What the Industrial Age knew

Piero Scaruffi

Part 2: Philosophy

What the Industrial Age knew

- Enlightenment/ “Les Lumieres”
  - Materialism: the world is ruled by physical laws
  - Reason: only reason is necessary to understand the world
  - Knowledge: everything reason has understood can be organized in encyclopedias for use by other humans
  - Atheism/deism: religion is superstition
  - Progress: understanding the (natural) world is the key to improving the (human) world

What the Industrial Age knew

- Enlightenment/ Causes
  - Scientific discoveries,...
  - Exploration of the world,...
  - The printing press,...
  - Religious fatigue after the religious wars of 1562-98,...
  - ...lead to: Cultural relativism

What the Industrial Age knew

- Enlightenment/ Causes
  - Scholastic faith in the human reason,...
  - Copernicus, Galileo, Newton,…
  - Descartes, Spinoza, Hobbes, Locke, ...
  - Knowledge through observation guided by reason,...
  - Question authority (Aristotle, the Bible),...
  - …lead to: The Roman Catholic comes to be viewed as the main obstacles to the scientific program

What the Industrial Age knew

- Enlightenment/ Causes
  - A consequence of the nation state: the nation cares for what the king does
  - Educated people feel entitled to argue with the king on how to administer the state

What the Industrial Age knew

- Enlightenment/ Causes
  - The democratization of knowledge brought about by the printing press

What the Industrial Age knew

- Enlightenment/ Causes
  - Why France?
    - No political freedom compensated by relative freedom of speech (e.g., salons) and of customs (e.g., sexual)
    - Jesuit schools (Voltaire and Diderot both educated by the Jesuits)
    - Legacy of Richelieu's technocratic state and French Academy
    - Envy of Britain's political freedom (Voltaire's exile in Britain)

What the Industrial Age knew

- Enlightenment
  - Opposed by
    - Church
    - State
    - Large part of the public
  - How did it manage to survive and even succeed?

What the Industrial Age knew

- Enlightenment
  - The age of prose:
    - The newspaper (The Spectator by Joseph Addison and Richard Steele, England, 1711, the first widely read one)
    - The essay (Diderot, Voltaire, but also DeFoe's "Proposal for Correcting the English Tongue", 1712; Thomas Paine's "Common Sense", 1776)
    - The novel (Daniel DeFoe, Samuel Richaradson, Henry Fielding, Laurence Sterne, Oliver Goldsmith)
    - Journalists are famous, essayists are famous, novelists are famous: they exert a strong influence on public opinion

What the Industrial Age knew

- Deism and atheism
  - Christianity weakened by
  - Scientific rationalism
  - Biblical studies (eg Johann-Jakob Griesbach's Greek Gospel synopsis of 1776)
  - Non-Christian religions (especially from India and China)
  - Freemasonry
  - Deism: the god of progress

What the Industrial Age knew

- Deism and atheism
  - Freemasonry
    - Faith in the "Great Architect of the Universe"
    - 1717: first Grand Lodge in London
    - 1731: lodge of Philadelphia
    - 1732: Paris
    - Benjamin Franklin

What the Industrial Age knew

- Deism and atheism
  - Demise of the Jesuits
    - 1759: expelled from Portugal
    - 1767: expelled from France and Spain
    - 1773: Pope Clement XIV suppresses the Jesuits

What the Industrial Age knew

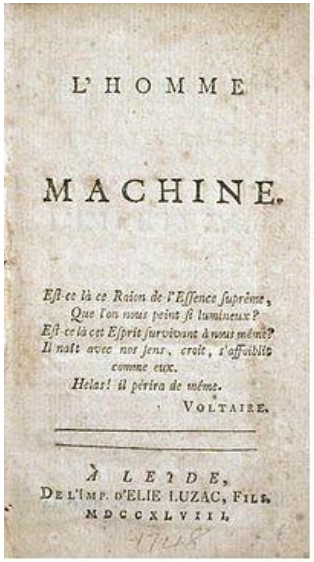
- Deism and atheism
  - Religious tolerance
    - Friedrich II of Prussia (1740-86)
    - Ekaterina II of Russia (1762-96)
    - Josef II of Austria (1765-90)

What the Industrial Age knew

- Deism and atheism
  - Julien LaMettrie (1748)
  - Georges Buffon (1749)
  - Voltaire (1756)
  - Paul-Henri Holbach (1770): there is no god

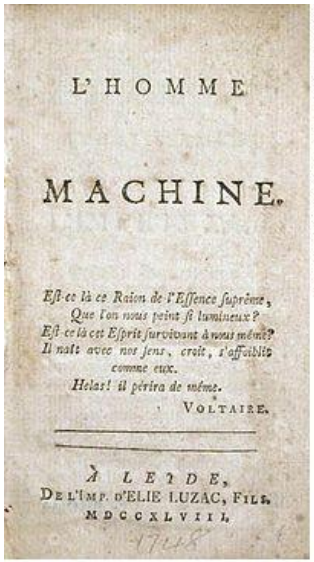
What the Industrial Age knew

- Julien Offray de LaMettrie (1748):
  - The mind is a machine
  - Thought is the physical processes of the brain
  - Perception and learning are changes in the physical structure of the brain
  - Motion is intrinsic to matter (no need for a soul)
  - Organisms are machines, but goal-directed machines


L'HOMME
MACHINE.
Est-ce là ce Raion de l'Essence suprême,
Que l'on nous peint si lumineux?
Est-ce là cet Esprit survivant à nous même?
Il naît avec nos sens, croît, s'affoiblit
comme eux.
Helas! il périra de même.
VOLTAIRE.
À LEYDE,
DE L'IMP. D'ELIE LUZAC, FILS.
M D C C X L V I I I.
1748

What the Industrial Age knew

- Julien Offray de LaMettrie (1748):
  - Anatomical correspondence and behavioral correspondence between animals and humans
  - Man is an animal
  - Animals have feelings too
  - Life arose from a primordial soup and then evolved


L'HOMME
MACHINE.
Eſt-ce là ce Raion de l'Eſſence ſuprême,
Que l'on nous peint ſi lumineux?
Eſt-ce là cet Eſprit ſurvivant à nous même?
Il naît avec nos ſens, croît, s'affoiblit
comme eux.
Helas! il périra de même.
VOLTAIRE.
A LEYDE,
DE L'IMP. D'ELIE LUZAC, FILS.
M. DCC. XL. VIII.

What the Industrial Age knew

- Georges Buffon (1749)
  - Earliest western account of the history of life and of the Earth that was not based on the Bible
  - Newton's natural forces to explain natural phenomena
  - Species cannot have originated in one place only (such as Linnaeus' primeval island or the Bible's ark) because they are adapted to specific regions and they cannot migrate through regions without dying
  - Each species was created in the region where it lives, i.e. many centers of creation

What the Industrial Age knew

- Georges Buffon (1778)
  - Fossils are past animals
  - The Earth must be a lot older than 6,000 years
  - The Earth went through a number of stages that changed its environment
  - Some animals became extinct

What the Industrial Age knew

- Georges Buffon
  - A Newtonian cosmogony
  - The Earth was created by a comet
  - The landscape of the Earth was caused by retreating oceans
  - The Earth is very ancient
  - History of the Earth divided in six stages corresponding to the six Biblical days of creation

What the Industrial Age knew

- Georges Buffon
  - Materialistic theory of life
    - Theory of degeneration: an ancestral form diverged into a number of species to adapt to different environments
    - Organic particles tend to organize themselves
    - Natural spontaneous generation of all forms of life, even the most complex organisms

What the Industrial Age knew

- Nature and Agriculture
  - Jethro Tull: "Horse-hoeing husbandry" (1731)
  - René Réaumur: "Curious Memoires relating to the History of Insects" (1734-42)
  - Duhamel Du Monceau: "The Physics of Trees" (1758)

What the Industrial Age knew

- History
  - Giambattista Vico: "La Scienza Nuova" (1744)
  - Montesquieu: “The Spirit of the Laws” (1748)
  - Voltaire: “Age of Louis XIV” (1751)
  - Guillaume Raynal: “Philosophical and Political History of the Two Indies” (1770)
  - Edward Gibbon: “Decline and Fall of the Roman Empire” (1776)
  - Herder: “Ideas on the Philosophy of History” (1784)

What the Industrial Age knew

- Ancient civilizations
  - Pompeii ruins discovered in 1748
  - Johann Winckelmann: "The History of Art in Antiquity" (1764)
  - Accademia Ercolanese: "The antiquities of Herculaneum" with illustrations (1744-92, translated all over Europe)

What the Industrial Age knew

- Ancient civilizations

Pianting of the Roman antiquities by Panini (1758)

What the Industrial Age knew

- Charles Bonnet (1754):
  - Essay on Psychology
  - The mind cannot influence the body ("epiphenomenalism")
  - The brain controls the body and causes the mind

