

# What the Industrial Age knew

**Piero Scaruffi**  
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Part II

# What the Industrial Age knew

- Industrial Revolution
- Slave trade

# What the Industrial Age knew

- Industrial Revolution
  - Bradford DeLong:
    - From the first humanoids of three million years ago 1800, living standards doubled (a growth rate of 0.00002% per year).
    - Another doubling took place from 1800 to 1870
    - Then living standards kept doubling much more often

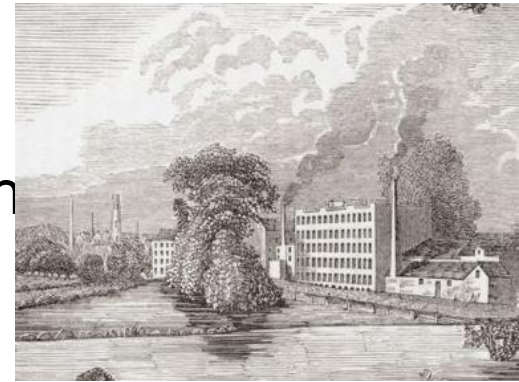
# What the Industrial Age knew

- Textile inventions



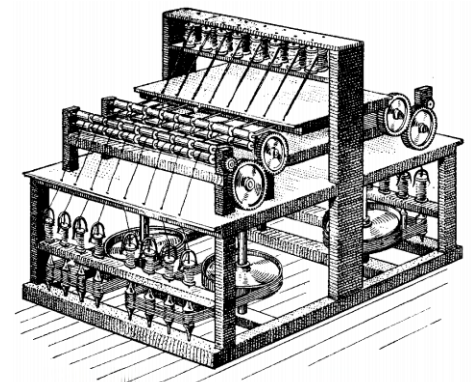
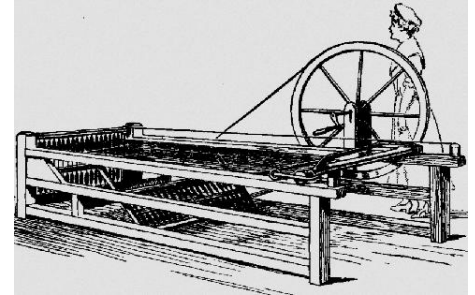
# What the Industrial Age knew

- Textile inventions
  - 1721: Thomas Lombe (Derby) builds the first factory in the world (for silk)
    - five-storey building
    - 30+ machines powered by a 7m-high waterwheel
    - 300 workers
    - 1832: Frances Trollope writes about terrible conditions of its factory workers
  - 1733: John Kay's flying shuttle for the woolen industry (clockmaker, Lancashire)
  - 1741: Lewis Paul, having invented a mechanical system to spin cotton, opens the first cotton mill (Northampton)



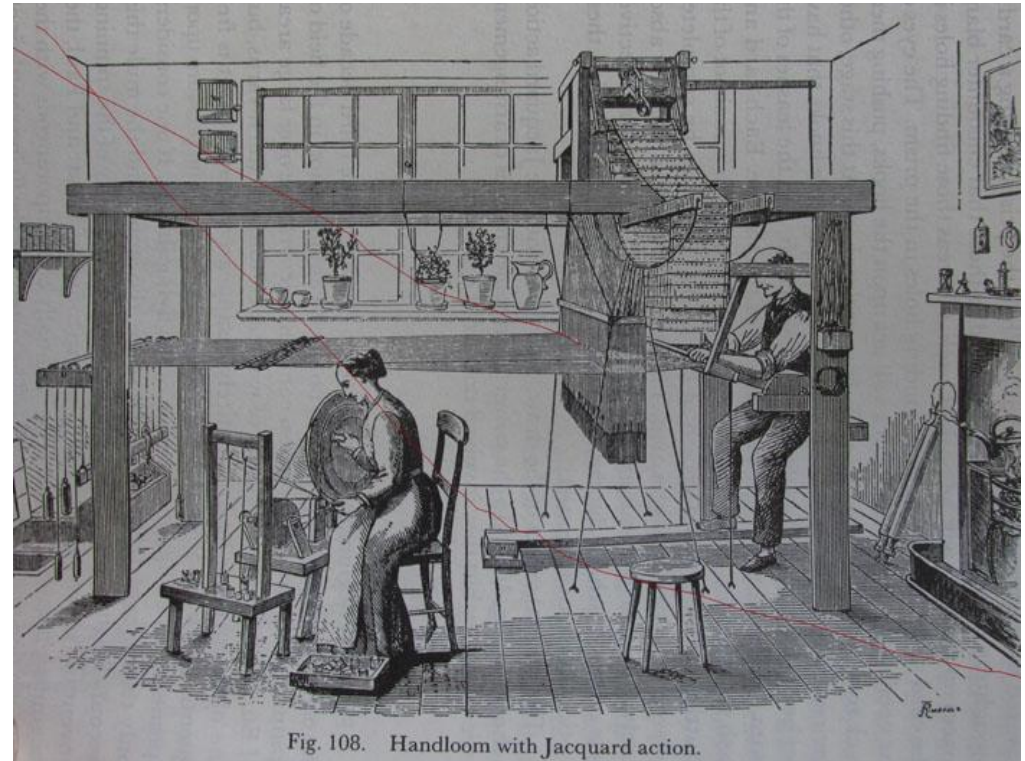
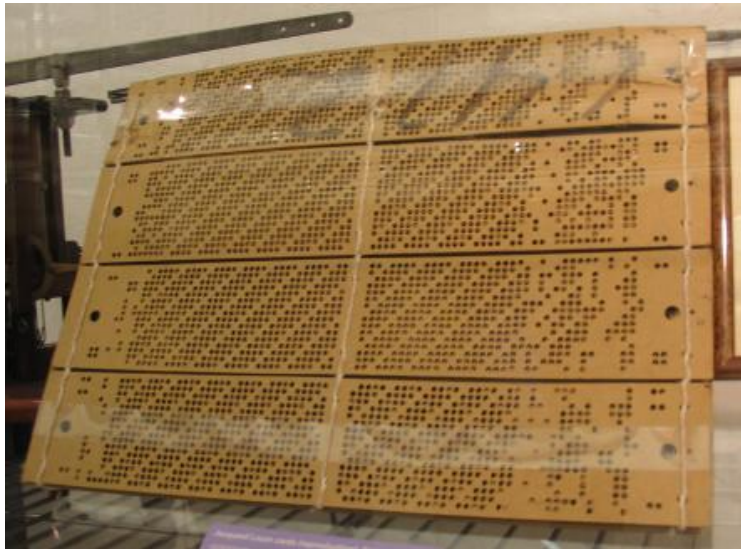
# What the Industrial Age knew

- Textile inventions
  - James Hargreaves' spinning jenny for the cotton industry (Lancashire, 1767)
  - Richard Arkwright's power-driven machinery (spinning frame, 1769) and factory system of production (the world's first water-powered mill at Cromford, Derbyshire, 1771)
  - Samuel Crompton's spinning mule (Lancashire, 1779), that combines the moving carriage of the spinning jenny with the rollers of Arkwright's water frame



# What the Industrial Age knew

- Textile inventions
  - Joseph Marie Jacquard's weaving machine (France, 1804), using "punch cards" to program the loom



(Usher: A History of Mechanical Inventions)

# The Industrial Revolution

- Britain
  - Joint-stock company ubiquitous
  - Stabilizing role of the Bank of England (1694)
  - Glorious revolution (1689)
  - The only country in Europe to move away from monarchical absolutism
  - Efficient and honest government
  - Rule of law (allowing those who made a lot of money to keep it)
  - Weak hold of the guild system



# The Industrial Revolution

- Britain
  - The publicly held corporation (an adaptation of the Roman "collegium")
    - Joint-stock company (17th c): stock certificates are transferrable (i.e. one can buy and sell an investment in a company)
    - Investment risk spread by buying shares of multiple companies
    - 1834: Britain recognizes the joint-stock company as a legal entity (that can sue and be sued)
    - 1856: Britain grants limitation of liability to joint-stock companies
    - 1864-70: Boom of incorporation in the northeastern states of the USA
    - 1890s: Market for industrial stocks

# The Industrial Revolution

- Britain
  - The Middle Ages began a slow process of replacing the arbitrary law of the lord with a rational system of taxation
  - Full confidence by capitalists in the system reached the 19th century
  - Then large immobile factories become feasible

# The Industrial Revolution

- Britain
  - Economic drivers
    - Shortage of wood shifts focus on coal
    - Plenty of streams of water and mills
    - Trade with India emphasizes cotton over wool but cotton is difficult to spin

# The Industrial Revolution

- **Britain**



First stage: cotton textile factories of Lancashire (first powered by waterwheels, then by steam)

Second stage: cast-iron factories of Shropshire (powered by steam)

# The Industrial Revolution

- Birmingham
  - Lunar Society, the most influential scientific academy, promotes the importance of machines
    - Joseph Priestly
    - James Watt's steam engine
    - William Murdoch's gaslight
    - John Wilkinson's cast-iron boat

# The Industrial Revolution

- Manchester
  - Water mills + coal mines + Liverpool's port + technology
  - Middle class runs most of the enterprises
  - 200 years of clock-making (cotton mechanics were clock-makers)
  - First polytechnic schools
  - Cotton: 0.6% of British industrial output in 1770, 9.2% in 1801, 25.3% in 1831 (more than 50% of the exports in 1830)

# The Industrial Revolution

- Steam engine
  - Boom of factories causes high demand for iron
  - Iron has to be smelt with coal
  - The demand for coke (coal ridden of its gases that enables higher temperatures) increases exponentially to smelt iron
  - Problem: pumping water out of coal mines

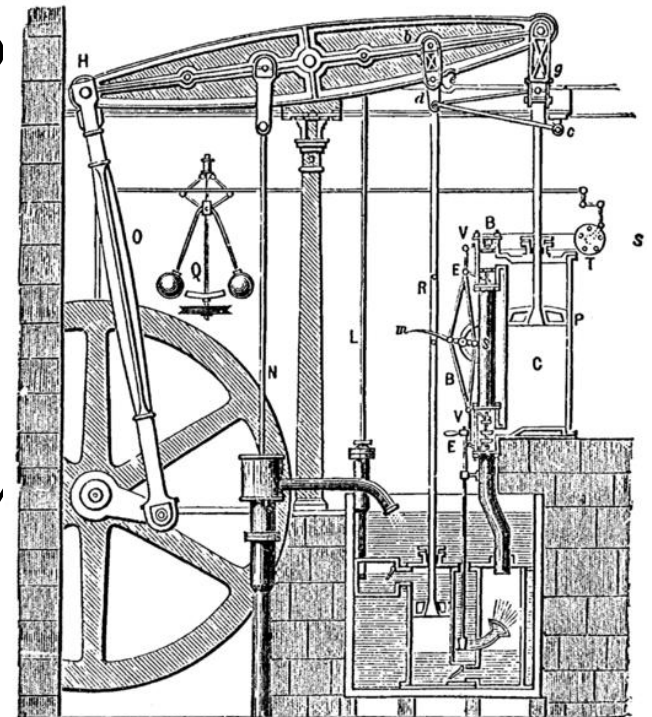
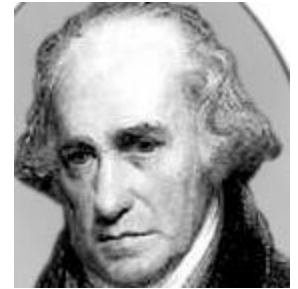
# The Industrial Revolution

- A timeline of industrialization
  - 1776: James Watt improves the steam engine
  - 1779: Samuel Crompton invents the "mule" for the cotton industry, which reduces the cost of spinning by 95% in 20 years
  - 1779: John Wilkinson builds the first cast-iron bridge, the first large cast-iron structure
  - 1782: the first steamboat sails the Clyde (Glasgow)
  - 1785: Edmund Cartwright mechanizes weaving (the "power loom")
  - 1787: Robert Peel builds an integrated spinning, weaving and printing factory
  - 1787: John Wilkinson builds the first iron boat



# What the Industrial Age knew

- James Watt (1776)
  - Fuel crisis due to deforestation
  - Coal is the substitute fuel but difficult to extract because of water in the mines
  - Steam engine needed to pump floodwater from coal mines
  - Watt perfects Thomas Newcomen's inefficient steam engine (1712)
  - Watts engine: reduces coal consumption by more than 50% (thanks to the "condenser")



# The Industrial Revolution

- Steam engine
  - 1800s: high-pressure steam engines
  - 1815: steam engine becomes feasible for designing locomotives and ships

# What the Industrial Age knew

- Steam engine
  - Transition from waterwheel to steam-power multiplies the output of textile mills
  - The textile industry moves from the riverside to the industrial city
  - Steam-power multiplies coke furnaces for cast iron
  - Freshwater more easily pumped to cities improving health
  - Steam-power revolutionizes transportation (train, steamship)

# The Industrial Revolution

- Steam engine
  - Before the steam engine:
    - waterwheels (need water)
    - windmills (need wind)
    - draft animals (need food, vulnerable to disease and exhaustion)
    - people (need food, vulnerable to disease and exhaustion)
  - After the steam engine:
    - Power (steam) can be produced anywhere any time...
    - ...as long as there is fuel (coal)
    - Industrialization favors regions near coal mines

# The Industrial Revolution

- Steam engine
  - Independent of location, time, weather, people
  - Moves the factory from the countryside (rivers) to the city (where there is plenty of labor)
  - Cities become industrial hubs
  - Cast iron becomes the plastic of its time
  - First major innovation in transformation of energy since the windmill
  - Biggest impact on daily life since the printing press

# The Industrial Revolution

- Steam engine
  - Consequence: high demand for iron to build steam engines
  - And in turn steam engines facilitate the mass production of iron
  - Collapsing price of cast iron makes it popular as a building material
  - John Wilkinson builds iron parts for Watt's engine and uses Watt's engine to make iron

# The Industrial Revolution

- The Factory
  - One source of power for many machines
  - 1771: Richard Arkwright opens the first factory powered by water power (Nottingham, for cotton spinning)
  - Labor force: mostly women and children and a few male supervisors
  - 1785: Arkwright installs Wall's steam engine and created the first steam-powered cotton mill
  - The location of a factory is no longer based on where the waterpower is (rural sites near rivers) but on where cheap labor, coal and merchants are: the town
  - 1800: Boulton & Watt have sold 500 steam engines mostly to mines but also to blast furnaces and to factories and to pump freshwater to cities (Paris, 1782)

# The Industrial Revolution

- Machines
  - Machines convert natural resources (water, coal) into work
  - Machines replace humans: they work 24 hours, no holidays, no illness, no mistakes
  - Inanimate sources of energy (water and coal) replace animate ones (horses, cattle, humans)
- Virtually unlimited supply of work
- Workers need little or no skills (ever younger children get employed by factories)
- Machines to build ever better machines that require ever fewer skills
- The issues becomes time



