used to living on a lord's estate or property
  - Full of crowded tenements
  - Few amenities
- Tenements – buildings with rented multiple dwellings
  - Apartment buildings with a more negative connotation
  - Overcrowded and unsanitary
- Workers were unsatisfied both inside and outside the factories

Working Conditions and Wages



Working Conditions and Wages

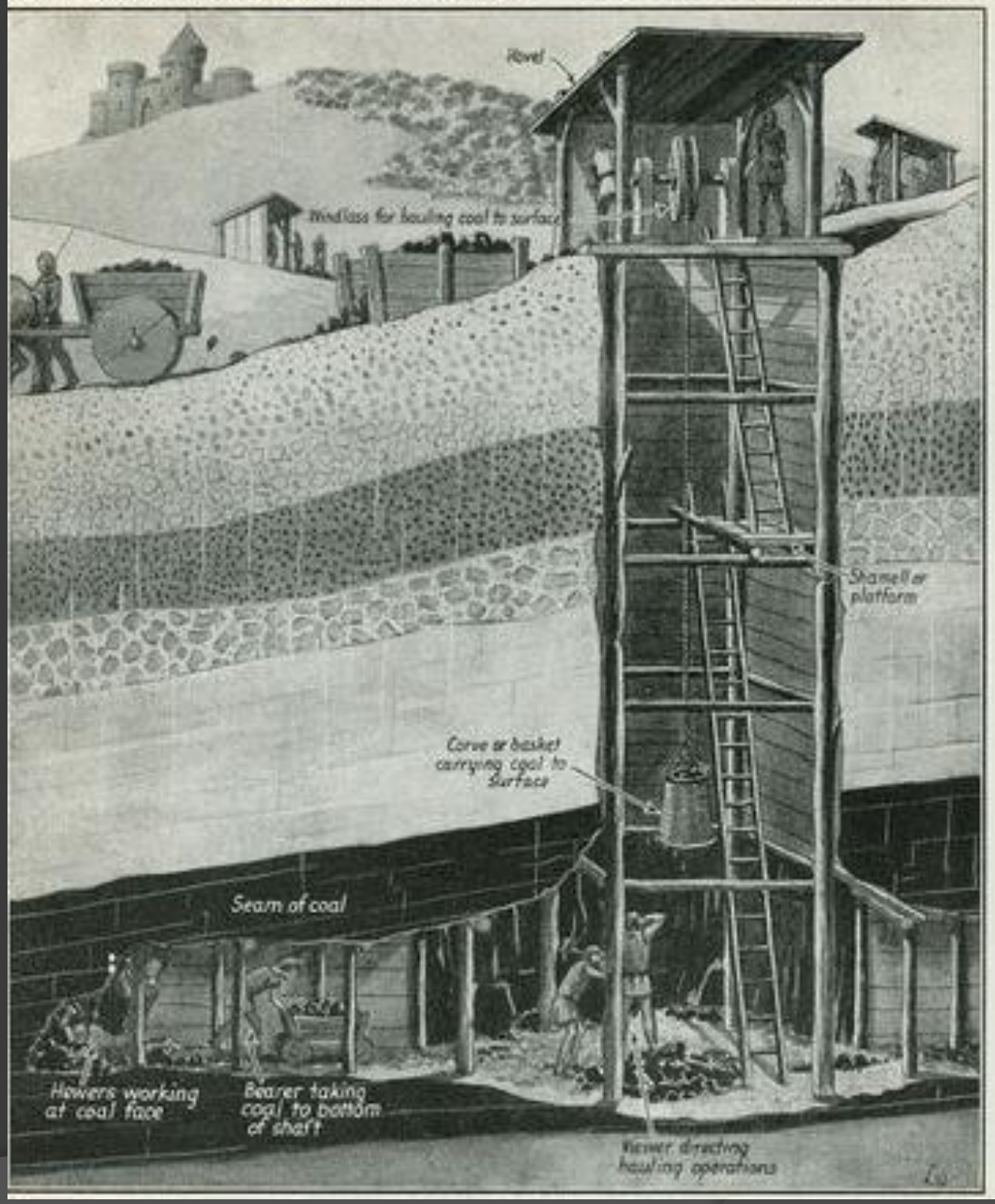
- The factory system was a major change for European workers:
  - Factory work became less skilled
  - Factory conditions were dirty, dangerous, and unhealthy
  - Workers worked long hours (12-16 hr day)
  - Factory workers were not paid well; Women & children were paid less than men
  - Owners required workers “clock in” &