What the Industrial Age knew

- Charles Bonnet
  - Charles Bonnet: "Considerations Sur Les Corps Organises" (1762)
    - The whole human race was created by God at the beginning and packed into germs that each and every woman contains
    - Each germ is a miniature of the whole organism
    - Humans were created from germs that appeared later in the history of the Earth

What the Industrial Age knew

- Etienne Condillac (1754)
  - John Locke's theory of mind without "reflection"
  - All human knowledge is the direct product of sensations
  - The structure of language reflects the structure of thought

What the Industrial Age knew

- Claude Helvétius (1758)
  - Hobbes + Locke with no free will
  - Man is a mechanical system whose ideas are determined by the outer world and whose actions try to maximize pleasure

What the Industrial Age knew

- Evolution of the Earth/II
  - Pierre Maupertuis: "Systeme de la Nature" (1751)
    - Critique of the germ theory
    - A property of matter is a tendency to self-organize
    - The units of matter are endowed with "will" to self-organize
    - Spontaneous generation of life through natural causes (instead of divine creation)
  - JeanBaptiste Robinet: "De La Nature" (1761)
    - There is a continuum of individuals
    - Species are an illusion due to the rarity of some intermediary individuals
    - Humans were created from germs that appeared later in the history of the Earth
  - No study of rocks and fossils

What the Industrial Age knew

- Evolution of the Earth/II
  - Astronomy reveals a vast evolving universe
  - Thomas Wright: “New Hypothesis of the Universe” (1750)
    - “Ten thousand times ten thousand worlds… peopled with myriads of intelligent beings”
  - Immanuel Kant: "The Universal Natural History and Theory of Heaven" (1755)
    - The solar system was created from a cloud of dust that collapsed because of its own gravity
    - There are other “island universes” (galaxies)
    - The universe is infinite
  - James Ferguson: “Astronomy Explained” (1756) becomes a bestseller
  - Jérôme Lalande: “Traité d'astronomie” (1764)

What the Industrial Age knew

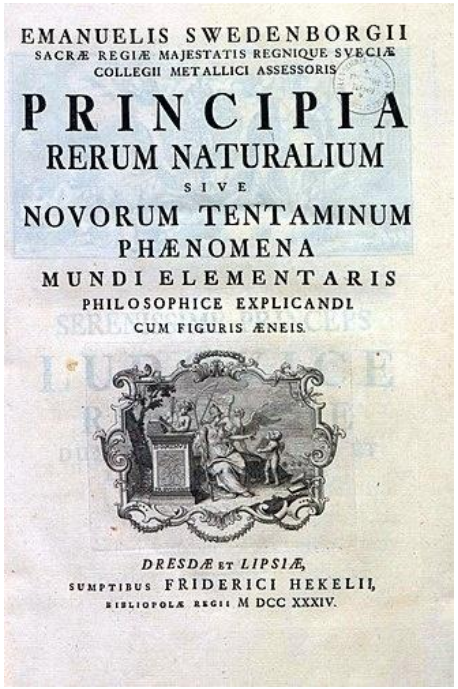
- Evolution of the Earth/II
  - Charles Messier: catalog of comets and nebulae, notably 13 new comets (1771)
  - William Herschel
    - 1781: discovery of a new planet, Uranus, the first new planet discovered since Ptolemy
    - Mathematical calculation (rather than observations) convinces the scientific community
    - The Moon and the Sun are inhabited
    - 1786: catalog of almost 1,000 galaxies
    - The universe is constantly changing
    - The Solar system is not the center of the universe (and the Earth is not the center of the Solar system)
    - Distant objects are also distant in time (light takes time to reach the Earth)
  - Caroline Herschel: the first female astronomer, who also discovers a comet (1786)

What the Industrial Age knew

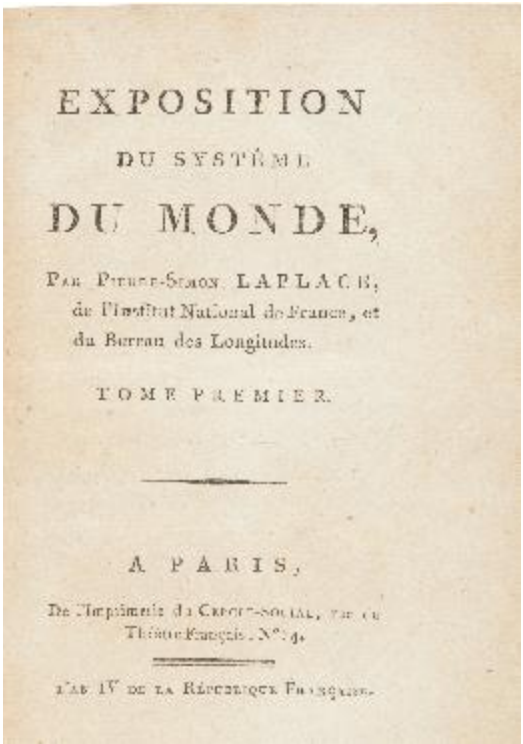
- Evolution of the Earth/II
  - John Bonnycastle: “Introduction to Astronomy in Letters to his Pupil” (1786)
    - The Earth is 2 million years old
  - Erasmus Darwin: “Botanic Garden” (1791)
    - Poem that imagines how the universe was created by a big bang and is evolving
  - Pierre Laplace: “Mecanique Celeste” (1799)
    - No need for God to explain the universe

What the Industrial Age knew

- Theories on the formation of the solar system
  - 1734 Emanuel Swedenborg's nebular hypothesis
  - 1755 Immanuel Kant
  - 1796 Pierre-Simon LaPlace's mathematical formulation


EMANUELIS SWEDENBORGII
SACRÆ REGIÆ MAJESTATIS REGNIQUE SVECIÆ
COLLEGII METALLICI ASSESSORIS
PRINCIPIA
RERUM NATURALIUM
SIVE
NOVORUM TENTAMINUM
PHÆNOMENA
MUNDI ELEMENTARIS
PHILOSOPHICE EXPLICANDI
CUM FIGURIS ÆNEIS.
DRESDÆ ET LIPSIÆ,
SUMPTIBUS FRIDERICI HEKELII,
BIBLIOPOLÆ REGII M DCC XXXIV.


Allgemeine
Naturgeschichte
und
Theorie des Himmels,
oder
Versuch
von der Verfassung und dem mechanischen Ursprunge
des ganzen Weltgebäudes
nach
Newtonischen Grundsätzen
abgehandelt.
von Imm. Kant.
Königsberg und Leipzig,
bey Johann Friederich Petersen, 17..


EXPOSITION
DU SYSTÈME
DU MONDE,
PAR PIERRE-SIMON LAPLACE,
de l'Institut National de France, et
du Bureau des Longitudes.
TOME PREMIER.
A PARIS,
De l'Imprimerie du CERCLE-SOCIAL, rue du Théâtre Français, N°. 4.
L'AN IV DE LA RÉPUBLIQUE FRANÇOISE.

What the Industrial Age knew

- Moses Mendelssohn (1755):
  - Beauty is in the eye of the beholder

What the Industrial Age knew

- The salons
  - Claudine de Tencin
  - Catherine de Rambouillet
  - Louise d'Epinay
  - Suzanne Necker
  - Emilie du Chatelet
  - Marie Geoffrin
  - Marie Anne du Deffand
  - Julie de Lespinasse
  - Marie-Madeleine de la Fayette
  - Madeleine de Scudery
  - Francoise de Graffigny
  - Anne-Catherine Helvetius

What the Industrial Age knew

- The Salons spread banned works
  - Voltaire's “Letters on the English” (1734)
  - LaMettrie’s “Natural History of the Soul” (1745)
  - Diderot’s “Philosophical Thoughts” (1746)
  - Helvétius’ “On the Spirit” (1758)

What the Industrial Age knew

- Enlightenment/ “Philosophes”
  - Charles de Montesquieu: "The Spirit of Laws" (1748)
    - Separation of powers for "checks and balances”: executive, legislative and judicial
  - Denis Diderot: "Encyclopedie" (1752)
  - Pamphlets, anonymous essays, journal articles, letters: the “liberal media”
  - Lisbon’s earthquake (1755) shatters certainties

What the Industrial Age knew

- **Lisbon's earthquake (1755)**

What the Industrial Age knew

- Enlightenment/ “Philosophes”
  - Voltaire (1756)
    - Deism, a purely rational religion
      - God created the universe and the physical laws that govern it
      - God has nothing to do with the affairs of the universe
      - God cannot be bribed by humans (prayers, rites)
      - Humans can choose good or evil
      - Humans shall be punished or rewarded accordingly

What the Industrial Age knew

- Enlightenment/ “Philosophes”
  - Voltaire (1756)
    - Moral crusade against intolerance, tyranny, superstition
      - The Church as a monster
      - The State as a mass murderer (“all murderers are punished unless they kill in large numbers”)
      - But also contempt for the masses