# The Industrial Revolution

- The textile industry
  - Powered machinery first used for spinning yarn in the cotton industry
  - 1788: 143 watermills in the cotton industry in Britain
  - 1787: Cartwright's power loom
  - Boom of cheap low-quality cotton garments for the lower classes
  - 1829: 55,500 power looms but still more than 200,000 handlooms
  - After the 1838 depression, the power loom wins
  - 1850: the quality of textiles produced by the power loom is almost equal to the handloom's

# The Industrial Revolution

- The textile industry
  - The industrial revolution is mainly a revolution in quantity of goods produced (thanks to the energy from coal via steam engines)
  - Technology of the industrial revolution: the grandchild of the clock, the most sophisticated mechanical artifacts (especially the portable watch)
  - The industrial revolution causes a revolution in transportation because raw materials (e.g. coal) need to be transported to the factory and goods need to be transported to the market (railways, ships)

# The Industrial Revolution

- Iron and steel industry
  - Before Watt's steam engine, furnaces have to be located close to forests because charcoal deteriorates when transported over long distances
  - The steam engine lowers the cost of mining coal, of transporting it and of casting iron/steel
  - 1856: Bessemer converter: cheap steel
  - Pig iron production in Britain: 25,000 tons in 1720, 125,000 tons in 1796, almost 8 million tons in 1880

# The Industrial Revolution

- The inventors
  - Inventors are ordinary people, not academics and not nobles
    - Hargreaves (poor weaver), Arkwright (barber, the 13th child of a poor family), etc
  - The automation of manufacturing begins in Lancashire, not at a royal court or at a university

# The Industrial Revolution

- Labor force
  - Artisans who lost their source of livelihood
  - Poor peasants who migrate to industrial cities
  - Unskilled women and children (the factory does not require skills)
  - A new social class: the proletariat

# The Industrial Revolution

- Labor force
  - Artisan's shop: unity of the household and the workplace, owner in an expert in the craft (even apprentices live with the family of the owner)
  - Factory: separation of workplace and household, social gap between owner and employees

# The Industrial Revolution

- The workers
  - The worker has to migrate from the town to the city
  - The worker is alienated from her natural environment and from the rhythms of nature
  - Wealth gap between capitalists and workers
  - Transition from rural poverty to urban poverty

# The Industrial Revolution

- The workers
  - Overcrowded factory towns beget new diseases (cholera epidemics of 1832, 1848, 1853)
  - Working conditions (long hours, dangerous machinery, pollution) shorten life expectancy
  - James Kay’s “The moral and physical condition of the working-class employed in the cotton manufacture in Manchester” (1832)
  - Edwin Chadwick’s “The Sanitary Condition of the Labouring Population” (1842)
  - Friedrich Engels’ “Condition of the Working Class in England” (1844)
  - Public Health Act (1848)
  - Great Stink of London (1855)



# What the Industrial Age knew

- The consumers
  - Mass production factories create consumerism
  - Consumerism creates the yearning for luxury
  - There are neither necessities nor luxuries anymore because the luxuries of the previous generation automatically become the necessities of the next one
  - The consumer has to live with the other byproducts of technology too: pollution, urban chaos

# The Industrial Revolution

- The bourgeoisie
  - Factory owners
  - Railroad builders and shipbuilders
  - Bankers and insurers
    - Barings funds Thomas Jefferson's purchase of Louisiana
    - Barings funds the indemnity paid by France to Germany after the Napoleonic wars
    - *"There are six great powers in Europe: England, France, Prussia, Austria, Russia and the Baring Brothers"* (5th Duke of Richelieu)
    - *"The Barings are the true lords of Europe"* (Byron)
  - Lawyers
  - Importers of raw materials
  - Exporters of finished goods
  - Engineers

# The Industrial Revolution

- In general:
  - Rising living standards
  - A constant expectation of progress
  - Shift of economic power from landowners/aristocrats/merchants towards industrialists
  - Large-scale human movement
  - Transportation revolution (and therefore trading revolution)

# The Industrial Revolution

- In general:
  - Traditional values and ways of life become obsolete
  - Many skilled workers find their skills worthless
  - New professions and specializations
  - Technology is ahead of science
  - A secular intellectual elite replaces the priest
  - Women excluded from engineering and science

# The Industrial Revolution

- In general:
  - 12th c - 16th c: Growth of trade drives technological progress
  - 18th c: technological progress drives growth of trade

# What the Industrial Age knew

- Industrial Revolution in Britain
  - For centuries the GDP per capita did not change: poverty was ubiquitous
  - The transition out of poverty started in one country: Britain
  - Britain:
    - Institutions: patents (that encourage inventors) and free market
    - Energy: coal and the steam engine
    - Iron and metallurgy
    - Fertile land
    - International trade (ports)

# What the Industrial Age knew

- Industrialization in the rest of the world:
  - The pace at which a nation developed depends on the distance between London and that nation's population centers
  - Industrial development takes place only in regions that have coal (e.g., not in Africa)

# What the Industrial Age knew

- The progress of Industrialization
  - Long-distance navigation creates a need for clockmaking (maritime chronometer) and optical instruments (telescope)
  - These technologies lead to the steam engine, first applied to mining
  - The steam engine triggers the industrialization of textile industry (the factory), transportation (the steamship) and agriculture (in the USA)



# A Timeline of the Working Class

- Tudors and Stuarts (15th-16th centuries): paternalistic system of labor
- 16th century: Poverty becomes an issue
- 1563: Statute of Artificers:
  - Enforcement of labor
  - Seven-year apprenticeship

# A Timeline of the Working Class

- 1601: Elizabethan Poor Law (The Poor Relief Act)
  - Poorhouses for the invalids and blind
  - Houses of Industry (workhouses) for poor people who can work
  - Houses of Correction for poor people who don't want to work
  - Apprenticeship for pauper children
  - Outdoor relief (money, food, clothing or goods in alternative to institutions)

# A Timeline of the Working Class

- 1660: Thomas Lawson (Quaker) publishes "An Appeal to the Parliament concerning the Poor, that there may not be a Beggar in England" (1660)
- 1662: Act of Settlement and Removal: parish serfdom
  - A person belongs to a parish
  - Restriction in the movement of poor people from one parish to another
  - Poor people forced to work but prevented from looking for work outside their home parish
- 1688: Glorious Revolution

# A Timeline of the Working Class

- 1696: John Bellers' utopian Colleges of Industry to provide full employment to the poor
- 1704: Daniel DeFoe proves that eliminating poverty would cause an economic catastrophe: without poverty people's productivity is lower and eventually this will cause famine, and giving poor people government jobs takes away cheap labor from private companies which in the long-term causes economic ruin

# A Timeline of the Working Class

- 1763: End of the Seven Years War
  - Boom of trade (notably of exports)
  - But also boom of poverty
  - Fluctuations in trade cause unemployment in both rural countryside and industrial towns
  - Overpopulation causes unemployment
  - Industrial towns are a cultural wasteland
  - The industrial revolution creates extreme wealth but also extreme poverty

# A Timeline of the Working Class

- 1795: Speenhamland Law
  - Abolition of parish serfdom
  - "Right to live": subsidies guarantee a minimum wage to
  - the laborer, rural communities given some protection from the competition of industrial towns
  - Consequence: Increase in spare time
  - Consequence: Decline of labor productivity
  - Consequence: The poor have little motivation to get out of poverty
  - Consequence: Subsidies prevent the emergence of a working class movement
  - Consequence: No revolution in Britain

# A Timeline of the Working Class

- 1786: Joseph Townsend's "A Dissertation on the Poor Laws" opposes public welfare assistance
- 1797: Arthur Young's Industry-Houses (exploitation of the labor of the assisted poor), 250 are built with 500,000 inmates
- 1798: Thomas Malthus' "An Essay on the Principle of Population" opposes public welfare assistance
- 1813: Robert Owen's "villages of unity and cooperation" (modeled after Bellers)
- 1815: Mass unemployment at the end of the Napoleonic Wars

# A Timeline of the Working Class

- 1830: John Doherty founds the National Association for the Protection of Labour
- 1832: The Great Reform Bill grants voting rights to the middle class
- 1834: Poor Law Reform: the labor market is liberalized, outdoor relief is abolished
  - Consequences: Labor becomes a commodity with prices set by the market
  - Consequence: Competition spawns the emergence of a working class movement
- 1847: Britain enacts the "Ten Hours Bill", which Karl Marx hails as the first victory of socialism



# The Industrial Revolution

- The British agricultural revolution (1750-1850)
  - No major progress in farming between the 8th and 18th centuries
  - 18th century:
    - new tools,
    - four-course system,
    - new American crops,
    - livestock breeding,
    - large-scale farming

# The Industrial Revolution

- The British agricultural revolution (1750-1850)
  - Tools
    - 1701: Jethro Tull's horse-drawn drill for planting seeds and the book "Horse hoeing husbandry" (1731)
    - 1703: The Rotherham plow
    - 1786: Andrew Meikle's threshing machine
    - 1808: Robert Ransom's iron plow
    - 1827: Patrick Bell's reaping machine

# The Industrial Revolution

- The British agricultural revolution (1750-1850)
  - Selective breeding of livestock
    - 1750s: Robert Bakewell's New Leicester sheep
    - 1780s: Robert and Charles Colling's shorthorn cattle breed

# The Industrial Revolution

- The British agricultural revolution (1750-1850)
  - Charles Townshend popularizes the four-year rotation (late 17th century): fodder crops and no fallow year (1. wheat, 2. turnips, 3. barley, 4.clover)
  - Turnips and clover preserve soil fertility
  - Increase in fodder leads to increase in livestock (which leads to a meat diet)
  - Increase in fertilizer produced by livestock (dung-pits to preserve animal manure, 1750s)
  - Also large-scale production of new crops, such as potato and maize (mid 18th c)
  - Arthur Young's Annals of Agriculture (1784)

# The Industrial Revolution

- The British agricultural revolution (1750-1850)
  - Land reclamation (clearing of woodland, cultivation of upland pastures)
  - The Inclosure Acts (1773-1801) allow wealthy landowners to purchase common fields from poorer farmers who become tenant farmers
  - Agrarian capitalism (efficient farm management): landowners, tenant farmers and laborers
  - More land available for farming and more efficient methods of farming

# The Industrial Revolution

- The British agricultural revolution (1750-1850)
  - The increase in the food supply causes a population boom
  - English population: 5.7 million in 1750 just like in the Roman period, but 16.6 million in 1850, and agricultural output expanded with it
  - The Agricultural Revolution creates unemployment in the countryside, i.e. emigration towards the cities, i.e. provides cheap labor for the industrial revolution
  - 1850: only 22% of the British workforce is still in agriculture

# The Industrial Revolution

- Agriculture
  - 1810: Nicholas Appert invents canning in glass containers
  - 1830s: Metal cans for canning food

# The Industrial Revolution

- The north/south cold/warm divide: temperature or religion?
  - Civilization had always thrived in the warm regions of the planet (Egypt, Greece, Mesopotamia, southern Italy, Indus Valley, Yellow River Valley, Islamic world) whereas the cold regions were the regions of the “barbarians” (agriculture/trade vs nomads)
  - By the age of the industrial revolution the pattern had reversed: northern (colder) countries were richer than southern (warmer) countries



# The Industrial Revolution

- The north/south cold/warm divide: temperature or religion?
  - The southern countries burned or silenced their scientists, such as Galileo
  - The northern countries rewarded their Newtons
  - The descendants of Newton invented the steam engine.
  - The descendants of Galileo invented the pizza.

# The Industrial Revolution

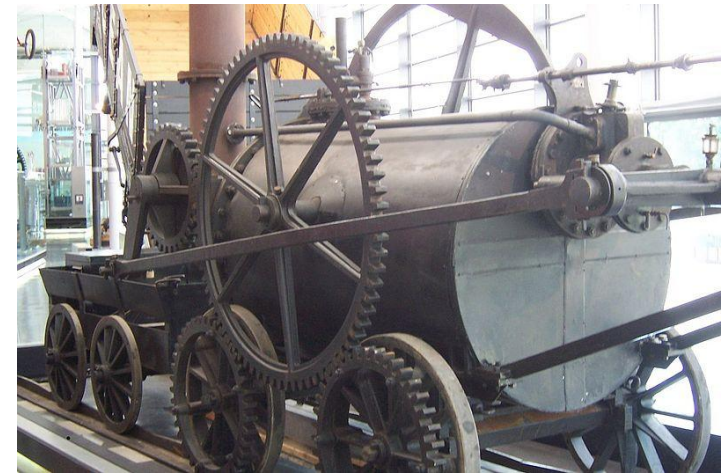
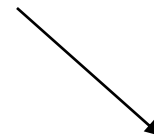
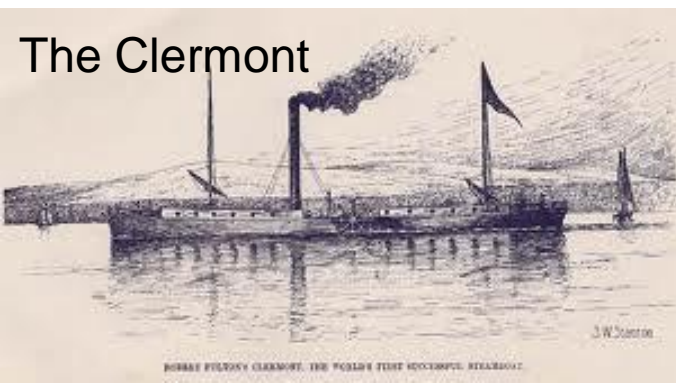
- **Transportation revolution**



Napoleonic coach

# The Industrial Revolution

- Transportation revolution
  - 1761: Francis Egerton finances the Bridgewater Canal
  - England's private sector creates a national network of canals to transport fuel and goods
  - 1800: Robert Fulton builds the first steam paddleship, the Clermont (propelled by Watt's steam engine) launching the era of steamships
  - 1804: Richard Trevithick builds the world's first locomotive ("Iron Horse"), launching the era of trains



# The Industrial Revolution

- Transportation revolution
  - 1812: Henry Bell starts the first commercial steamboat service in Glasgow
  - 1819: The "Savannah" (New York shipyard of Fickett & Crockett) completes the first transatlantic crossing by a steamboat (in 28 days)
  - 1820: The first iron steamship, the "Ann Manby"
  - 1829: George Stephenson's "Rocket" steam engine to propel a train
  - 1830: The world's first commercial railroad opens (George Stephenson's Liverpool-Manchester)
  - 1838: Regular transatlantic ship service begins