Conditions in the Coal Mines

Conditions in Coal Mines

- The invention of the steam engine increased demand for coal:
  - Coal production grew from 5 million tons
    in 1750 to 23 million tons in 1830
  - Men, women, children were used in mines
  - Mines were unhealthy & dangerous: Lung disease, poison gas, drowning, explosions cave-ins were common for workers

AN EARLY COAL MINE AT WORK IN ENGLAND



Child Labor

The Day of a Child Laborer, William Cooper

William Cooper began working in a textile factory at the age of ten. He had a sister who worked upstairs in the same factory. In 1832, Cooper was called to testify before a parliamentary committee about the conditions among child laborers in the textile industry. The following sketch of his day is based upon his testimony.

5 A.M. The workday began. Cooper and his sister rose as early as 4:00 or 4:30 in order to get to the factory by 5:00. Children usually ate their breakfast on the run.

12 NOON The children were given a 40-minute break for lunch. This was the only break they received all day.

3 P.M. The children often became drowsy during the afternoon or evening hours. In order to keep them awake, adult overseers sometimes whipped the children.

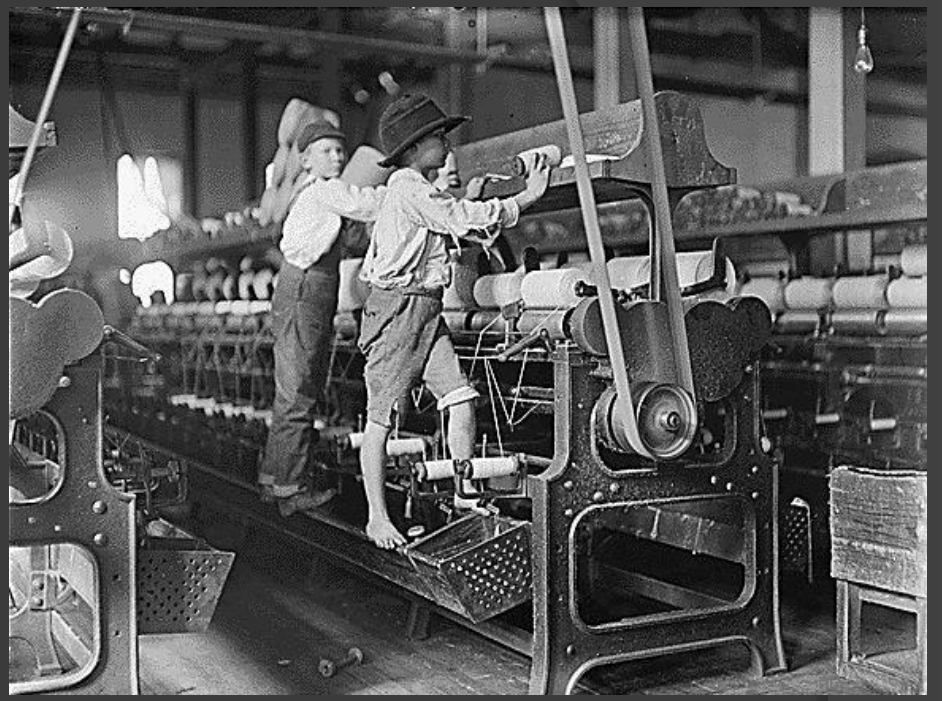
6 P.M. There was no break allowed for an evening meal. Children again ate on the run.