What the Industrial Age knew

- Enlightenment/ “Philosophes”
  - Voltaire (1756)
    - Freedom of thought (“Je ne suis pas d'accord avec ce que vous dites, mais je défendrai jusqu'à la mort le droit que vous avez de le dire”)
    - Invention of public opinion (he addresses the masses, not the elite)

What the Industrial Age knew

- Enlightenment/ “Philosophes”
  - The Enlightenment
    - discredited revealed religion (Voltaire, Diderot)
    - discredited the ancient regime (Rousseau)
    - emergence of a critical spirit

What the Industrial Age knew

- Enlightenment/ “Philosophes”
  - France becomes the cultural dictator of Europe, determining taste in literature and art
  - French replaces Latin as the language of the European aristocracy

What the Industrial Age knew

- Enlightenment in Europe
  - General optimism about the human mission, grounded in science and reason (will last till the world wars)
  - Scientific determinism gradually replaces religious faith
  - Realism

What the Industrial Age knew

- Enlightenment in Europe
  - The public sphere where new ideas circulate
    - The novel
    - The newspaper
    - The concert
  - Books replace music as the main entertainment
  - The ideas of the intelligentsia spread to the middle class
  - Emancipation of middle-class taste from the dogmas of the aristocracy
  - The literary critic

What the Industrial Age knew

- Deism in the USA
  - George Washington
  - Thomas Jefferson
  - Benjamin Franklin
  - Tom Paine (“The Age of Reason”)

What the Industrial Age knew

- Loss of credibility by the Bible
  - 1492: America is not mentioned in the Bible
  - 1572: A new star appears in the sky (a nova)
  - The other continents never heard of Jesus and have different prophets
  - Contradictions between Old and New Testaments
  - Church dogmas not justified by the scriptures
  - Louis Cappel: The Old Testament was written in Aramaic, not Hebrew
  - Edward Gibbon: Christianity caused the fall of the Roman Empire

What the Industrial Age knew

- Loss of credibility by the Bible
- Consequences:
  - Mind replaces soul (Locke)
  - Observation replaces revelation (Newton)
  - Study of ancient history, because the past extends way beyond the Biblical past

What the Industrial Age knew

- Romanticism
  - The influence of Idealism and Schelling:
    - Consciousness is moving towards a higher level
    - The meaning of life is not contemplation (the stereotype created by monastic life) but action
    - Each individual has to search for meaning, realize himself against all odds
    - Work is not an ugly duty but a metaphysical project
    - Art is an endless search for beauty

What the Industrial Age knew

- Romanticism
  - Reaction to the rationalism of the Enlightenment
    - Rousseau
    - Shelley's "In Defense of Poetry" (1821)
  - A period of peace: no major wars in Europe between 1815 and 1853

What the Industrial Age knew

- Romanticism
  - The psychological effect:
    - The heroic martyr
    - The misunderstood genius
    - The titanic madness

What the Industrial Age knew

- Romanticism in Literature
  - Reaction against Classicism
  - Prominence of imagination and feelings
  - Patriotism
  - Heroic action
  - Nature
  - Solitary genius
  - Fascination with
    - Middle Ages
    - Folk music and literature
    - Historical heroes
    - Horror
    - Science

What the Industrial Age knew

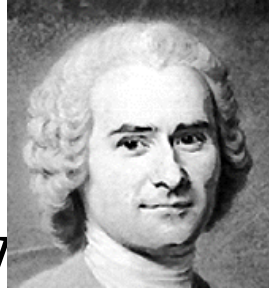
- Romantic science
  - Reaction to Newton's clockwork universe
  - Fascination for invisible phenomena
  - Chemistry and electricity
  - Scientific research for the sake of scientific research
  - The laboratory instead of the church
  - Pre-Darwinian concept of evolution (from inert matter towards higher consciousness)
  - Pre-Freudian concept of the unconscious (that drives that evolution)

What the Industrial Age knew

- Romanticism
  - The discovery of imagination
    - Imagination was considered a dangerous distortion of reality by the generation of Locke and Hume
    - "Reason is to imagination as the instrument to the agent, as the body to the spirit, as the shadow to the substance" (Shelley)
    - Imagination is not opposed to reason but complements it (Kant)

What the Industrial Age knew

- Democratization of science
  - The scientific revolution (Copernicus, Galileo, Descartes, Newton) was elitist and written in the lingua franca of scholarship (Latin) for a small international audience
  - Romantic science is for public consumption and written in national languages
  - Public lectures and popular science books



What the Industrial Age knew

- JeanJacques Rousseau (1761)
  - Human nature is good
  - Evil arises with society
  - Primitive humans were innocent, civilized humans are evil (“the thinking man is a depraved animal”)
  - Private property is the original sin
  - Science and arts create artificial desires which cause the loss of individual freedom

What the Industrial Age knew

- JeanJacques Rousseau (1761)
  - Emotions/instincts are superior to reason (prodromes of Romanticism)
  - The “state of nature” is superior to the civilized state
  - Pursuing a simple life is the real salvation
  - All humans are equal (prodromes of Democracy)
  - The “social contract” surrenders the individual's rights to the community in return for protection

What the Industrial Age knew

- JeanJacques Rousseau (1761)
  - Progress is the original evil because it created artificial desires that make humans unhappy
  - Humans tend to desire what other humans have and they don't have
  - Society makes humans aware of what they don't have
  - A collector is unhappy about the gaps in his collection instead of being happy about the objects that are already in the collection

What the Industrial Age knew

- Thomas Bayes (1761)
  - Probabilities
  - “The probability of any event is the ratio between the value at which an expectation depending on the happening of the event ought to be computed, and the value of the thing expected upon its happening”
  - Bayes’ theorem: how a subjective degree of belief should rationally change to account for evidence

$$P(W|L) = \frac{P(L|W)P(W)}{P(L)}$$

What the Industrial Age knew

- Thomas Bayes (1761)
  - Our knowledge is mainly probabilistic
  - As we learn more facts, we update our "confidence" in our beliefs
  - Learning is an incremental process of getting closer and closer to the truth
  - Trivia: unpublished manuscript discovered after his death

What the Industrial Age knew

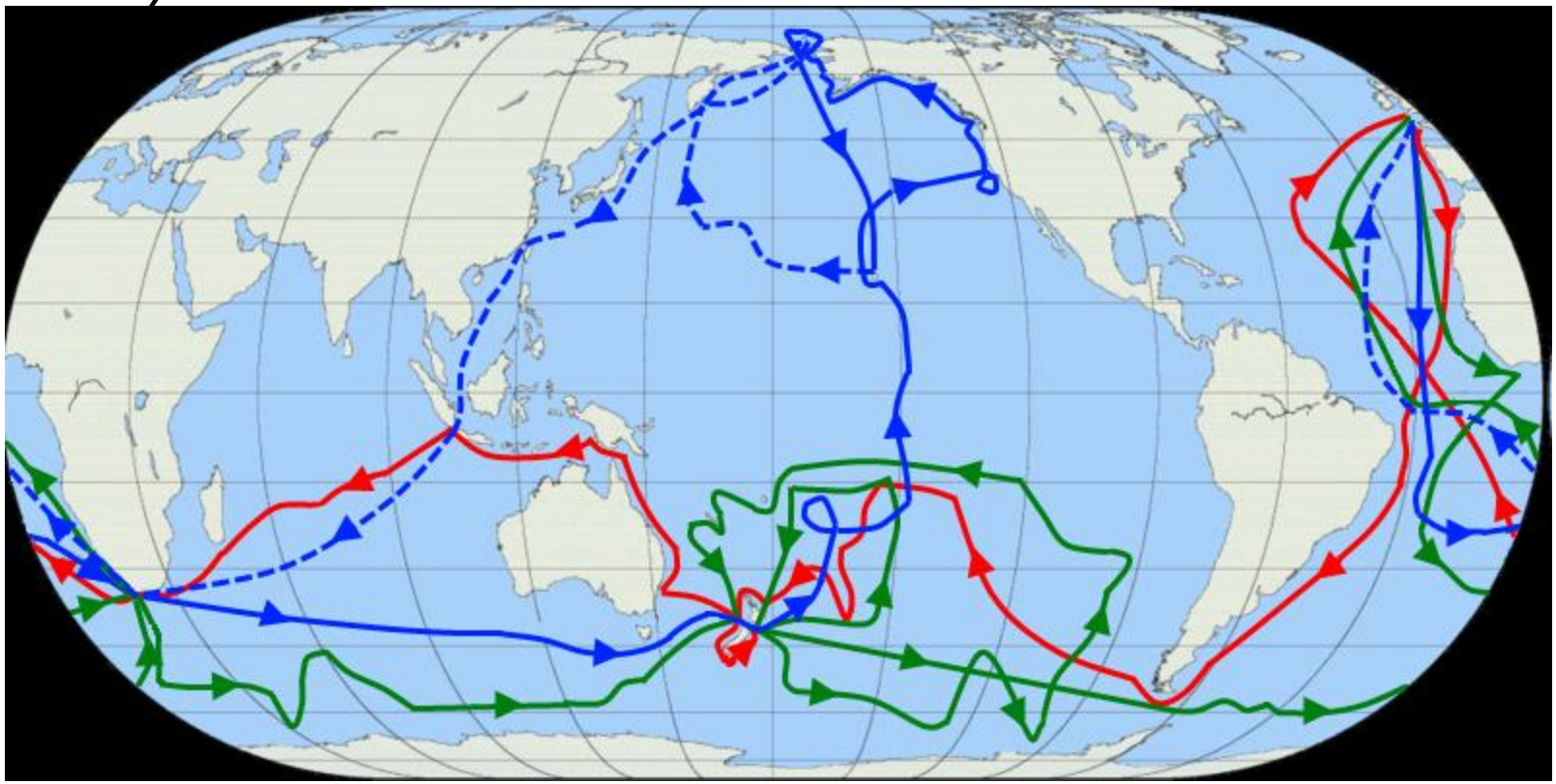
- Other civilizations
  - “Sapientia Sinica” (1622), Jesuit’s translation of Confucius
  - Adriaan Reland: “Des Mahometans” (1721)
  - Jean-Baptiste Du Halde: “Description géographique, historique, chronologique, politique, et physique de l'empire de la Chine” (1736)
  - Hermann Samuel Reimarus: “Schutzschrift fir die verniinftigen Verehrer Gottes” (1768)
  - Abraham Anquetil-Duperron: “Avesta” (1771) in French