The Savannah



# The Industrial Revolution

- Transportation revolution
  - 1829: George Stephenson's "Rocket" steam engine to propel a locomotive
  - 1830: The world's first commercial railroad opens (George Stephenson's Liverpool-Manchester)
  - 1838: Regular transatlantic ship service begins

The Savannah



Stephenson's  
"Rocket"  
locomotive  
(Museum of  
Science,  
Chicago)



# What the Industrial Age Knew

- Electrical revolution
  - William Gilbert (1600): coins the term "electricity" (from "elektron", the Greek word for amber: amber becomes charged by rubbing)
  - Otto von Guericke (1660): the first machine for producing static electricity
  - Robert Boyle (1675): electric force is transmitted through a vacuum
  - Stephen Gray (1729): conductors and nonconductors, positive and negative charge (electricity flows from one place to another)
  - Pieter van Musschenbroek (1745): invents the Leyden jar, a "condenser" that can store static electricity but discharge it only all at once

# What the Industrial Age Knew

- Electrical revolution

- Benjamin Franklin (1752): lightning is a form of electricity
- Luigi Galvani (1771) discovers that nerve cells are conductors of electricity
- Charles Coulomb (1791): law of attraction and repulsion

$$F_{elec} = K \frac{q_1 q_2}{r^2}$$

- Alessandro Volta (1800): battery converts chemical energy into electricity
- Thomas Young (1801) discovers the wave nature of light
- Humphry Davy's "On Some Chemical Agencies of Electricity" (1806): chemistry and electricity are related

# What the Industrial Age Knew

- Electrical revolution
  - Hans-Christian Oersted (1820): an electrical current has magnetic properties
  - 1825: William Sturgeon invents the electromagnet
  - 1831: Michael Faraday invents the transformer and the dynamo (electricity and magnetism together can produce motion)
  - Faraday proves that all electricities (Franklin's, Galvani's, Volta's) are the same and views space as full of electricomagnetic fields (but does not use mathematical proofs, only intuition)
  - The identity of electrical and chemical forces



# What the Industrial Age Knew

- Chemistry
  - Joseph Black (1755): carbon dioxide
  - Henry Cavendish (1766): hydrogen
  - Joseph Priestly (1774): oxygen
  - Henry Cavendish (1785): water and air are not elements but compounds (oxygen+hydrogen, oxygen+nitrogen)
  - Antoine Lavoisier (1777): combustion is a form of oxidation (combination with oxygen), water contains oxygen and hydrogen
  - Antoine Lavoisier (1789): conservation of mass (the quantity of matter is the same at the end as at the beginning of every chemical reaction)

# What the Industrial Age Knew

- Chemistry
  - Alessandro Volta invents the battery (1800)
  - John Dalton (1803): matter is composed of atoms of differing weights
  - Humphry Davy (1806-8): potassium, sodium, calcium
  - Humphry Davy's "On Some Chemical Agencies of Electricity" (1806): chemistry and electricity are related
  - Joseph von Fraunhofer invents the spectroscope (1814)

# What the Industrial Age Knew

## Lighting revolution

1792: William Murdoch invents gas lighting

1812: The London and Westminster Chartered Gas-Light and Coke Company is established

# The Atlantic Slave Trade

- Sugar consumption in Europe
  - 1400: exotic rarity
  - 1700: a necessity, but an expensive one
  - 1800: 4 kgs/year per person
  - 1900: 50 kgs/year per person
  - (2000 in USA: 30 kgs per person)

# The Atlantic Slave Trade

- History of Sugar Plantations till 1700
  - Originally from Southeast Asia, then India (ubiquitous by Alexander's time), then Iran
  - Greeks and Romans used honey as a sweetener
  - Arabs acquired sugar when they invade Iran and spread it all over the southern Mediterranean in large scale operations
  - Crusaders discovered sugar in Palestine/Lebanon and Italians managed sugar operations
  - Mongol expansion and loss of Palestine (1291) force the Italians to move operations elsewhere
    - Cyprus, Crete, Sicily
    - Labor-intensive
    - Capital-intensive

# The Atlantic Slave Trade

- History of Sugar Plantations 1200-1700
  - Portuguese possessions
    - Madeira (1480s): Italian techniques and capital (Sicilian technology and marketing by Lomellino family of Genoa), indigenous labor force (biggest exporter of sugar in the world in 1500)
    - Sao Tome` (1500s): exclusively slave labor, faster-growing operations (between 1501-1550 it imports more African slaves than Europe or America)
    - Brazil (1540s): Amerindian and African slaves, larger and faster-growing operations (funded by Genoese entrepreneurs)

# The Atlantic Slave Trade

- History of Sugar Plantations 1200-1700
  - Portuguese possessions
    - The combination of sugar and slaves brings imperial wealth
    - Sugar becomes as important as Asian spices
    - The sale of African slaves to Spain helps pay for Asian spices

# The Atlantic Slave Trade

- History of Sugar Plantations 1200-1700
  - Portuguese possessions
    - 1547: The Inquisition forces many Jews to emigrate to the American colonies of the Iberian kingdoms
    - 1648: Netherlands protects the Jews persecuted by Spain and Portugal and gains their knowledge and skills in international trade
    - 1654: Netherlands leaves Brazil and the Jews spread to the West Indies (Curacao), Surinam and North America (New Amsterdam), turning them into major operations



# The Atlantic Slave Trade

- History of Sugar Plantations 1700-1900
  - Caribbean islands, 1700s
    - Barbados, Jamaica (English): Estates over 200 acres, over 100 slaves
    - Martinique, Guadelupe , Saint Domingue (French): Estates over 1000 acres, over 200 slaves
      - In 1763 Britain offers the whole of Canada for Guadeloupe
    - From 1713 to 1822 the West Indies lead Asia, Africa and North America in commodities exported to Britain
    - The Haiti revolution (1791) shifts production to North America, Brazil and Cuba

# The Atlantic Slave Trade

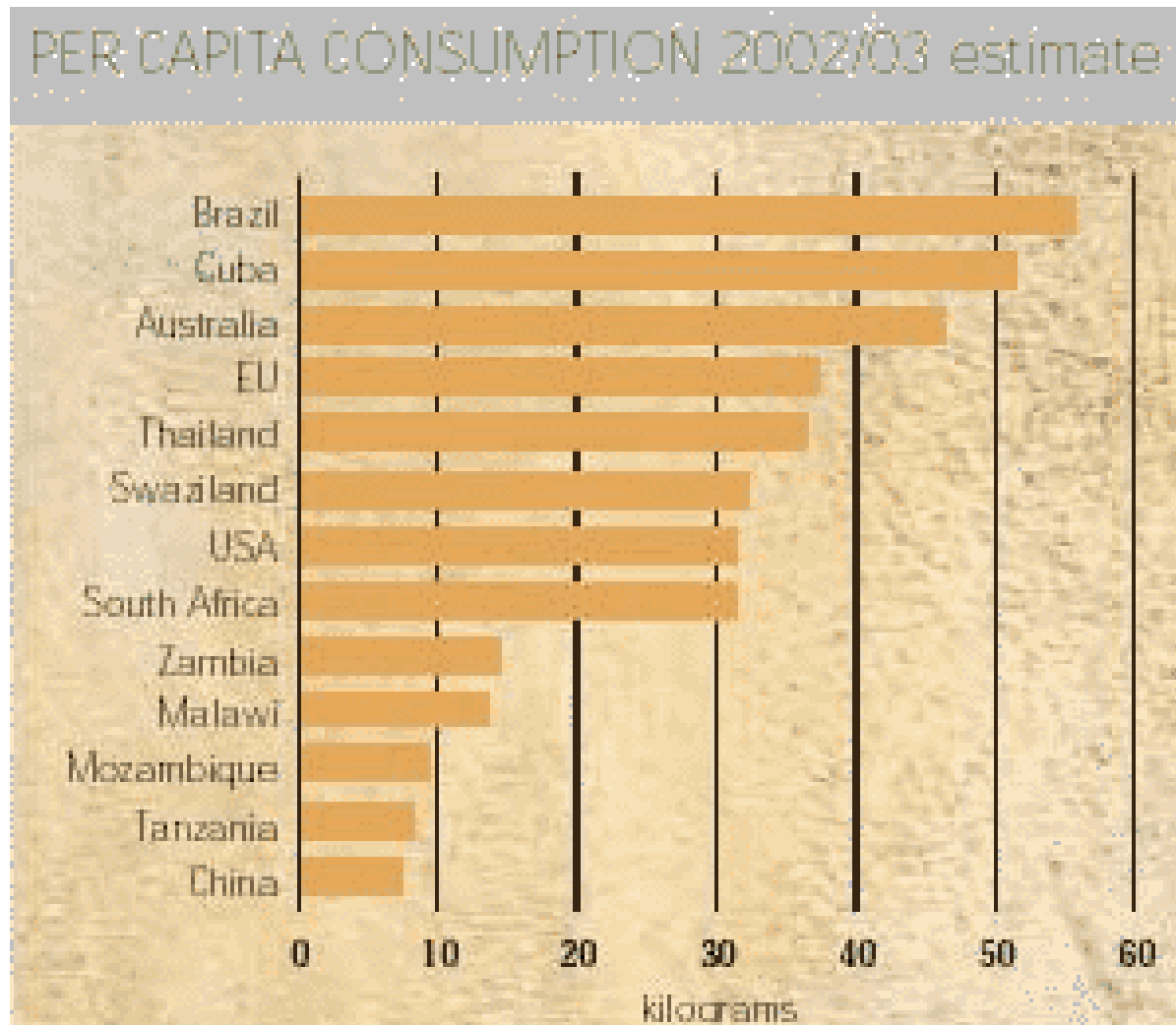
- History of Sugar Plantations 1700-1900
  - USA Plantations, 1800s
    - Population not self-sustaining, required constant flow of new slaves
    - Diversification: tobacco, cotton
    - Cotton fueled industrial revolution
    - Large-scale, capitalist operations
    - Specialization and mass production

# The Atlantic Slave Trade

- History of Sugar Plantations 1700-1900
  - Britain
    - Sugar has become a necessity by 1800
    - Britain: 9 kgs per person per year
    - France: not even 1 kg
    - Imported sugar indispensable for drinking imported tea, imported coffee and imported chocolate from imported porcelain

# The Atlantic Slave Trade

- **History of Sugar Plantations 1700-1900**



# The Atlantic Slave Trade

- 700: Zanzibar becomes the main Arab slave trading post in Africa
- 1325: Mansa Musa, the king of Mali, makes his pilgrimage to Mecca carrying 500 slaves and 100 camels
- 1453: After the fall of Constantinople and the loss of their eastern trading posts, the Italians turn to Africa for slaves
- 1482: Portugal founds the first European trading post in Africa (Elmira, Gold Coast)
- 1494: The Treaty of Tordesillas gives Portugal a virtual monopoly over the supply of labor from West Africa
- 1500-1600: Portugal enjoys a virtual monopoly in the slave trade to the Americas
- 1528: Spain issues "asientos" (contracts) to private companies for the trade of African slaves

# The Atlantic Slave Trade

- 1650: Holland becomes the dominant slave trading country
- 1700: Britain becomes the dominant slave trading country

# The Atlantic Slave Trade

- 1750s: Britain transports 200,000 African slaves per decade to North America
- 1750s: Brazil imports 170,000 African slaves (50% from Luanda) to the ports of Rio and Bahia and exports salsaparilla, coffee, tobacco and alcohol
- Britain defeats France in the Seven-years War (1756-63) in India, Canada and Africa
- 1758: Britain captures French “factories” in Africa
- More than 60% of all slaves are still employed in sugar plantations
- Spain is producing most of the world’s sugar but its people are too poor to buy it
- Mostly triangular trade (Africa-Europe-America) but also direct (Angola-Brazil)

# The Atlantic Slave Trade

- 1760s: Britain transports 250,000 African slaves from Benin, Niger Delta, Loango
- 1760s: Brazil imports 160,000 African slaves
- 1767: French colonies export more sugar than British colonies and import slaves mostly from Loango
- 1770s: Saint-Dominique imports 40,000 slaves a year
- 1780s: 750,000 African slaves transported to America
- 1781: An English ship in trouble throws 132 slaves overboard to claim the insurance on valuable goods (not redeemable if the slaves had died a natural death)



# The Atlantic Slave Trade

- Trivia: the death rate among the white crews of the slave ships (20-25%) was higher than the rate among black slaves (15%) because slaves were more valuable than sailors

# The Atlantic Slave Trade

- Abolitionists
  - Quakers of England and the USA
  - Charles de Secondat Montesquieu: “De l'Esprit des lois” (1748)
  - Anthony Benezet: “Observations on the enslaving, importing and purchasing of Negroes” (1760)
  - William Blackstone: “Commentaries on the Laws of England” (1769)
  - John Wesley (founder of Methodism): “Thoughts upon Slavery” (1774)
  - Adam Smith: “The Wealth of Nations” (1776) on purely technical grounds (slavery is a restraint on individual self-interest)
  - Guillaume Raynal: “Histoire des deux Indes” (1770)

# The Atlantic Slave Trade

- Abolitionists
  - William Paley: “Moral Philosophy” (1785)
  - Thomas Clarkson: “An Essay on the Slavery and Commerce of Human Species” (1786)
  - Committee for Effecting the Abolition of the Slave Trade, London (1787)
  - French Revolutionaries (1789)

# The Atlantic Slave Trade

- 1780: Pennsylvania abolishes slavery
- 1791: Successful slave insurrection in Haiti
- 1807: Britain outlaws slavery
- 1820: The king of Ashanti inquires why the Christians do not want to trade slaves with him anymore, since they worship the same god as the Muslims and the Muslims continue the trade like before
- Muslims believed that outlawing slavery was yet another Christian attack on Islam (slavery is allowed by the Quran)
- France believes that Britain does not need slaves simply because it has a virtually infinite labor force in India, whereas France has to rely on slaves or succumb to Britain

# The Atlantic Slave Trade

- 1814: Britain leads the anti-slavery movement
- 1831: Slave insurrection in Jamaica
- 1840: World Anti-slavery Convention in London
- 1845: British ships are authorized to search Brazilian ships for slaves
- 1848: France abolishes slavery
- 1850s: David Livingstone's expeditions reveal the extent of the Arab slave trade to the British public
- Brazilian and Cuban slave trade still prosper

# The Atlantic Slave Trade

- 1851: The population of the USA is 20,067,720 free persons and 2,077,034 slaves
- 1865: the Union defeats the Confederates and slavery is abolished in the USA
- 1873: Britain forces Zanzibar to outlaw the slave trade
- 1888: Brazil abolishes slavery
- 1890: The Brussels Conference Act forbids the European powers from tolerating in slavery
- The African slave trade continued with the Arabs