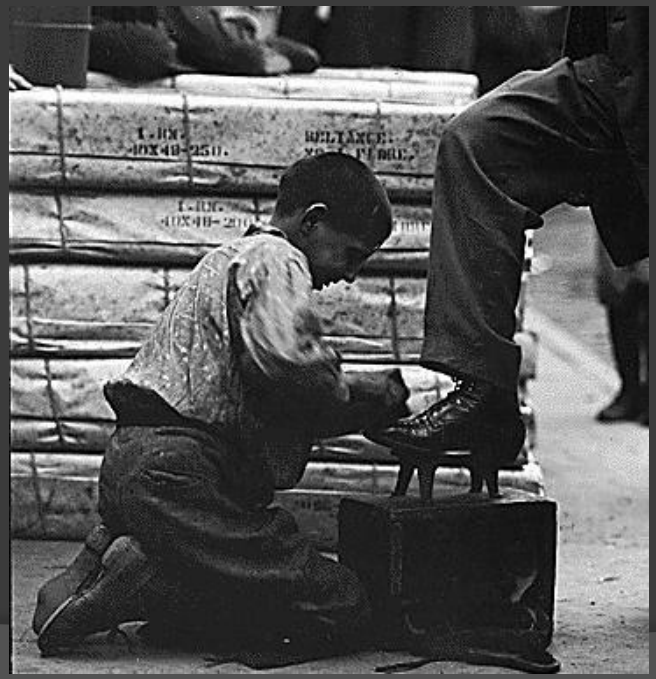
9 P.M. William Cooper's day ended after an exhausting 16-hour shift at work.

11 P.M. Cooper's sister worked another two hours even though she had to be back at work at 5:00 the next morning.

Child Labor

- The Industrial Revolution changed the lives of many children:
  - Rather than working for their parents on family farms, many children in the cities worked in factories, brickyards, or mines
  - Living in cities was expensive so poor families needed their kids to work
  - Child workers earned 10% of an adult wage, worked long hours in dangerous conditions, were often beaten





Changing Role of Women

Changing Role of Women

- The Industrial Revolution changed the lives of many women:
  - Rather than working with their husbands on family farms and taking care of children, poor women in cities worked in factories
  - Some women worked as domestic servants
  - Factory jobs for women required long hours away from their children and could leave women crippled, sick, or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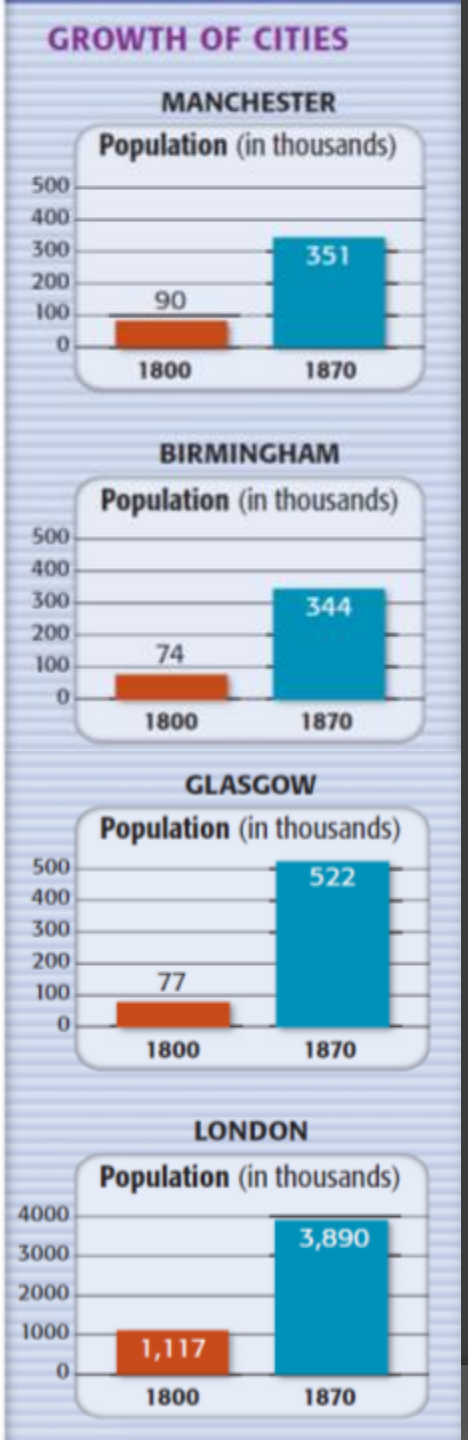
STRIVE TO EXCEL.
C. H. THOMSON'S SKIRT MANUFACTORY.