What the Industrial Age knew

- **Other civilizations**
  - **Progressive awareness of non-European civilizations**
  - **Undermining European dogmas**
  - **Bossuet's "Histoire Universelle" is discredited**

What the Industrial Age knew

- James Cook's voyages (1768–71, 1772–75, 1776–79)



What the Industrial Age knew

- Joseph Banks, James Cook's botanist, studies the civilization of Tahiti
  - Surfing
  - Infanticide (as birth control)
  - Sex on sale (one nail for an intercourse)

What the Industrial Age knew

- Punishment
  - Before the Enlightenment
    - Public punishment, notably torture and executions
    - The punishment has to match or even exceed the crime
    - Punishment for serious offences always involves physical pain (besides fines and banishment)
    - The art of pain: the pain suffered by the criminal must somehow match the gravity of the offense
    - No prison: expulsion, fine, torture

What the Industrial Age knew

- Punishment
  - Before the Enlightenment
    - Common punishments: flogged, broken on the wheel, quartered by horses, decapitated, burned at the stakes
    - Most trials are secret, the accused cannot defend him/herself, anonymous accusations and unreliable witnesses are common, no defense lawyer
    - Confessions extorted by force or blackmail
    - Public torture/execution is public entertainment
    - Punishment is not so much a deterrent as a spectacle

What the Industrial Age knew

- Punishment
  - Before the Enlightenment
    - Critique of torture remains rare
    - Auguste Nicolas: "If torture is a means to verify secret crimes" (1682), first text critical of torture

What the Industrial Age knew

- Punishment
  - Cesare Beccaria: "On Crimes and Punishments" (1764)
  - John Howard: "The State of the Prison" (1777)
  - Benjamin Rush: "An Enquiry into the Effects of Public Punishments" (1787)
  - Joseph-Ignace Guillotin's speech at the National Assembly in Paris (1789)
  - Louis Michel le Peletier's speech at the Constituent Assembly in Paris for the abolition of the death penalty and of the galleys (1789)

What the Industrial Age knew

- Punishment
  - Development of a wider spectrum of punishment (vs the medieval choice of death or release)
  - Rise of disciplining and reforming imprisonment
  - Conviction does not require confession because the conviction does not have to be certain
  - Torture abolished: Prussia (1754), Austria (1776), France (1788), Netherlands (1798), Russia (1801), Spain (1808), Portugal (1826)
  - London police force (1829): England separates the police from the public, nationalizes it, and supervised it by the national politicians

What the Industrial Age knew

- Punishment
  - After the Enlightenment
    - Punishment becomes progressively less visible (the prison)
    - Punishment becomes progressively less about bodily pain and more about revoked rights
    - Hanging machine in England (1783) and guillotine in France (1792)
    - After 1848 public executions are rare in Europe
    - 223 capital punishments in English law
    - Emphasis on responsibility (a mad person is not "guilty")
    - Punishment as a scientific cure

What the Industrial Age knew

- Punishment
  - After the Enlightenment
    - 1704: The Hospice of San Michele (Rome)
    - 1704: Maison de Force (Ghent, then Netherlands)
    - 1790: Gloucester (England)
    - 1790: Philadelphia's Walnut St Prison

What the Industrial Age knew

- Vitalism
  - Théophile de Bordeu & Louis de Lacaze: “The Physical and the Moral” (1755)
    - A compromise between Locke-ian mechanists and Stahl-ian animists
    - Sensations cause electrical currents in the brain; innate consciousness controls the brain
  - Paul-Joseph Barthez: “New Elements of the Science of Man” (1778)
    - The “vital principle” of life
    - The “synergy”: organs and nerves work together
    - Disease is caused by a breakdown in synergy

What the Industrial Age knew

- Medicine
  - Smallpox outbreak of 1711 kills the Holy Roman emperor Joseph I; three siblings of the future Holy Roman emperor Francis I; and the heir to the French throne, the grand dauphin Louis
  - Smallpox kills King Louis I of Spain (1724); Emperor Peter II of Russia (1730); King Louis XV of France (1774); and Maximilian III Joseph of Bavaria (1777).

What the Industrial Age knew

- Medicine
  - Variolation: in 1718 Mary Wortley Montagu, wife of the ambassador to the Ottoman Empire, inoculates her son
  - Vaccine: 1796 Edward Jenner invents the smallpox vaccine

What the Industrial Age knew

- Breeding
  - 1760s: Robert Bakewell invents quasi-scientific sheep and cattle breeding by separating males from females, and allowing only carefully programmed mating
  - His success in creating new kinds of cows and sheep inspires Darwin's theory of evolution by natural selection (or, in this case, "artificial selection")

What the Industrial Age knew

- Paul-Henri Holbach (1770)
  - The history of the world is history of causes and effects
  - The universe is matter in continuous transformation: it never had a beginning and will never end
  - Every event has an influence on the universe
  - All natural phenomena can be understood in terms of the motion and features of matter
  - All that exists is visible to us

What the Industrial Age knew

- Paul-Henri Holbach (1770)
  - The soul is a property of the physical body, which dies when the body dies
  - There is no god that controls destiny and rewards or punishes individuals
  - The behavior of an individual (whether animal or human) is determined by the environment

What the Industrial Age knew

- Paul-Henri Holbach (1770)
  - Matter is capable of self-organizing into living organisms whenever the circumstances are appropriate
  - Species change all the time: nature is continuously experimenting new forms

What the Industrial Age knew

- Paul-Henri Holbach (1770)
  - The misery that afflicts humankind is caused by religion and superstition
  - Ethics is enlightened self-interest
  - A state's goal is to preserve the general welfare ("ethocracy")

What the Industrial Age knew

- End of the Lumieres
  - 1778: Voltaire and Rousseau die
  - 1780: Condillac dies
  - 1783: d'Alembert dies
  - 1784: Diderot dies

What the Industrial Age knew

- Oriental renaissance
  - Abraham Anquetil-Duperron's translation of the "Zend Avesta" (1771)
  - William Jones' Bengal Asiatic Society (1784)
  - Charles Wilkins' translation of the "Bhagavad Gita" (1784)
  - William Jones' discovery that Sanskrit is related to European languages, and it is even older and more complex than Greek (1786)
  - Karl Friedrich von Schlegel's "On the Language and Wisdom of India" (1808)
  - Jean-Francois Champollion's cracking of the hieroglyphic script (1822)

What the Industrial Age knew

- Adam Smith (1776)
  - The production and distribution of wealth
  - Free enterprise system
  - Free competition and free trade
  - Competition works for the common good ("invisible hand")
  - The value of a commodity is the amount of labor that it commands
  - The division of labor results in efficiency which results in surplus value
  - Surplus value is legitimate reward for capitalists
  - Capitalism creates a wealth gap but also reduces poverty

What the Industrial Age knew

- Adam Smith (1776)
  - “It is not from the benevolence of the butcher that we expect our dinner but from their regard to their own interest”
  - “He intends only his own gain, and he is in this led by an invisible hand to promote and end which was no part of his intention”
  - “By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it”

What the Industrial Age knew

- Adam Smith
  - “The Theory of the Moral Sentiments” (1759): moral values are innate

What the Industrial Age knew

- Adam Smith
  - The American colonies are a cost (money and blood)
  - They only benefit the capitalists but not Britain as a whole
  - Weakens the theoretical foundations of the British Empire

What the Industrial Age knew

- French Enlightenment and Germany
  - Germany is split in many states, some liberal and some totalitarian
  - Frederick II of Prussia is enlightened (LaMettrie, Voltaire, Wolff, Stael, Kant…)

What the Industrial Age knew

- German Idealism
  - A reaction to the new authority of science
  - A reaction to the French Enlightenment that believes there is no limit to reason
  - There is a limit to human knowledge/reason
  - There is a reality that the human mind cannot know
  - The mind is not a machine but a creator of reality

What the Industrial Age knew

- Immanuel Kant (1781)
  - Critical method: an inquiry into the limitations of human knowledge

What the Industrial Age knew

- Immanuel Kant (1781)
  - Phenomena (the world as we perceive it through our senses, the world of the senses) vs noumena (the world as it really is, the world of the intellect)
  - Reaction to Descartes' dualism: the world is itself a product of our mind
  - The self (not the world) is the focus
  - We are not passive experiencers of the world; we are the creators of the world we experience.
  - Time and space themselves are not inherent qualities of the physical world but tools of the mind.