# The Atlantic Slave Trade

- **By century**

- **1500-1600: 328,000 (2.9%)**
- **1601-1700: 1,348,000 (12.0%)**
- **1701-1800: 6,090,000 (54.2%)**
- **1801-1900: 3,466,000 (30.9%)**

- **By trading country**

- **Portugal/Brazil: 4.6m**
- **Britain: 2.6m**
- **Spain: 1.6m**
- **France: 1.25m**
- **Holland: 0.5m**
- **U.S.A.: 0.3m**

- **By destination**

- **Brazil: 4,000,000 35.4%**
- **Spanish Empire: 2.5m 22.1%**
- **British West Indies: 2m 17.7%**
- **French West Indies: 1.6m 14.1%**
- **British North America: 0.5m 4.4%**
- **Dutch West Indies: 0.5m 4.4%**
- **Total 1500-1900: 11,328,000 100.0%**

# The Atlantic Slave Trade

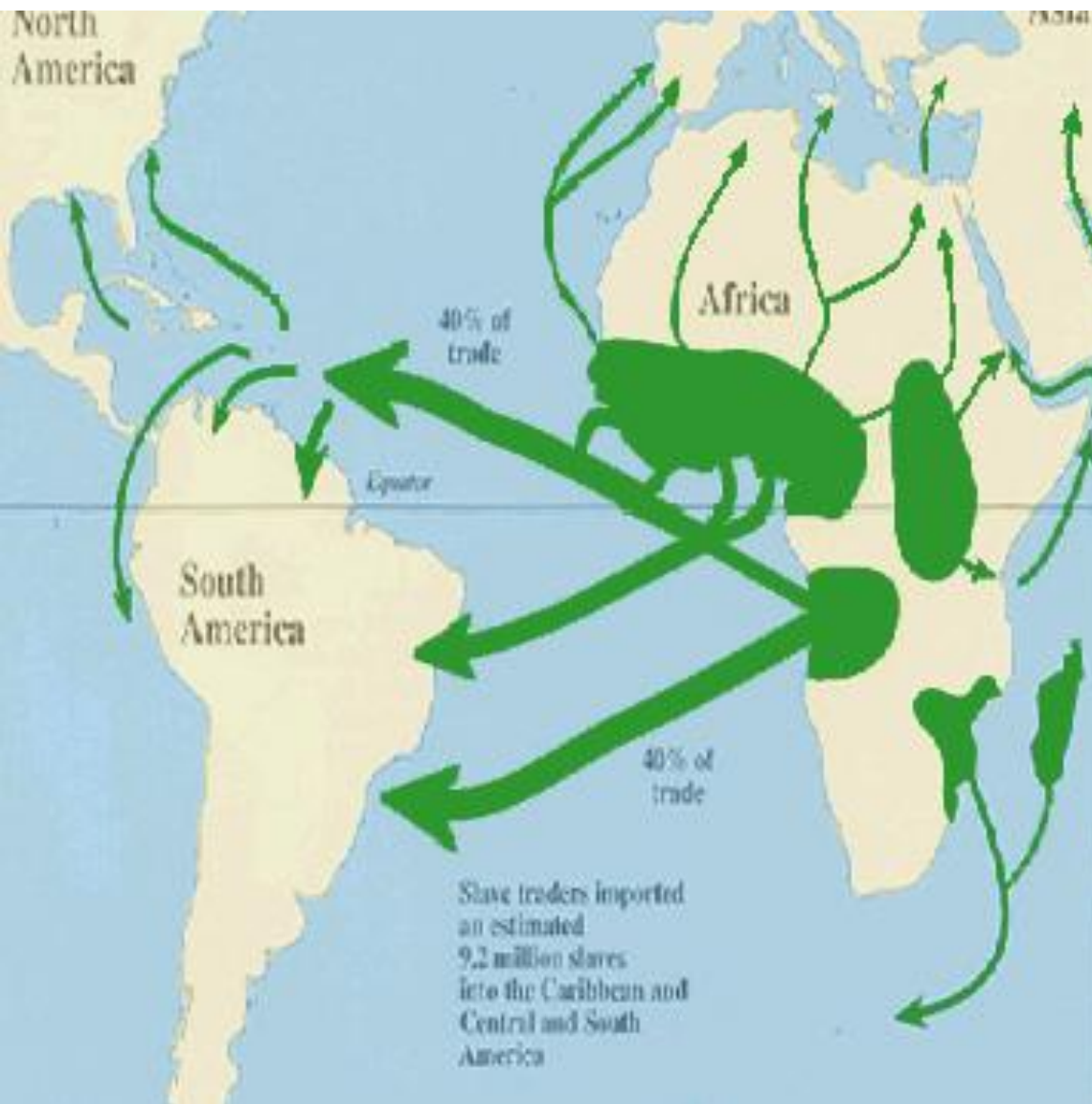
- **Origins of black slaves**
  - **Senegambia: 5.8%**
  - **Sierra Leone: 3.4%**
  - **Ivory Coast: 12.1%**
  - **Gold Coast (Ghana): 14.4%**
  - **Bight of Benin (Nigeria): 14.5**
  - **Bight of Biafra (Nigeria): 25.1%**
  - **Cameroon- Angola: 24.7%**



# The Atlantic Slave Trade

- Slavery in Africa: prisoners of war used as domestic servants (humane, not racist)
- Slavery in Arabia: African captives used as domestic servants and small-business helpers (humane, racist)
- Slavery in America: African captives used for mass (plantation) labor (dehumanized, racist)

# The Atlantic Slave Trade



LIBRARY OF CONGRESS

**TO BE SOLD**, on board the  
Ship *Banc-Island*, on tuesday the 6th  
of *May* next, at *Abley-Ferry*, a choice  
cargo of about 250 fine healthy

**NEGROES,**  
just arrived from the  
Windward & Rice Coast.

—The utmost care has  
already been taken, and  
shall be continued, to keep them free from  
the least danger of being infected with the  
**SMALL-POX**, no boat having been on  
board, and all other communication with  
people from *Charles-Town* prevented.

*Austin, Laurens, & Appleby.*

N. B. Full one-Half of the above Negroes have had the  
**SMALL-POX** in their own Country.

# The Atlantic Slave Trade

- Slavery propelled by three rapid imperial expansions
  - Roman empire
  - Arab empire
  - Spanish and Portuguese empires
- Coincidence of slavery with commercial expansion

# The Atlantic Slave Trade

- Haitian Revolution 1791-1804
  - 45% of the Africans brought to the Americas came to the Caribbean
  - 1780s: 40,000 Central-African slaves brought to Haiti every year
  - The French colony of Saint-Domingue was the richest of the plantation colonies of the Americas
  - 90% of the population was enslaved
  - More than 50% of them were African-born in 1791
  - They grew up in African societies with their own traditions of political thought
  - Catholicism embraced by the Kingdom of Kongo in the 16th century

# What the Industrial Age knew

- Cotton
  - A global mass consumer good.
  - Cotton is easier to paint than linen and therefore appealed to the higher classes, whereas linen remains cheap and typical of the lower classes.
  - Cotton destabilizes the wool, linen and silk industries of Europe.
  - Cotton is mass produced in Britain after 1783 thanks to the invention of the rotary printing machine.

# What the Industrial Age knew

- Cotton
  - By the turn of the century, the crowds of European cities are no longer dressed in black and white but in colors.

# What the Industrial Age knew

- Porcelain
  - Another global consumer good
  - Until the 18th century China has the monopoly
  - 1791: The East India Company stops importing porcelain from China because porcelain is now made mostly in Europe

# What the Industrial Age knew

- Exotic addictions
  - The European taste changes dramatically:
    - tea from China and later (after 1840) India,
    - sugar from the West Indies and the Middle East,
    - coffee from Yemen (already popular in the Arab world) and West Indies (transplanted by the Europeans),
    - tobacco from North America
    - cocoa from Mexico and later Venezuela (and much later Ghana)



# What the Industrial Age knew

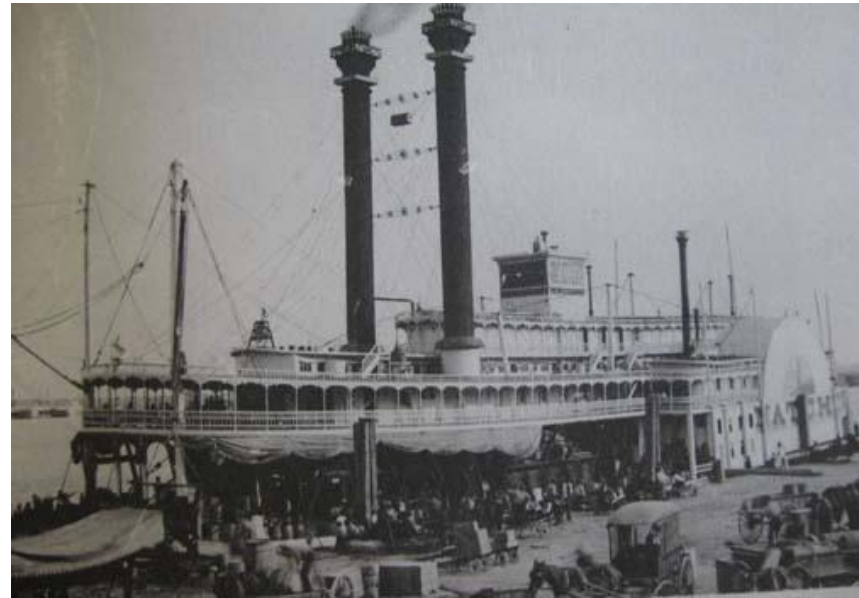
- Exotic addictions
  - The European plantation system was largely driven by the growing demand for these addictive substances.
  - They also created a new social life: the coffee house ("The Angel", Oxford, 1650)

# What the Industrial Age knew

- Weapons
  - 1801: Robert Fulton's "Nautilus" submarine

# What the Industrial Age knew

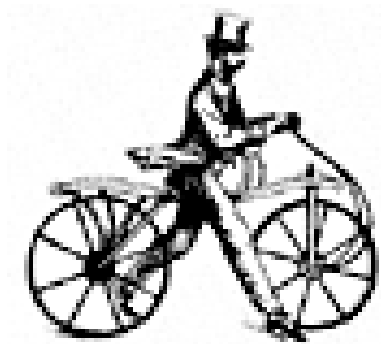
- Transportation
  - Railways
  - Steamships
  - National postal systems
  - 1855: Panama railway
  - 1869: Suez canal



New Orleans: the Natchez (1879)

# What the Industrial Age knew

- The draisine (1818)
- The velocipede (1858)
- The ordinary (1872)
- The bicycle (1884)



# What the Industrial Age knew

- The First Postage Stamp (1840): “Penny Black “



- The first greeting card (London, 1843)
- The first postcard (John Charlton, Philadelphia, 1861)

# What the Industrial Age knew

- The book in the railway age:
  - The paperback is born, that can be taken outside the home
  - 1841: Christian Tauchnitz in Leipzig begins printing paperbacks
  - 1858: Reclam in Leipzig begins publishing all the classics in paperback format
  - The portable personal library is born: an individual can carry with him any book anywhere

# What the Industrial Age knew

- The book in the railway age:
  - 1804: Bryan Donkin in England builds the first papermaking machine, invented by Henry and Sealy Fourdrinier
  - 1814: A steam-powered press is installed at the London Times
  - 1820: Friedrich Koenig opens a steam-powered printing press in London that can print more than 1,000 pages per hour

# What the Industrial Age knew

- Paper in the railway age:
  - 1719: René de Réaumur discovers that wasps make paper with fibers of plants instead of rags
  - 1839: Anselme Payen discovers cellulose
  - 1840: The first paper made of wood-pulp (Friedrich Keller in Germany)
  - 1867: Two Germans (Albrecht and Rudolf Pagenstecher) make paper from wood-pulp near Boston
  - 1873: The USA becomes the #1 papermaking country in the world



# What the Industrial Age knew

- Coal economy
  - 16th-17th century London
    - Coal heats homes better than wood
    - Wood scarce, coal plenty
  - 18th century England
    - Coal wealth
    - Shipbuilding technology improved to transport coal to London
    - Canals built to transport coal
    - Railroads invented for coal (1825)
    - Pollution
    - Miners

# What the Industrial Age knew

- Coal economy
  - 20th century USA
    - Melting Pot (Ireland, Poland, Italy, Bohemia, Lithuania,...)
    - Strikes (1900 salary: \$1.15 to \$4 per day)
    - 1867-2000: 716 mining accidents in the USA, 15,183 miners killed
    - 1899 production was more than 54,000,000 tons

# What the Industrial Age knew

- International Standards
  - 1582: Gregorian calendar
  - 1744: Celsius degrees
  - 1800: Metric system
  - 1884: Greenwich time

# What the Industrial Age knew

- Globalization
  - Industrial revolution: new technologies and new economies of scale
  - America: slaves, land, mineral resources
  - The marriage yields a global economy with a vested interest in peace
  - The powers are largely at peace between 1815 and 1914

# What the Industrial Age knew

- Women's liberation
  - 1789: Marie Gouze aka Olympe de Gouges: "Declaration of the Rights of Women and Citizen"
  - 1792: Mary Wollstonecraft's "A Vindication of the Rights of Woman"
  - 1837: Sarah Grimke's "Letters on the Equality of the Sexes"
  - 1848: Queen's College is established to provide women with a higher education
  - 1848: First women's rights convention in the USA