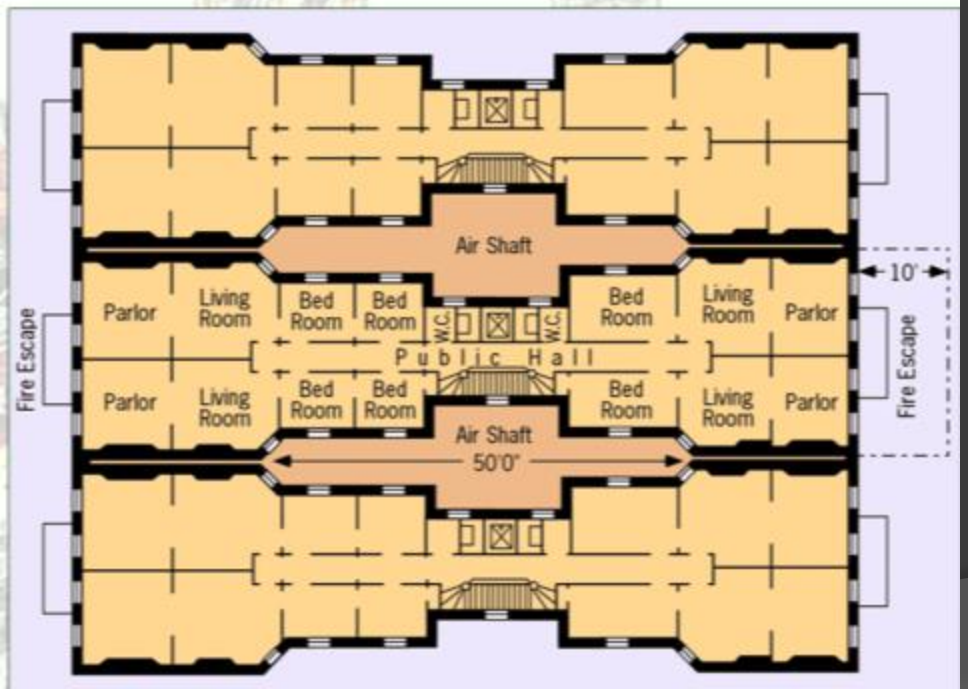
Urbanization



Urbanization

- Urbanization increased dramatically:
  - The increase in population and enclosure of farms forced people to move to cities
  - Poor families lived in poorly constructed apartments built by factory owners called tenements in neighborhoods called slums
  - Many families shared cramped apartments that lacked running water or sanitation

"Dumbell " Tenement



Rise of Labor Unions

- Before labor unions, workers bargained individually – "individual bargaining"
  - Before factories, a worker could bargain for better wages and working conditions by arguing his or her particular skills
  - But in factories, work is routine and one worker can easily replace another
- With labor unions, workers bargained together as a group, or collective – "collective bargaining"
  - Organized groups of workers elected leaders to bargain on their behalf
  - Used tools (such as strikes) to gain rights

Legal Protections for Workers

- Limited hours for women
  - Later – equal pay for equal work
- Eventual end to child labor
  - Schools and requirements for school attendance grew as children were removed from the workforce
- Health and safety codes
- Minimum wage
- Legalization of unions

Rights of Female and Child Workers

- Women and children could legally be paid less than men for the same work
  - Factory owners were more willing to hire them
  - Male workers grew resentful
- English child laborers
  - England had a history (going back to the 17th century) of training pauper children (even those younger than five years old) in a trade
  - Poor children followed their mothers into factories
- Early male-dominated unions fought to banish women and children from the workplace
  - Eventually this strategy was abandoned
  - Women eventually won right to equal pay for equal work
    - Though women today, in reality, still earn less than men at the same types of work