What the Industrial Age knew

- Immanuel Kant (1781)
  - Phenomena exist only insofar as the mind perceives them as ideas
  - The ultimate reality (the thing-in-itself, "ding an sich") cannot be experienced by the human mind
  - We experience the world as we perceive it through our (human) nature
  - We cannot know how things are in themselves
  - We cannot know the objects of the world, but only our perceptions of such objects

What the Industrial Age knew

- Immanuel Kant (1781)
  - The ultimate reality (the thing-in-itself, "ding an sich") cannot be proven or disproven
    - Free will
    - Immortality of the soul
    - God

What the Industrial Age knew

- Immanuel Kant (1781)
  - The world is deterministic but we have free will and free moral choice
  - Immortality of the soul
    - It is impossible to know whether the soul is immortal or not (we can only know what it is when embodied, i.e. our mind), but
    - a moral person necessarily believes in the immortality of the soul because a moral person cannot achieve the highest good in a finite time
  - God
    - The mind cannot know directly the transcendent
    - But the highest good is impossible without God's will

What the Industrial Age knew

- Immanuel Kant (1781)
  - Idealism
    - There exists a thing in itself..
    - …but it is unknowable to us
    - The empirical world is my representation
    - Causality is a relation among representations, not between them and something else
    - Space, time and causal relationships are not features of reality in itself: they are features of our mind

What the Industrial Age knew

- Immanuel Kant (1781)
  - Not all our knowledge is derived from experience
  - Some basic knowledge is built into the human mind at birth
  - These “categories” (such as space and time) are basically organs of perception
  - Newton had introduced an absolute space and time “outside” the mind. Kant located them inside the mind.

What the Industrial Age knew

- Immanuel Kant (1781)
  - All our concepts derive from some innate knowledge (“trascendentalist idealism”)
  - Innate knowledge includes categories of quantity (unity, plurality, totality), categories of quality (reality, negation, limitation), categories of relation (substance-and-accident, cause-and-effect, reciprocity), and categories of modality (possibility, existence, necessity)
  - Anything that we experience is located by our mind in space and time and is classified by our mind within those categories
  - Space and time pre-exist, but only in our mind

What the Industrial Age knew

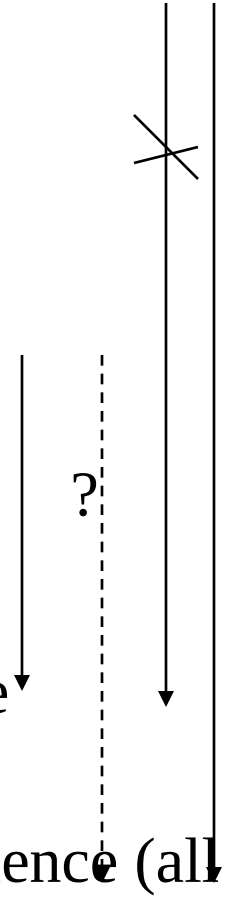
- Immanuel Kant (1781)
  - Knowledge is in our mind, and therefore everything that we know is in our mind (space, time, objects)
  - The qualia of an object (color, smell) are not in the object but in our mind, they are manufactured by the perceptive subsystem of our mind
  - The mind shapes perceptions
  - One cannot “infer” the existence of objects (as Descartes had done)
  - The primacy of intuition for noumena

What the Industrial Age knew

- Immanuel Kant (1781)
  - A-priori knowledge is indispensable to perception
  - Experience involves processing sense-data (applying a-priori categories to perceptions)
  - The human mind is an active originator of experience rather than just a passive recipient of perception
  - Perceptual input must be processed, i.e. recognized, or it would just be noise
  - Knowledge depends on the structure of the mind
  - It is this process of “recognizing” perceptions that generates consciousness (the self)

What the Industrial Age knew

- Immanuel Kant (1781)
  - Analytic proposition: the predicate is logically contained in the subject (its negation would be meaningless)
    - Examples: "Every thing has a size", "Americans are people"
    - Truth is self-evident once the concept is analyzed
    - Knowledge is not increased
  - Synthetic proposition: their truth is not self-evident
    - Examples: "My car is white", "This room is large"
    - Truth is based on experience of the world
    - Knowledge is increased
  - Empirical proposition: their truth depends on experience
    - Example: "My car is white", “Rob is American”
  - A-priori proposition: their truth is independent of experience (all analytic propositions are a-priori)
    - Example: ”God exists"



What the Industrial Age knew

- Immanuel Kant (1781)
  - Synthetic proposition: their truth is not self-evident
  - A-priori proposition: their truth does not depend on experience
  - Synthetic a-priori propositions: their truth is not dependent on reality, but only on intuition (“2+2=4”, “A straight line is the shortest distance between two points”, “Every event has a cause”), they could be denied without logical absurdity although we consider them “true” (e.g., non-Euclidean geometry)

What the Industrial Age knew

- Kant (1781)
  - All mathematical propositions are synthetic a-priori: they depend on intuition (they apply a-priori concepts to space and time, which are also a-priori):
    - Intuition is of a “spatial” kind in geometry (judgements of geometry are about the structure of space)
    - Intuition is of a “temporal” kind in arithmetic (judgements of arithmetic are about the structure of space)

What the Industrial Age knew

- Immanuel Kant (1781)
  - Physics is made of synthetic a-posteriori (empirical) propositions but also uses synthetic a-priory propositions (e.g., that one event causes another event), which apply a-priory concepts such as causality
  - Each category implies a corresponding principle of Physics

What the Industrial Age knew

- Immanuel Kant (1781)
  - Analytic and a-priori: ok (Analytic and empirical: no)
  - Synthetic and empirical: ok (Physics)
  - All propositions of Physics constitute synthetic a-posteriori (empirical) judgements: they are indefinitely revisable
  - Synthetic and a-priori: can we increase our knowledge independently of experience?
  - Kant's thesis: Yes (transcendentalism). Synthetic and a-priori judgments are possible (Physics can yield new knowledge)
  - Knowledge consists in categorizing perceptions

What the Industrial Age knew

- Immanuel Kant (1781)
  - Leibniz: all propositions are analytic, even empirical ones (all empirical propositions can be shown to be logically necessary)
  - Hume: only analytic a-priori and synthetic empirical, but no synthetic a-priori propositions

What the Industrial Age knew

- Immanuel Kant (1781)
  - A synthetic a-priori judgement is one that is true not because
    - 1. experience
    - 2. the predicate is logically contained within the subject
  - It can be proven true via a "transcendental argument", which is a set of methods to use the mind's own functioning to increase the mind's own knowledge. Example:
    - "There are objects that exist in space and time outside of me"
    - Proof: It would not be possible to be aware of myself as existing without presupposing the existence of something permanent outside of me to distinguish myself from
  - Synthetic a-priori knowledge:
    - "The amount of energy is always conserved"
    - "The angles of a triangle always add up to 180 degrees"
  - Physics is valid (Hume claimed it is not)

What the Industrial Age knew

- Immanuel Kant (1781)
  - Kant's psychology:
    - Senses perceive objects (particulars)
    - Thought handles concepts (universals)
    - Synthetic propositions are applications of a concept (universal) to an object (particular)
    - Concepts are:
      - a-posteriori/empirical concepts (abstracted from perceived objects),
      - a-priori concepts or "categories" (not abstracted from objects, but still applicable to objects),
      - ideas (neither abstracted from nor applicable to objects)

What the Industrial Age knew

- Kant (1781)
  - Kant's psychology:
    - Synthetic a-priori propositions are applications of categories (a specific kind of concepts) to the perceived objects
    - The subjective universe of perceived objects is transformed into the objective universe of causally-linked physical objects by the application of categories to perception
    - A chaotic senseless universe of disconnected events is turned into an ordered, meaningful universe of connected events
    - It is the thinking being who creates this ordered, meaningful reality (by means of the categories)