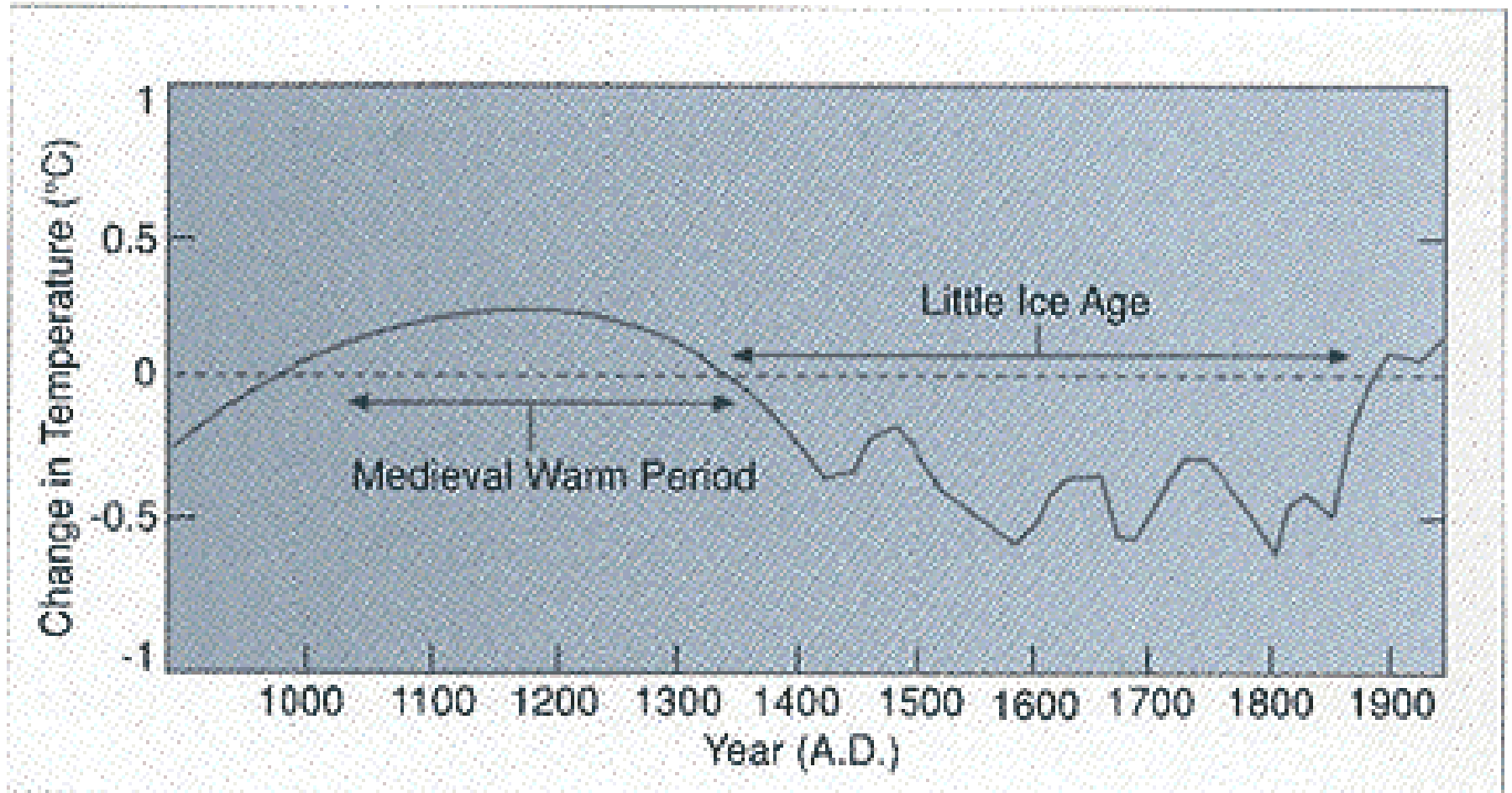
# What the Industrial Age knew

- 1815: Mt Tambora erupts
  - 60,000-120,000 people die in Indonesia
  - China's Yunnan province: cold summer, poor rice harvest, mass starvation
  - Europe: cold weather, shortage of grain, starvation, disease (typhus)
  - India's Bengal: cholera
  - USA: economic boom thanks to grain exports to Europe, migration of farmers from the Appalachians to the warmer Ohio Valley



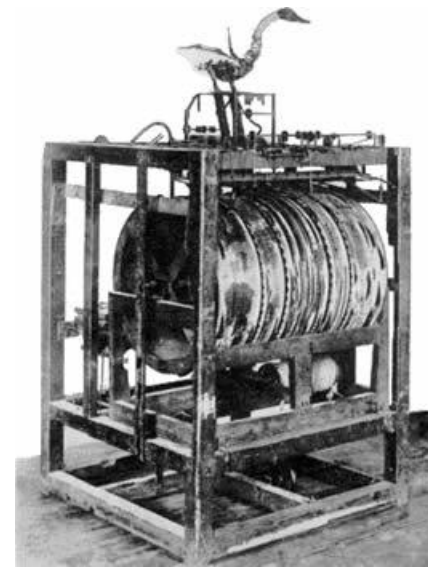
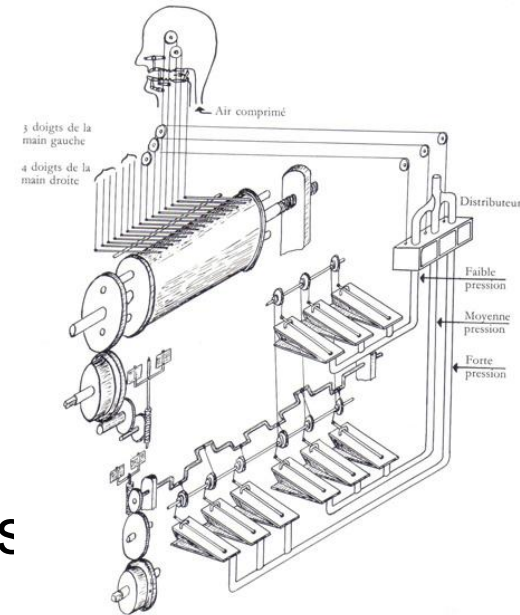
# What the Industrial Age knew

- **End of little ice age (1560-1850)**



# What the Industrial Age knew

- Jacques de Vaucanson (1741)
  - Automata
    - The flutist (1738)
    - The duck (1741)
    - Textile industrial automation (1740s including an automated loom that predates Jacquard's)
    - Three-story high silk factory at Aubenas that predates Arkwright's





# What the Industrial Age knew

- Pierre Jaquet-Droz (1774)
  - Automata



Musée d'Art et d'Histoire, Neuchâtel, Switzerland

# What the Industrial Age knew

- Automata
  - Alexandre Theroude's Mandarin Bird Trainer with Flute (1840s) and Waltzing Couple (1850s)



# What the Industrial Age knew

- Automata
  - Gustave Vichy's automata (1870s)



# What the Industrial Age knew

- Automata
  - Gustave Vichy's automata (1870s)



# What the Industrial Age knew

- Automata
  - Jean Roullet's automata (1870s)



# What the Industrial Age knew

- Automata
  - Blaise Bontems' Singing Bird Jardiniere (1880)



# What the Industrial Age knew

- Birth of Mass Media
  - Industrialization (ability to mass produce at low prices)
  - Urbanization (concentration of consumers and faster distribution)
  - Literacy (increasingly required for the occupations of the middle class)
  - Before the 18th century the only literary entertainment for the masses was the theater (spoken, not written)

# What the Industrial Age knew

- Birth of Mass Media
  - Summaries of scholarly books (Memoirs of Literature, 1710; Literary Magazine, 1735)
  - Single-essay "magazine" (Tatler, 1709; Spectator, 1711)
  - The Blue Stockings Society (1750) revolutionizes women's social life (education)
  - The circulating library (1740)



# What the Industrial Age knew

- Birth of Mass Media
  - The newspaper
    - Licensing Act of 1695 leads to an explosion of newspapers (mostly read in coffee houses, often aloud, eg the Kit-Cat Club)
  - The magazine
    - News and entertainment magazine (Gentleman's Magazine, 1731)
    - Literary criticism (Monthly Review, 1749; Compendious Library, 1751; Critical Review, 1756)
  - 1788: A boom of pamphlets and periodicals in France after the monarchy lifts censorship

# What the Industrial Age knew

- Birth of Mass Media
  - The newspaper
    - Morning Herald (London, 1780) hires John Wight, the first crime reporter

# What the Industrial Age knew

- Birth of Mass Media
  - The serialized romance (Richardson's "Pamela", 1740)
  - Sentimental novel (Goldsmith's "The Vicar of Wakefield", 1766)
  - Domestic tragedies (Goerge Lillo, 1730s)
  - The gothic novel (Walpole's "Castle of Otranto", 1764; Lewis' "The Monk", 1796)
  - Juvenile books (booming in the 1780s)
  - Theatrical "spectacles" (pantomime, ballet opera)
    - The Licensing Act of 1737 limits drama to the two patent theatres (at Drury Lane and Covent Garden)

# What the Industrial Age knew

- Birth of Mass Media
  - Being a writer becomes a profession (no need for aristocratic sponsors)
  - Anybody can be a writer (even housewives)
  - Publishing and selling books becomes a lucrative business (notably Lackington, 1774)
  - Women become a major class of readers, and later of writers (replacing card games with bluestocking clubs)
  - The writer becomes an observer of real life
  - Proliferation of public and private libraries
  - Moralizing and aesthetic movement ("Thus are the arts and virtues mutually friends", Lord Shaftesbury, 1711) vs sensationalist novelists

# What the Industrial Age knew

- Birth of Mass Media
  - Literary criticism
    - Addison's Spectator (1711)
    - Pope's "Essay on Criticism" (1711)
    - Hume's "The Rise and Progress of the Arts and Sciences" (1742)
    - Voltaire's "Essay on Taste" (1757)
    - Johnson's "Idler" (1760)
    - Goldsmith's "Essay on the Theater" (1772)

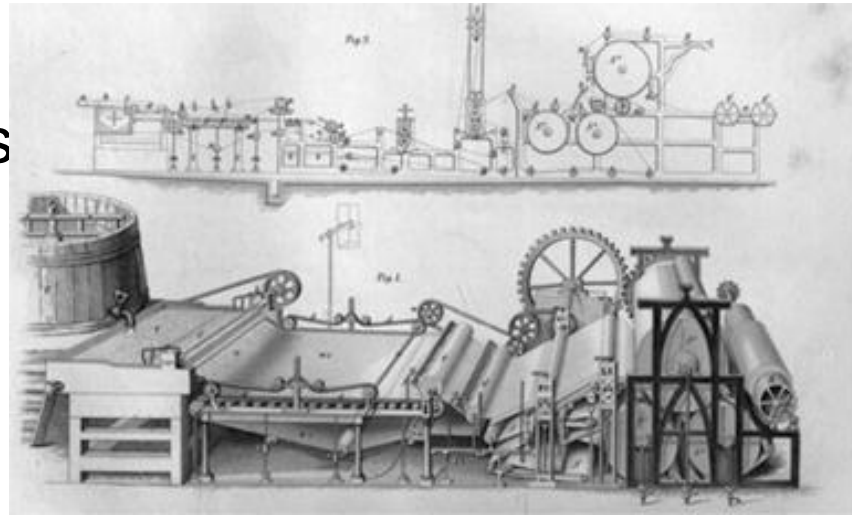
# What the Industrial Age knew

- Communications media
  - 1833: Gauss' telegraph
  - 1844: Samuel Morse sends the first telegraph message
  - 1856: Antonio Meucci's telephone



# What the Industrial Age knew

- Paper machines
  - Nicolas Robert (France, 1798)
  - John Gamble invents the paper machine (Britain, 1801)
  - Bryan Donkin (Britain, 1804), sold by Henry and Sealy Fourdrinier
  - The paper machine makes paper cheap and plentiful



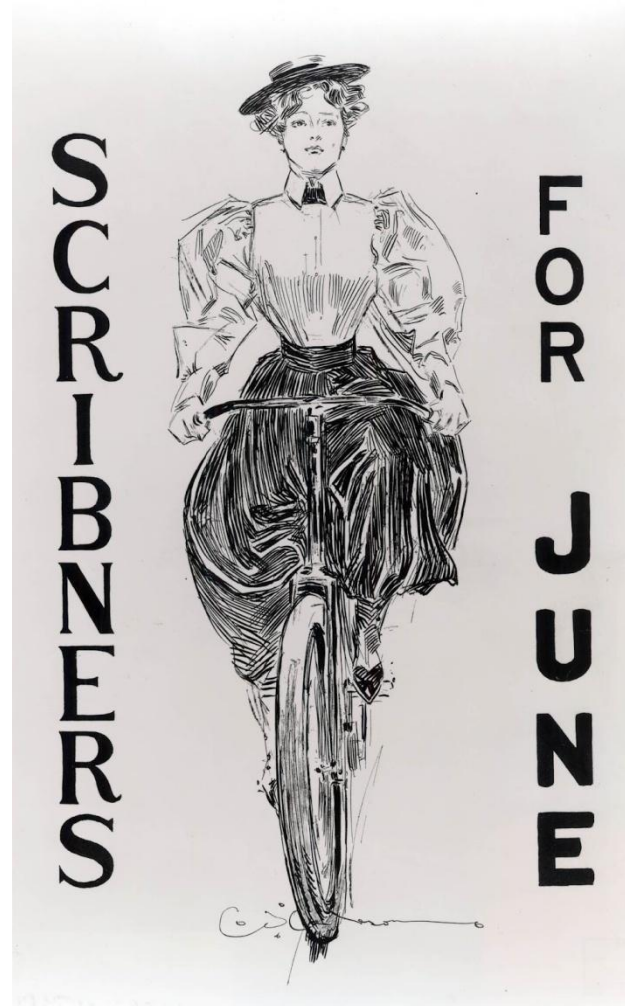
# What the Industrial Age knew

- The Press/ industrialization of printing
  - Friedrich Koenig (German printer): steam-powered high-speed press in London (1810)
  - The "Times" of London is printed using a steam-powered press (1814)



# What the Industrial Age knew

- The Press
  - "Gisbon girls"