What the Industrial Age knew

- Kant (1781)
  - Kant's psychology:
    - Ideas are due to an infinite series of deductive inference (why? why? why?…)
    - There are only three and they originate
      - Psychology (what is the soul?)
      - Cosmology (what is the world?)
      - Theology (what is God?)
    - Ideas cannot be applied to experience

What the Industrial Age knew

- Kant (1781)
  - Categories can only be applied to perceptions
  - Applying categories to non-perceived (abstract) ideas (e.g. time) leads to an antinomy (a thesis and its antithesis can both be proven true), the domain of metaphysics
  - Antinomies can both be proven true:
    - 1. "The world has a beginning in time and is limited as regards space" and "The world has no beginning and no limits in space"
    - 2. "Every complex substance is made of simple parts" and "Nothing is composed of simple parts"
    - 3. "Humans have free will" and "Humans have no free will"
    - 4. "There exists a necessary being (God) in the world" and "There does not exist a necessary being (God) in the world"
  - The domain of the thesis is the mental world, the domain of the antithesis is the spatiotemporal world

What the Industrial Age knew

- Kant (1781)
  - Antinomies are examples of the limits of pure reason
  - Pure reason can only know the “phenomenal” world, never the “noumenal” world (the ultimate truth)

What the Industrial Age knew

- Kant (1781) - technicalities
  - Aesthetic: intuition
  - Analytic: understanding (representations of representations of sensations, I.e. concepts)
    - Judgement: linking two concepts
      - Quantitative (totality)
      - Qualitative (reality)
      - Relational (substance)
      - Modal (necessity)

What the Industrial Age knew

- Kant (1781) - technicalities
  - Dialectic: reason (linking judgements in syllogisms)
    - Categorical: unconditioned subject (psychology)
    - Conditional: unconditioned object (cosmology)
    - Disjunctive: perfect being (theology)

What the Industrial Age knew

- Kant (1781)
  - Kant's Ethics:
    - Reaction to the utilitarianism of the Enlightenment: a morality that determines duty regardless of pleasure and pain
    - There is an absolute good
    - The existence of morality is as evident as the existence of physical objects
    - Categorical imperative: good actions are those that one would want as universal laws

What the Industrial Age knew

- Kant (1781)
  - Proofs of God are flawed (they apply an idea to experience, as if it were a category)
  - The only evidence of God is that there is no justice (reward proportional to virtue) in this world, therefore there must be an afterlife
  - “God is not a being outside me but merely a thought inside me”
  - We believe in God because our minds are programmed to believe in a higher being
  - Reason is the final authority for morality ("choose your action as if the principle guiding your action were to become a universal law")

What the Industrial Age knew

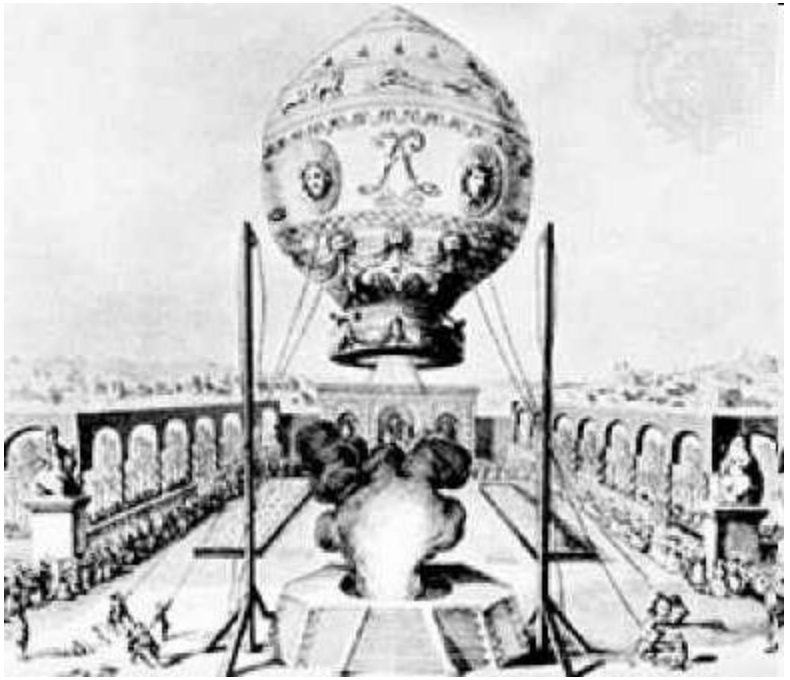
- Immanuel Kant (1755)
  - “Universal Natural History and Theory of Heaven" (published anonymously in 1755)
  - Birth of cosmology: a history of the universe based on Newton’s theory
  - Model of star and planet formation

What the Industrial Age knew

- Kant’s influence
  - Metaphysics becomes popular again: the ultimate reality (the thing-in-itself, "ding an sich") cannot be proven or disproven
  - The “transcendetal a priori” is a quasi-mystical concept
  - The I creates its reality, therefore inner life is important
  - Fichte, Schelling, Hegel, etc

What the Industrial Age knew

- Flying humans



The Montgolfier brothers and their first pilot Pilatre

What the Industrial Age knew

- Flying humans
  - England, 1766: Henry Cavendish discovers “inflammable air” (hydrogen) that is lighter than air
  - England, 1774: Joseph Priestly discovers several types of “air” including "dephlogisticated air" (oxygen, in reality already discovered in 1772 by Karl Scheele)
  - France, 1783: Antoine Lavoisier introduces the term “gas” and names both oxygen (1778) and hydrogen (1783)

What the Industrial Age knew

- Flying humans
  - France, Nov 1783: Joseph and Jacques Montgolfier launch the first balloon, propelled by hot air, piloted by Jean-Francois Pilatre (the first “aeronaut”)
  - France, Dec 1783: Alexandre Charles makes the first ascent in a hydrogen balloon (hydrogen impresses a much stronger lift) equipped with instruments (barometer, thermometer, telescope, sandbags) reaching 3000 meters of altitude in ten minutes
  - England, Sep 1784: Vincenzo Lunardi builds and flies the first English balloon
  - 1784: Balloon craze in France and England with 181 balloon flights
  - England, June 1785: Margaret Sage becomes the first female aeronaut

What the Industrial Age knew

- Flying humans
  - England, Nov 1784: Jean-Pierre Blanchard builds the first balloon that can be steered, modeling it after ships, and flies it with John Jeffries, who markets it as a scientific experiment
  - Jan 1785: Blanchard and Jeffries cross the English channel
  - France, Jun 1785: Pilatre's death in a balloon accident ends the balloon craze
  - Egypt, 1798: Napoleon uses balloons in his military campaign
  - England, 1799: England fears that Napoleon will invade from the air

What the Industrial Age knew

- Flying humans
  - France, 1804: Joseph Guy-Lussac ascends to 6000 meters
  - Ballooning does not provide a new view of the sky (as originally expected) but a new view of the Earth, e.g. the impact of human civilization on the natural environment

What the Industrial Age knew

- Thomas Reid (1785)
  - Philosophy of common sense
  - Things “obviously” exist
  - I “obviously” exist
  - Perceptions provide knowledge about the external world
  - Sensations are only “signs” inside our minds
  - Sensations presuppose a sentieng being

What the Industrial Age knew

- Thomas Reid (1785)
  - The tangible world is three-dimensional and Euclidean
  - The visible world is two-dimensional and non-Euclidean

What the Industrial Age knew

- Johann Blumenbach (1787)
  - Five races of humankind: five, Caucasian, Mongolian, Malayan, Ethiopian, and American

What the Industrial Age knew

- Prehistory of Linguistics
  - William Jones (1786): English and sanskrit descend from a common ancestral language, the Aryan language
  - Rasmus Rask (1818): similarities among Indo-European languages
  - Jacob Grimm (1822): Grimm's Law
  - Wilhelm von Humboldt (1836): classifies (morphologically) the world's language.

What the Industrial Age knew

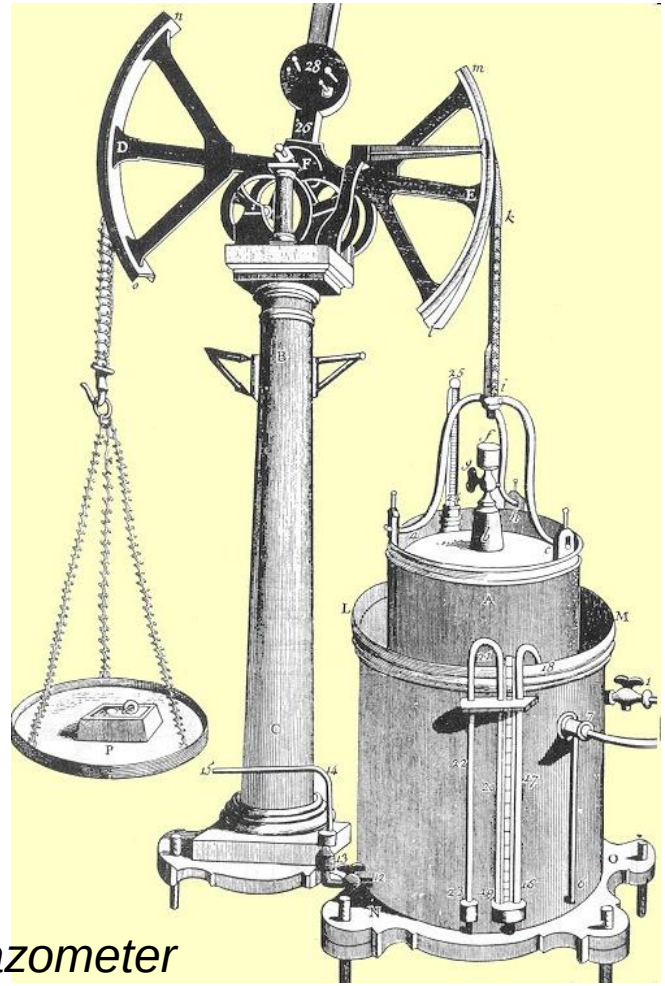
- Henry Cavendish
  - Pioneer of chemistry
  - 1766 discovers “inflammable air” (hydrogen) that is lighter than air
  - 1781: Water is made of oxygen and hydrogen
  - 1785: Air is made of oxygen and nitrogen

What the Industrial Age knew

- Joseph Louis Lagrange (1788)
  - “Mecanique Analytique”: mechanics reduced to calculus

What the Industrial Age knew

- Antoine Lavoisier (1789):
  - Founding of Chemistry
  - Table of the Elements
  - His home is a laboratory
  - His wife is his assistant



Marie Lavoisier's drawing a *gazometer*

What the Industrial Age knew

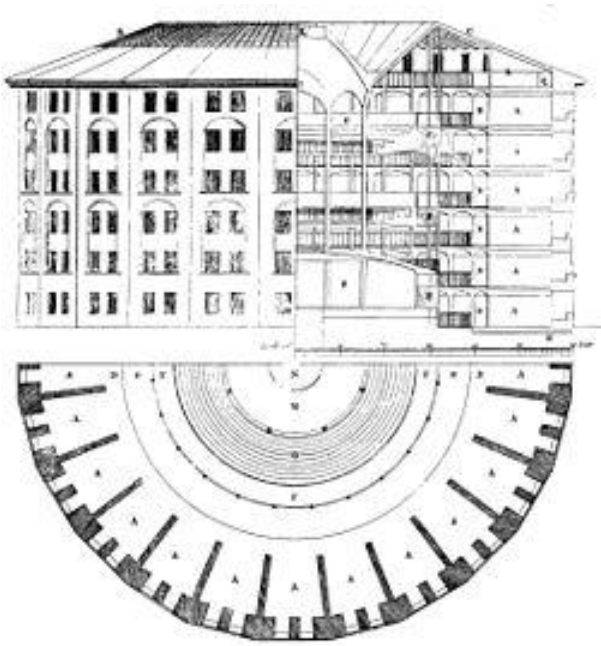
- Antoine Lavoisier:
  - 1783: introduces the term “gas”
  - 1777: combustion is a form of oxidation (combination with oxygen)
  - 1778: names oxygen
  - 1783: names hydrogen
  - 1789: conservation of mass (the quantity of matter is the same at the end as at the beginning of every chemical reaction)

What the Industrial Age knew

- Antoine Lavoisier:
  - Replaces the four ancient elements (water, fire, air, earth) with iron, copper, oxygen, hydrogen, sulphur, etc: ,
  - Fire is rapid oxidation
  - Water is a combination of oxygen and hydrogen

What the Industrial Age knew

- Jeremy Bentham (1789):
  - Human nature is governed by two fundamental motivations: seeking pleasure and avoiding pain
  - Moral values are to be based on the principle of utility: every action has to be judged based on how it augments or diminishes happiness
  - “The greatest good for the greatest number of people”



Panopticon penitentiary (1791)

What the Industrial Age knew

- Johann Herder (1791)
  - Nature and human history obey the same laws
  - Each individual belongs to a community (nation) and inherits its history
  - Each community has its own criteria (eg, there is no absolute definition of happiness)
  - “I am nothing… the whole is everything”

What the Industrial Age knew

- Johann Herder (1791)
  - The human race is divided in Volks (nations) defined by the languages they speak
  - Language determines how one thinks
  - A nation is not a group of people within some borders under some ruler but a natural entity

What the Industrial Age knew

- Johann Herder (1791)
  - What are humans?
  - Rejects the mechanistic view of nature (“counter-enlightenment”)
  - Nature consists of dynamic, goal-directed forces that interact with each other
  - Concept of "culture": the whole lifestyle of a people
  - Cultures evolved towards greater "humanity"

What the Industrial Age knew

- Johann Herder (1791)
  - As animal became more complex, they added structures to their nervous systems and brains

What the Industrial Age knew

- Johann Fichte (1792)
  - An unconscious “I” creates reality
  - Instead of the thing-in-itself: an absolute self that continuously shapes the outer world
  - Empirical science (that takes outside stimuli as ultimate reality) is meaningless

What the Industrial Age knew

- Johann Fichte (1792)
  - The natural world is construed by an infinite self
  - Self = primordial action of the intellect that originates the individual selves
  - The Non-self (the natural world) is created by the Self as a challenge to itself
  - The Self continuously confronts the non-Self, which it has created, and their interaction defines each
  - The Self creates the Non-self as a field in which to operate, and thus needs the Non-self to appear an independent reality
  - The original Self was not conscious, but the selves produced by this interaction become conscious

What the Industrial Age knew

- Johann Fichte (1792)
  - The self can only exist in the context of other selves, each one recognizing the other
  - The self emerges from being limited by the other selves

What the Industrial Age knew

- Claude Chappe
  - The optical “telegraph”, a semaphore system that eventually spans all of France
  - First line: Paris-Lille, May 1794
  - Initially used only for military purposes (the code is a state secret)
  - Extended by Napoleon to Italy, Germany, the Netherlands

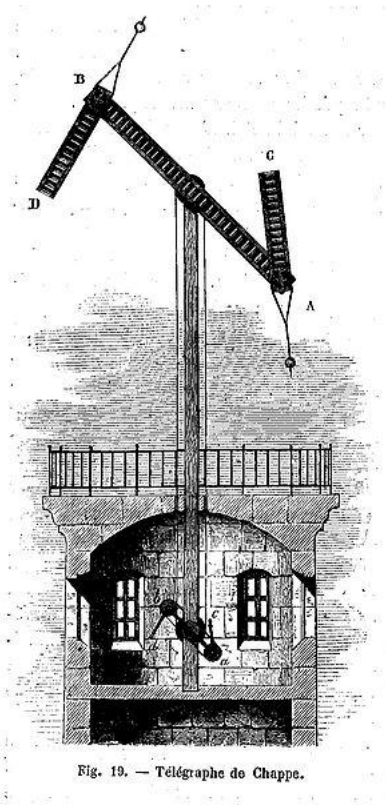


Fig. 19. — Télégraphe de Chappe.

What the Industrial Age knew

- Nicolas de Condorcet (1795)
  - Application of Mathematics to the social sciences just like Galileo and Newton applied it to Physics
  - Culture is governed by mathematical laws just like matter
  - Scientific and technological optimism
  - Belief in progress as a force for good
  - Science will eventually extend life forever

What the Industrial Age knew

- Franz-Joseph Gall (1796)
  - Phrenology: mental faculties are localized in specific brain regions (of which 19 are shared with animals and 8 are exclusive to humans)
  - All humans possess the same functions
  - But each person has a different performance because of the size and shape of the regions that implement those functions
  - Purely materialistic view of the mind: the mind is the brain
  - No free will: our behavior is (mostly) biologically determined (except for outside conditioning)
  - We inherit most of our behavior and fate

What the Industrial Age knew

- Franz-Joseph Gall (1796)
  - Humans are not equal: they are born different (vs Locke's "tabula rasa" that all humans are born equal)
  - Democracy is unnatural
  - Popular uprising are a form of madness
  - Moral responsibility is an illusion
  - Education can control impulses
  - Most influential theory of mind until 1840