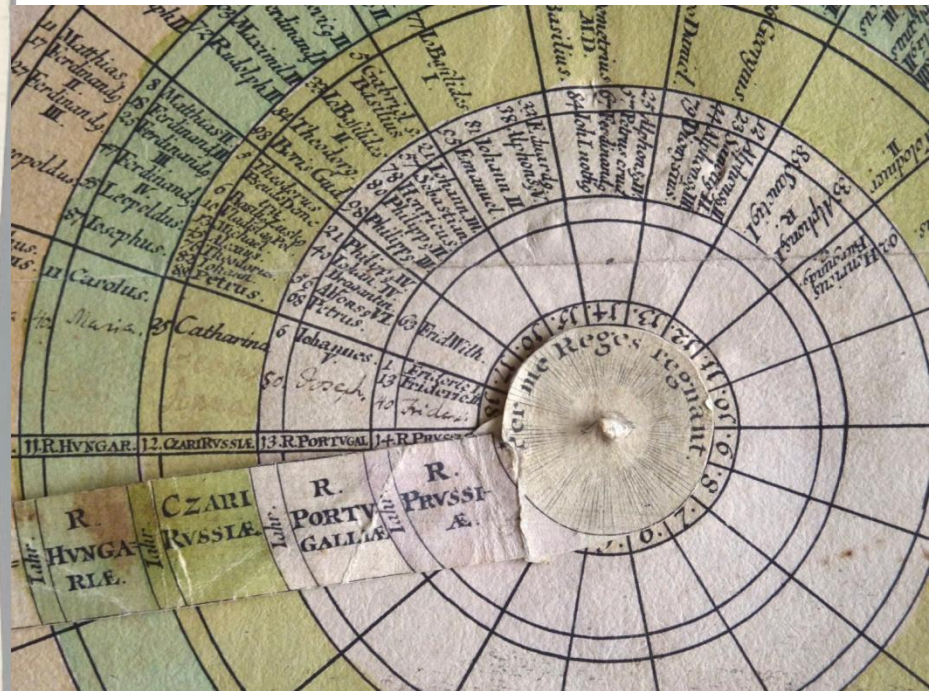
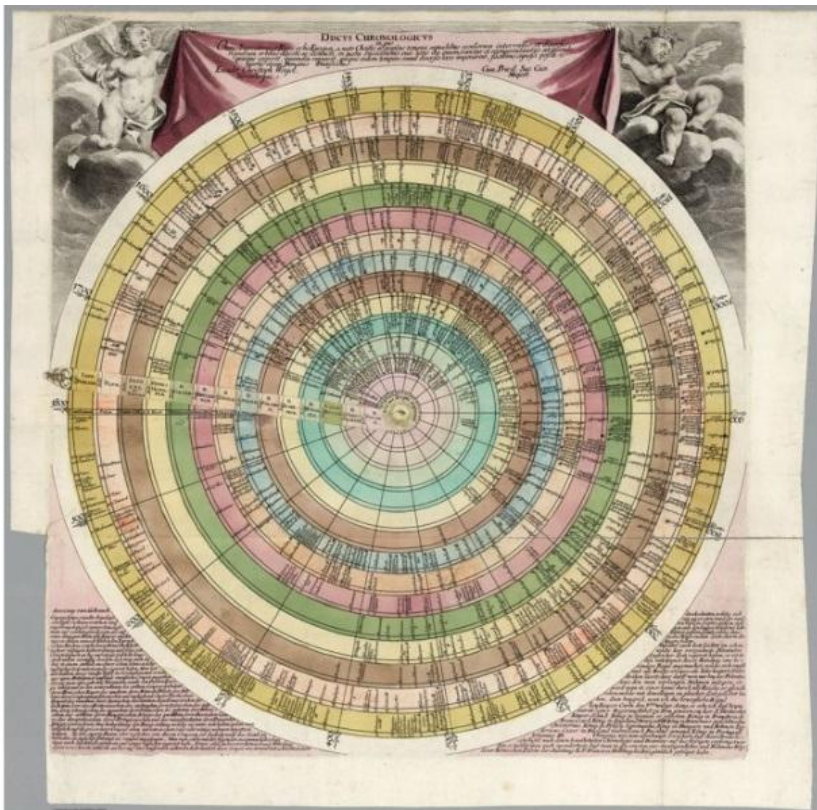
Charles Dana Gibson

# What the Industrial Age knew

- Data visualization
  - Christop Weigel's *Discus Chronologicus in quo Omnes Imperatores et Reges Orbis Europaei* 1730
  - Joseph Priestley's *A New Chart of History* 1769
  - Claude Renaudot's *Chronology of England* 1781
  - August Crome compared the size of the countries and the size of its population of all states and countries in Europe 1785
  - William Playfair's *Principal Nations in Europe* 1802 (the first pie chart!)
  - Charles Smith's *Comparative View of the Heights of the Principal Mountains in the World* 1816
  - Franz Raffelsperger's *Packet Boat and Steamship Connections between Europe and Overseas Ports* 1829
  - Emma Willard's *The Temple of Time* 1846

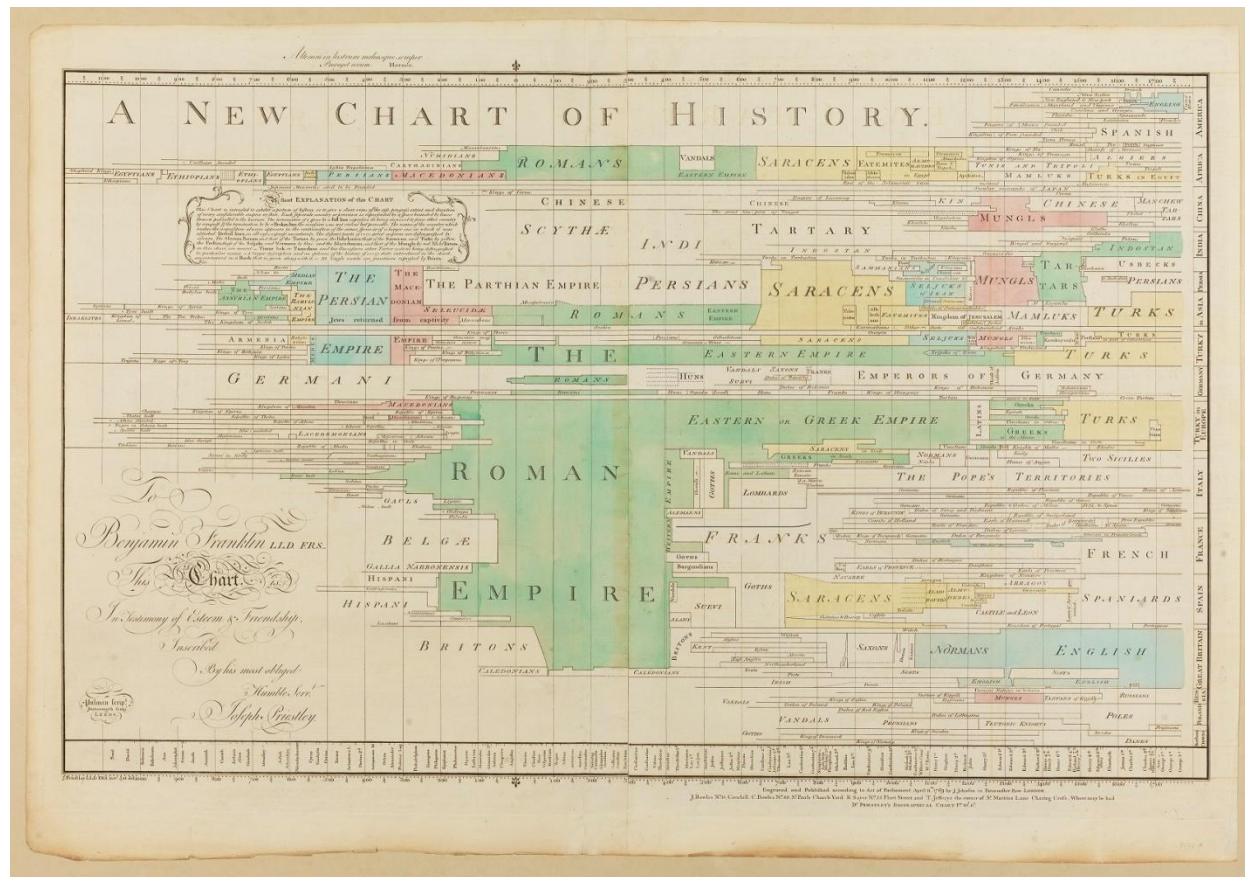
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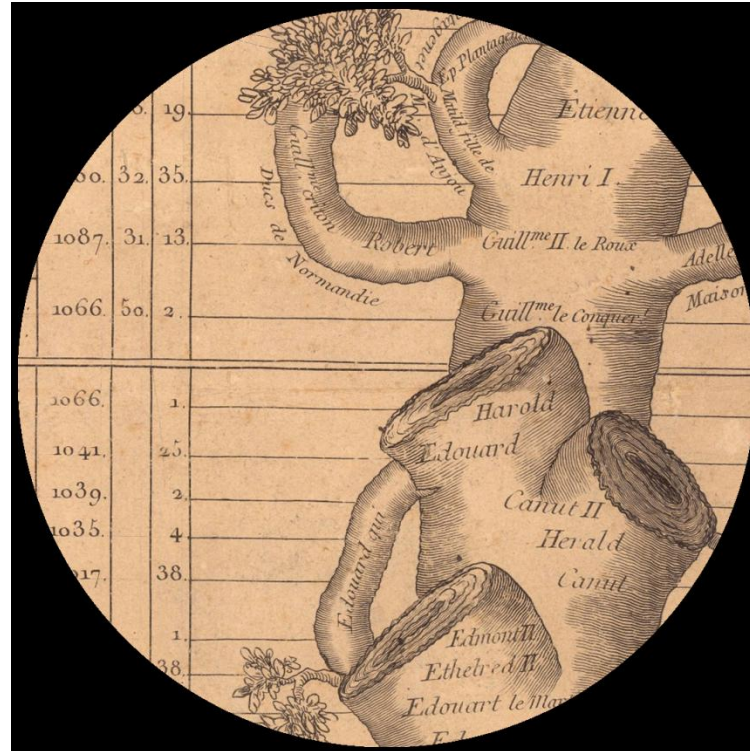
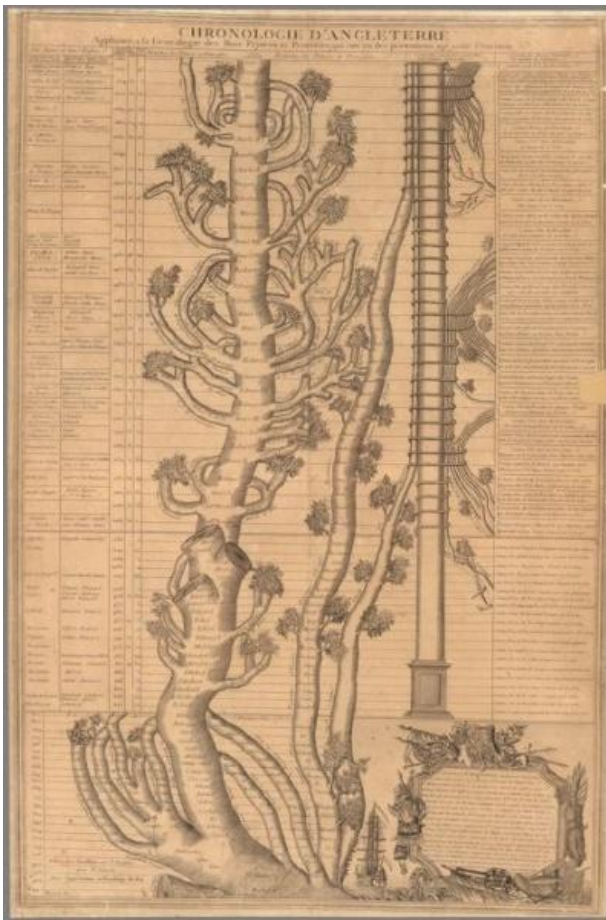
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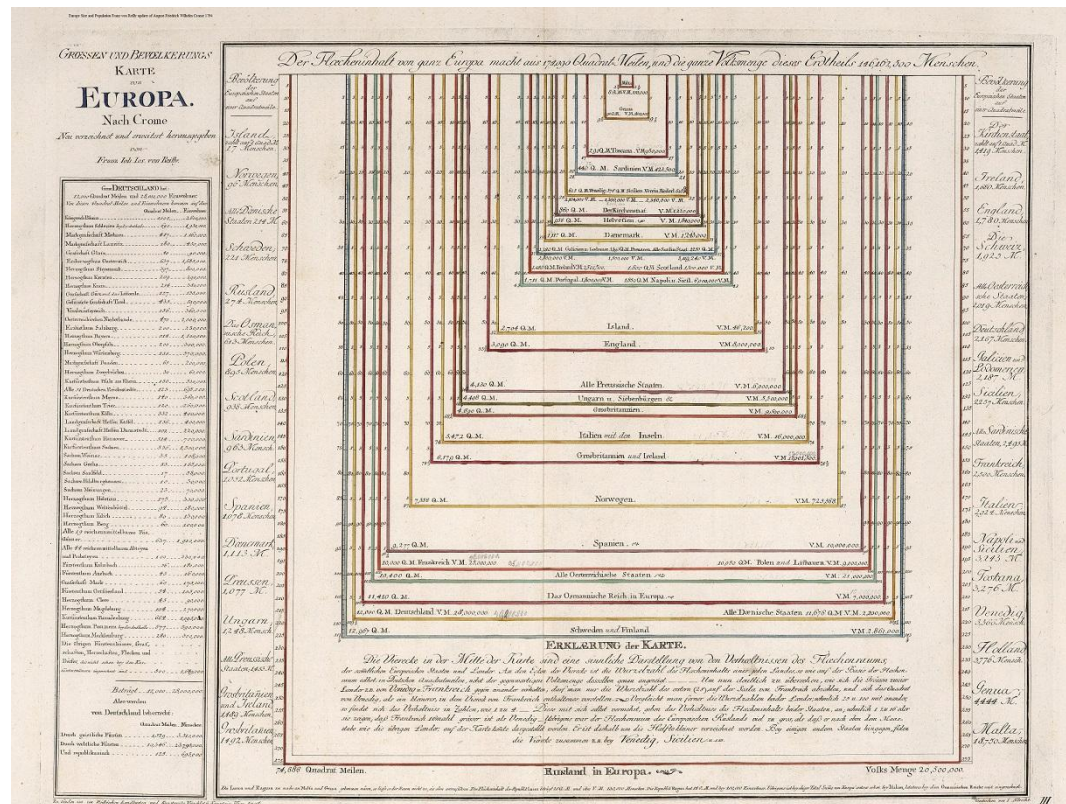
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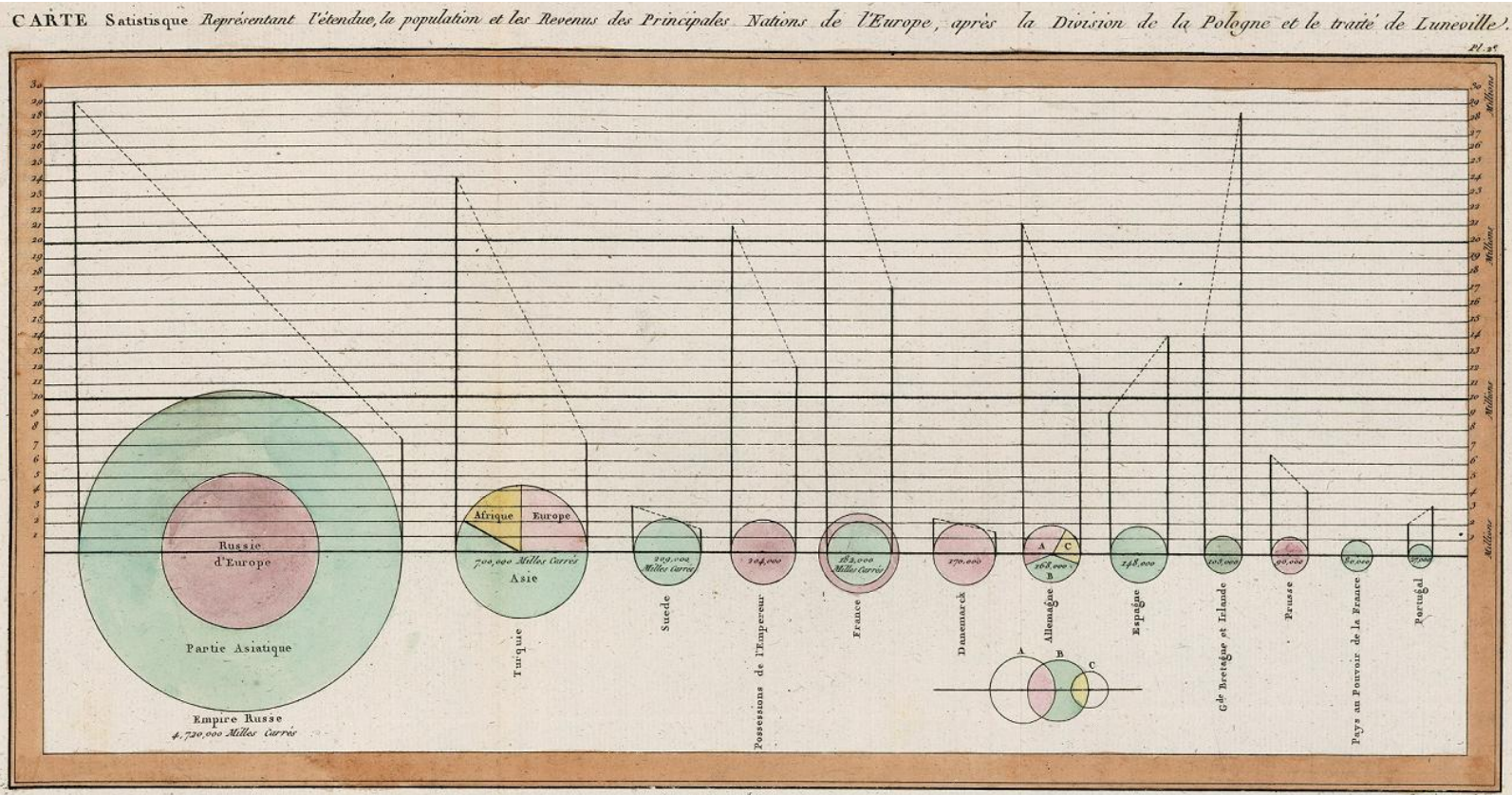
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# What the Industrial Age knew

- Data visualization
  - William Playfair's Principal Nations in Europe 1802 (the first pie chart!)

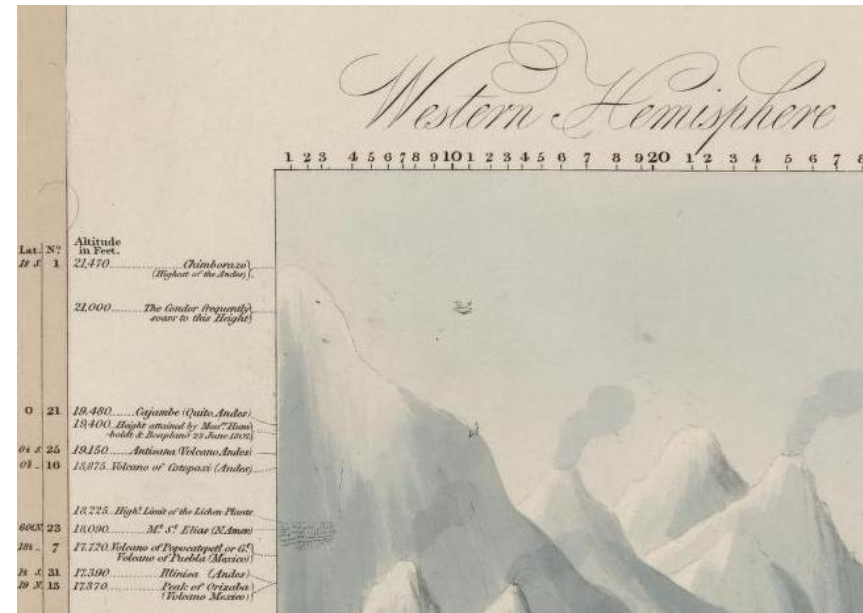
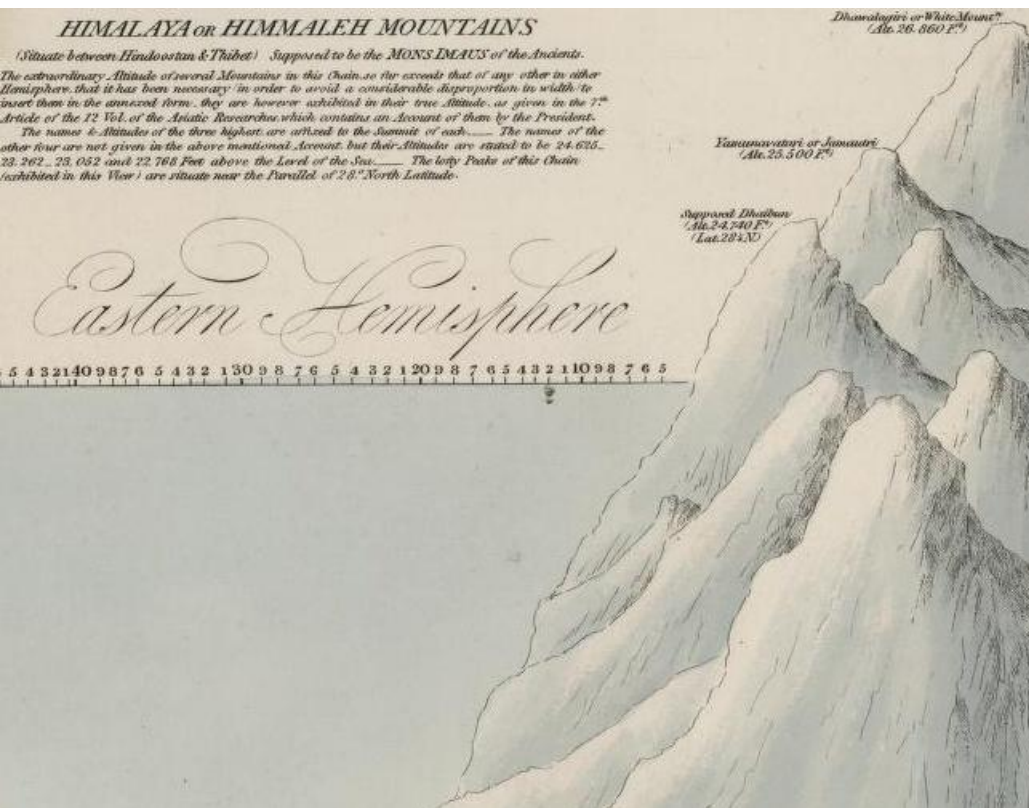






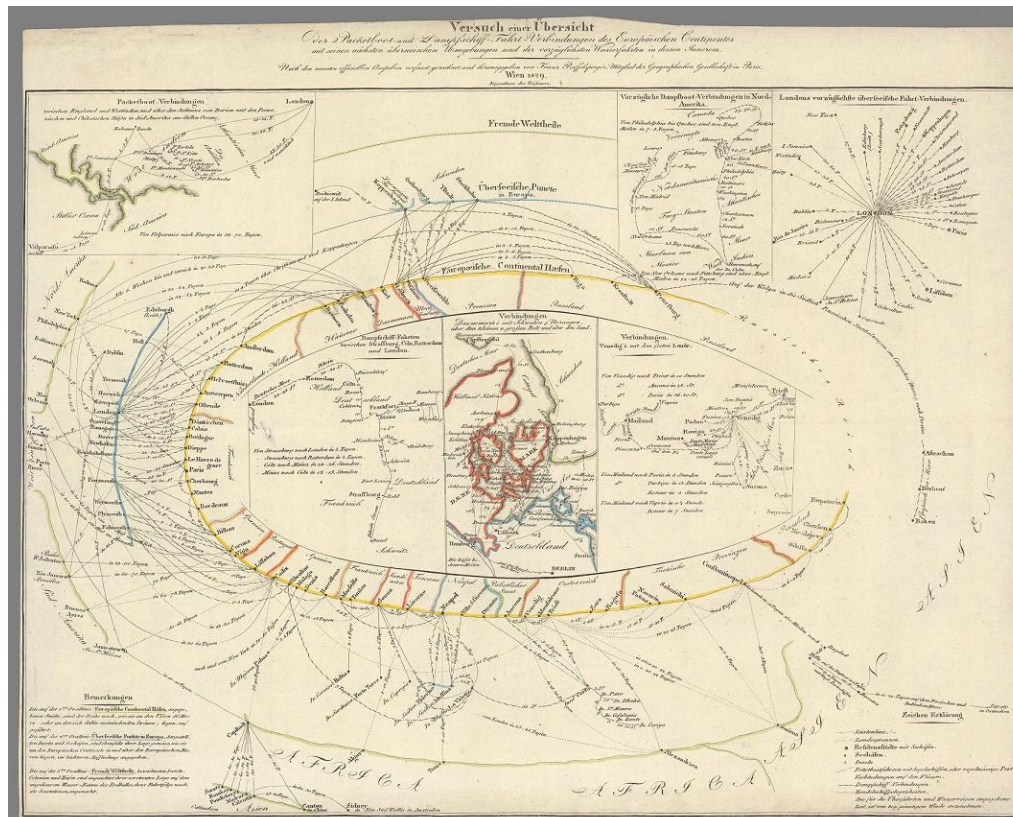
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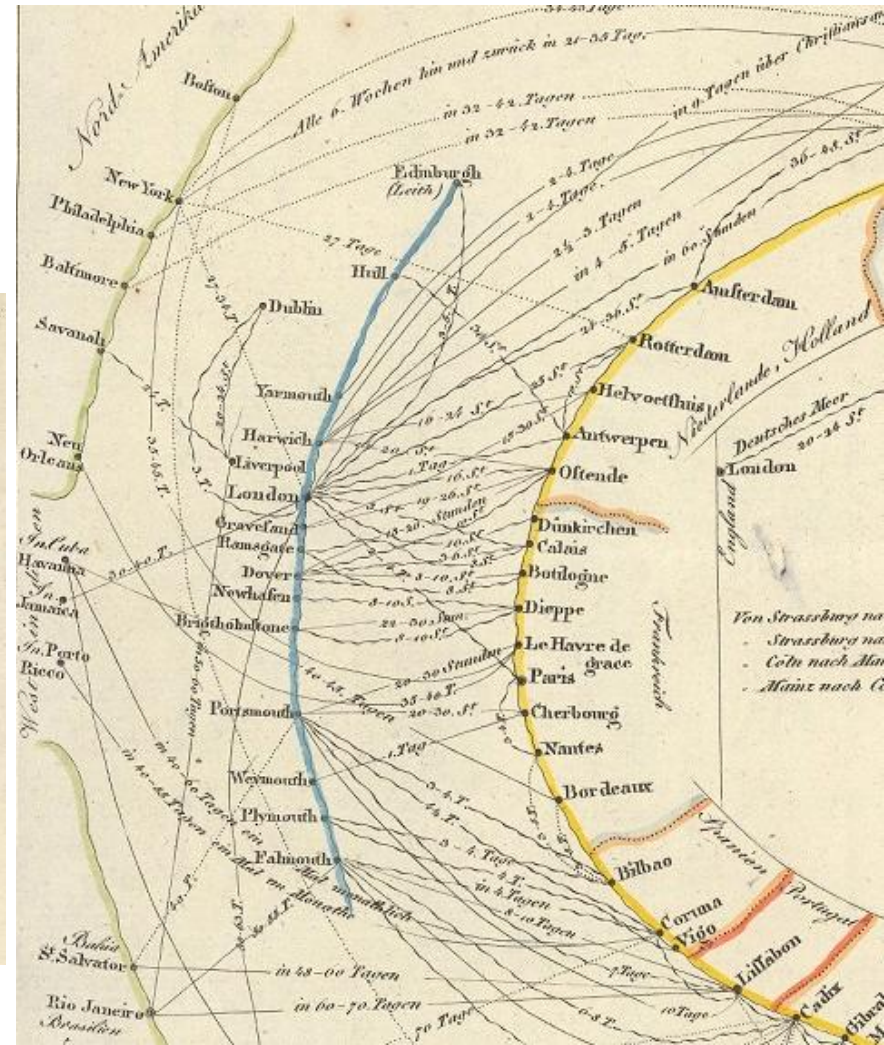
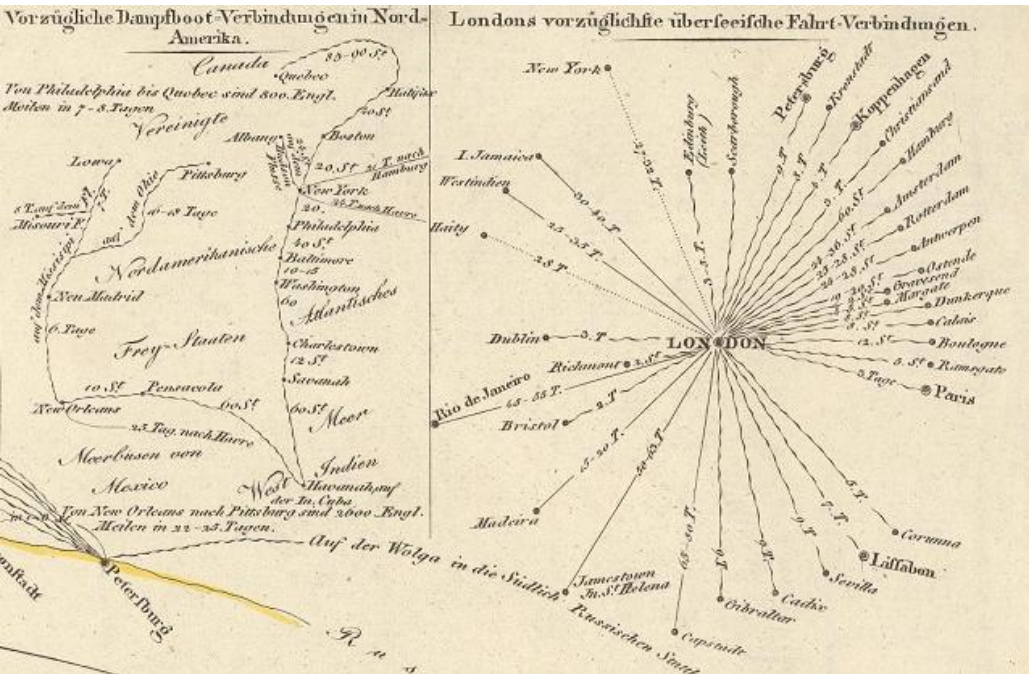
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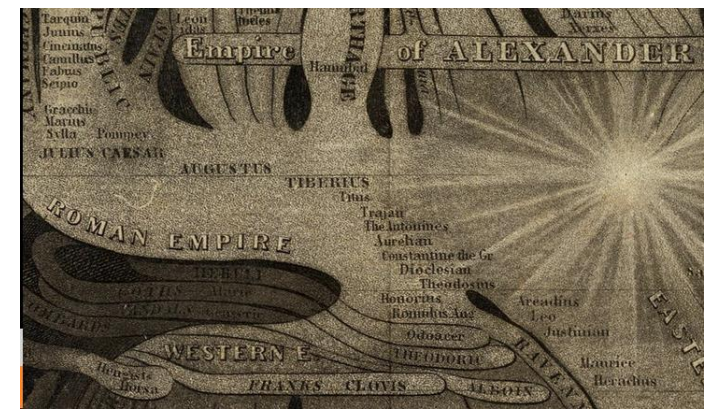
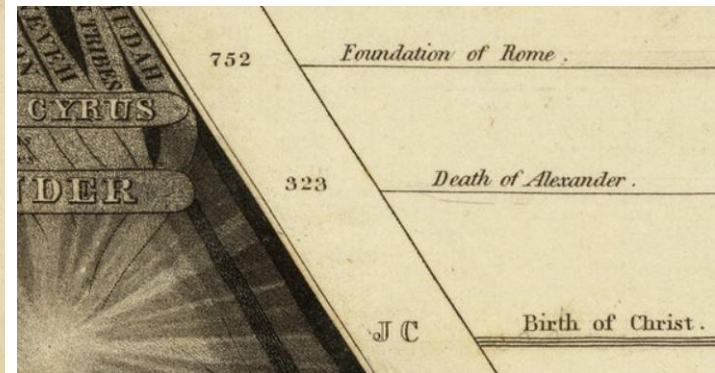
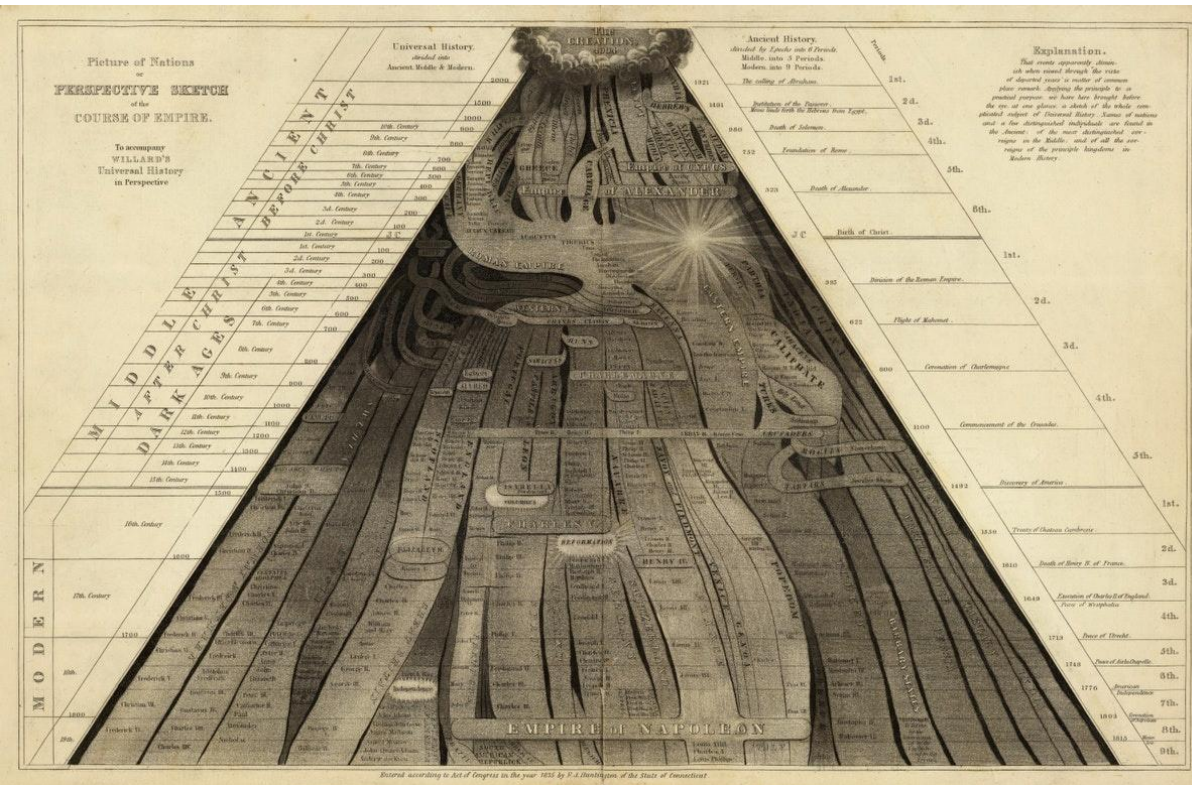
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- Data visualization
  - Franz Raffelsperger's 1829



# What the Industrial Age knew

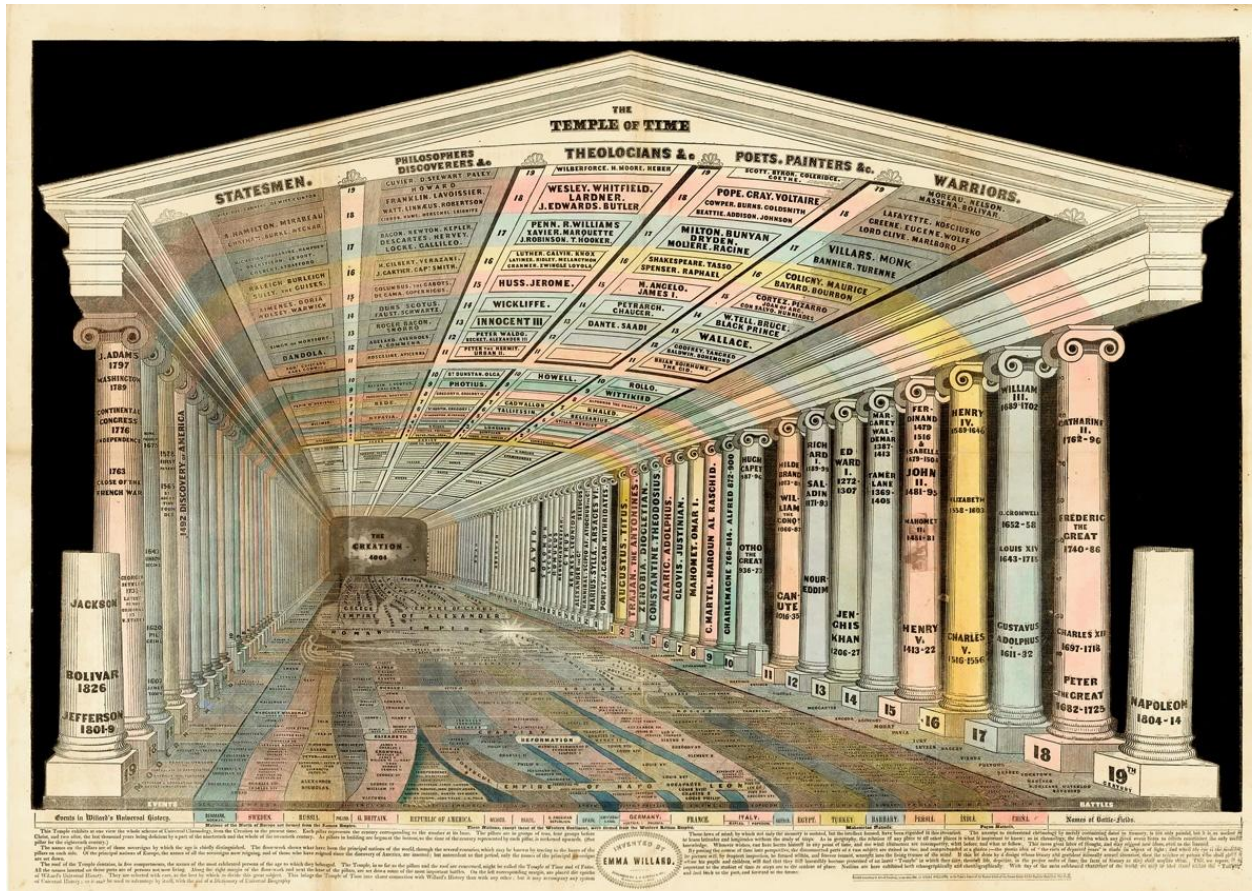
- Data visualization
  - Emma Willard's "Picture of Nations" (1836)



Revised according to Act of Congress in the year 1835 by F. A. Huntington of the State of Connecticut.

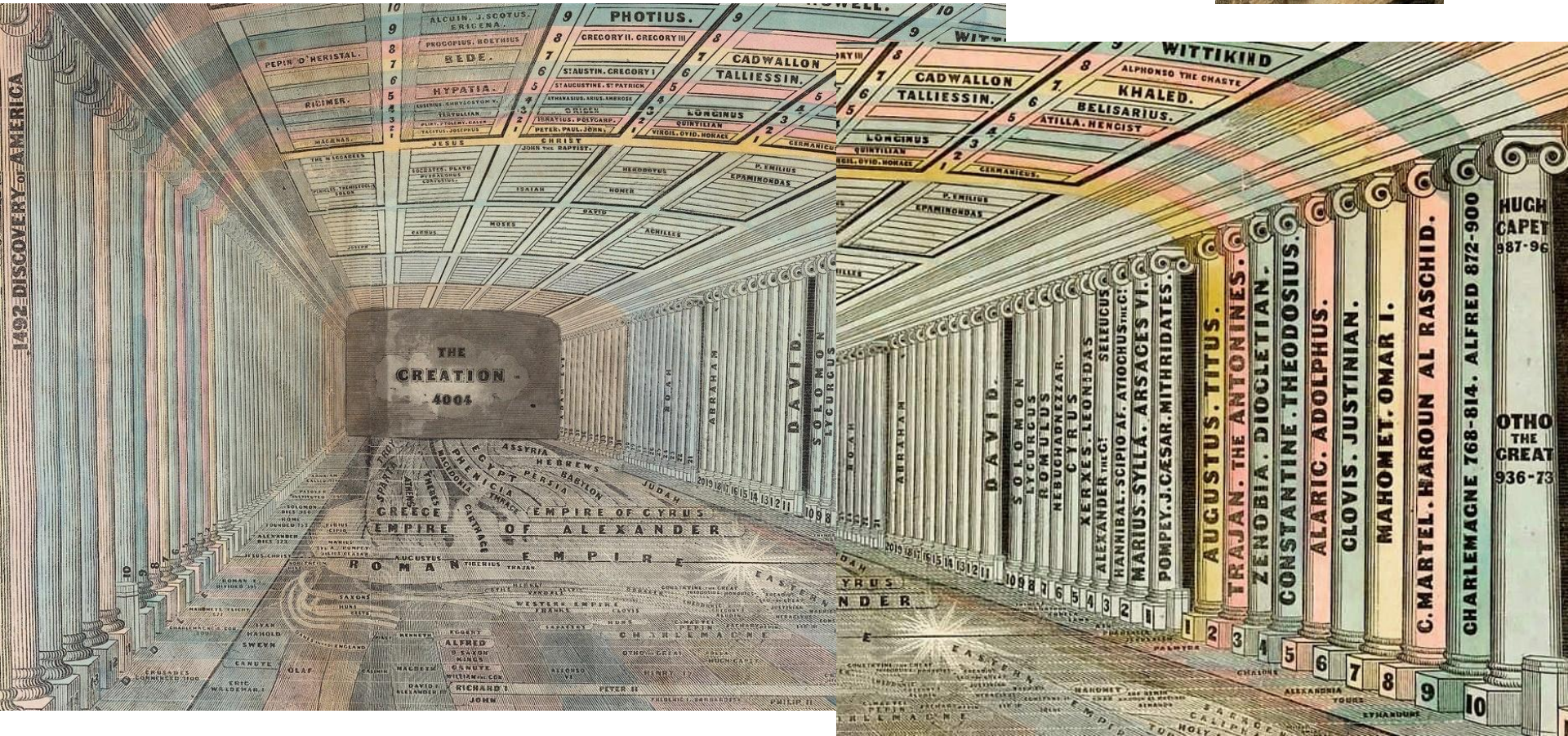
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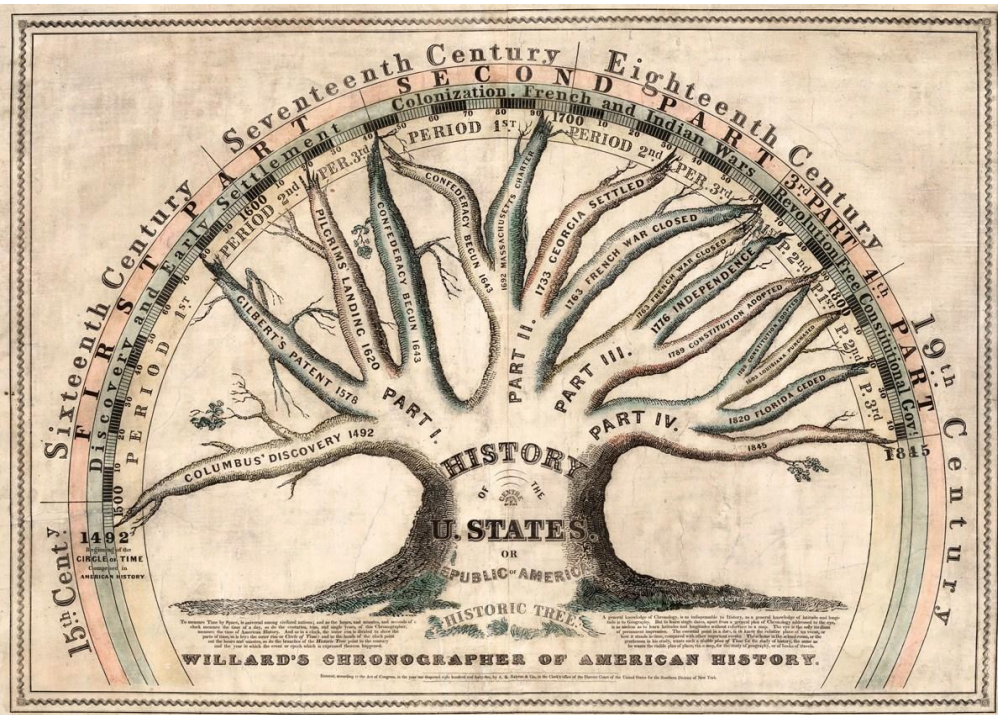
# What the Industrial Age knew

- Data visualization
  - Emma Willard's The Temple of Time 1846



# What the Industrial Age knew

- Data visualization
  - Emma Willard's Abridged History of the USA (1860)





What the Industrial Age knew  
Piero Scaruffi  
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- **Continues on indusphi**