What the Industrial Age knew

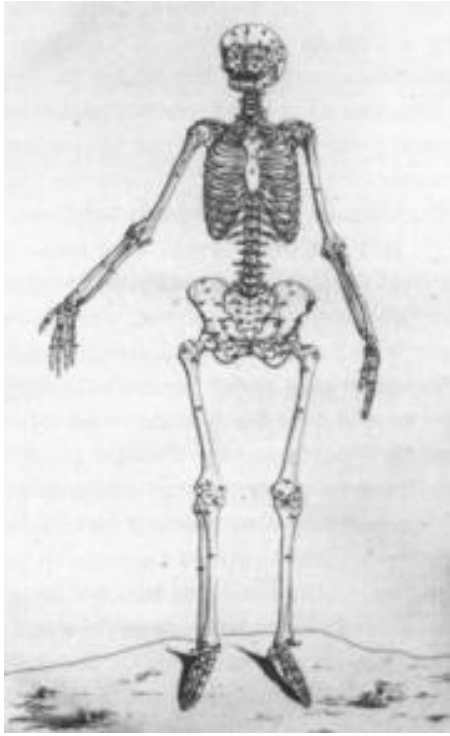
- Women's Liberation
  - Mary Wollstonecraft: "A Vindication of the Rights of Woman" (1792)
  - Thomas Beddoes (1790s): women are as intelligent as men, but "victims of studied neglect"

What the Industrial Age knew

- Sex
  - Delarivier Manley: "Secret Memoirs and Manners of Several Persons of Quality, of both Sexes, From The New Atalantis" (1709)
  - John Cleland: "Fanny Hill" (1748)
  - "Onania; or, The Heinous Sin of Self-Pollution, And All its Frightful Consequences, in both Sexes“
  - Samuel-Auguste Tissot: “L'onanisme. Dissertation sur les maladies produites par la masturbation” (1760)
  - JDT Bienville: “La Nymphomanie, ou Traité de la fureur utérine” (1771)

What the Industrial Age knew

- Enlightenment's view of female anatomy:
  - Marie-Geneviève-Charlotte Darlus (1759): first detailed female skeleton in an anatomy book
  - Pierre Roussel (1775): "The Physical and Moral System of the Woman"
  - Theodor von Bischoff (1843) and Adam Raciborski (1844): Ovulation occurs spontaneously, I.e. woman is a "spontaneous ovulator"
  - Georg-Ludwig Kobelt (1844): "Die männlichen und weiblichen Wollust-Organe des Menschen und einiger Säugetiere/ The Male and Female Organs of Sexual Arousal in Man and some other Mammals"



What the Industrial Age knew

- Enlightenment's view of female anatomy:
  - Conception is due to the union of male sperm and female egg
  - Oskar Hertwig (1876): the male sperm penetrates the female egg and the union of their nuclei constitutes fertilization
  - Sexual pleasure induces women to have sex even if it is dangerous to their survival
  - The two sexes are different

What the Industrial Age knew

- Evangelicals
  - Campaign to save England from moral decadence
  - Emergence of middle-class values to counterbalance loss of values in the aristocracy
  - Authority of a man derives from his moral status
  - A woman is a mother and a wife
  - Separate sexual spheres become middle-class institutions
  - Definition of proper private life

What the Industrial Age knew

- Evangelicals
  - Hegel: the family as a product of reason and will (e.g., arranged marriage instead of love passion)
  - Kant: the family is the foundation of social order

What the Industrial Age knew

- Hannah More: “Coelebs in Search of a Wife” (1807)
  - Condemns shallow and decadent lifestyle of cities
  - Emphasis on familial duties
  - Woman’s life centered in her home and family
  - Equality of the sexes is unnatural and immoral
  - Birth of Victorian morality

What the Industrial Age knew

- Thomas Malthus (1798)
  - Population growth depends on natural resources
  - Fertility leads to economic crises
  - Linear increase of food supply vs geometrical increase of population
  - Any gain in income will be offset by population growth
  - Population will always outstrip food supply and famine is a permanent feature of human society

What the Industrial Age knew

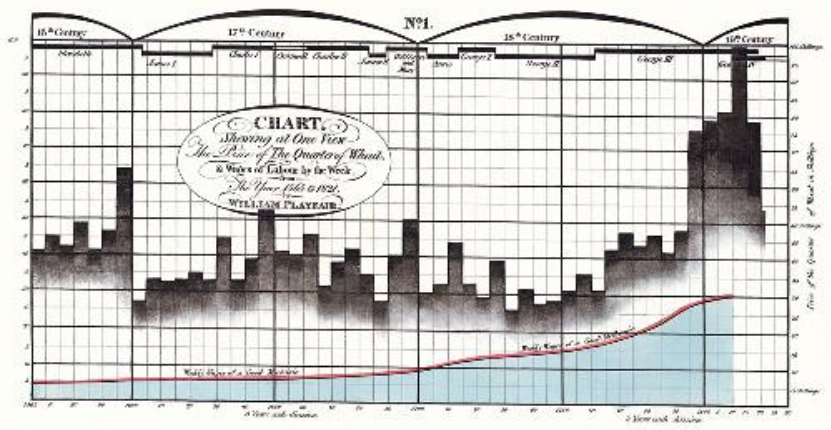
- Thomas Malthus (1798)
  - The state should not help the poor because limiting the number of poor is in the interest of society: improving the lives of the poor encourages the poor to make more children which will deprive everybody of resources and make everybody poorer
  - It is good that the poor have to struggle to survive

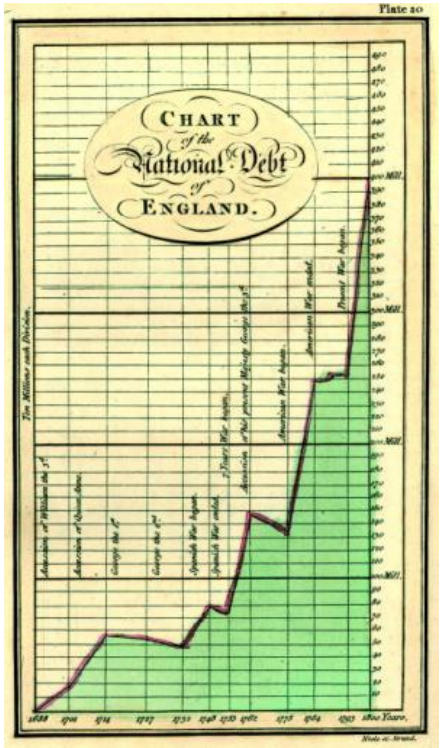
What the Industrial Age knew

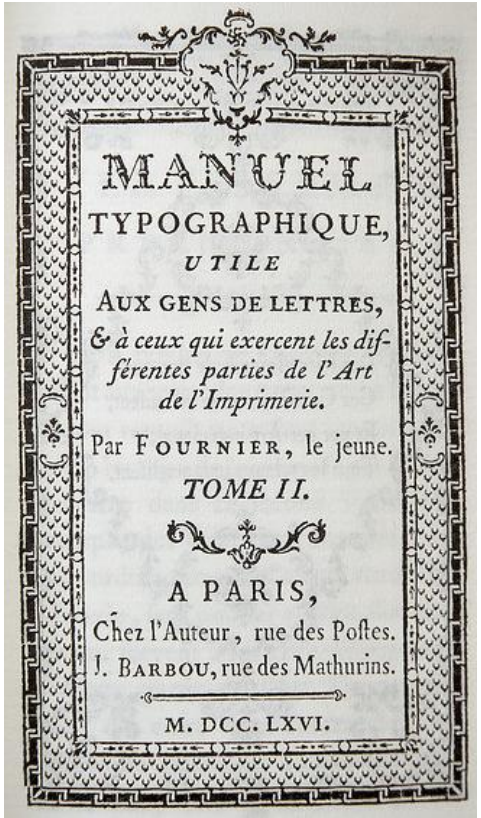
- Thomas Malthus (1798)
  - He did not foresee technological progress
  - He did not foresee that a country can simply produce goods, sell them, and buy food from other countries, instead of growing its own food

What the Industrial Age knew

- The evolution of the book
  - Pierre-Simon Fournier (France): "Manuel Typographique" (1764)
  - William Playfair (Britain): "Commercial and Political Atlas" (1786)
  - Graphs and charts







What the Industrial Age knew

- The evolution of the book
  - Giambattista Bodoni (Parma, Italy): "Saggio Tipografico" (1771)
  - Birth of modern font
  - But the printing presses are still Gutenberg's hand press
  - Aloys Senefelder invents lithography (Bavaria, 1796)

What the Industrial Age knew

- Percy Bysshe Shelley (1813)
  - Eating meat is unnatural (vegetarianism in the West)
  - Eating meat is the cause of "tyranny, superstition, commerce and inequality"
  - God does not exist

What the Industrial Age knew

- David Ricardo (1817)
  - Wages are determined by the price of food, which is determined by the cost of production, which is determined by the amount of labor required to produce the food, i.e: labor determines value
  - The value of labor must be higher than the wages paid to the laborer
  - The poor are meant to be poor

What the Industrial Age knew

- Evolution of the Earth/III
  - Geology is the first discipline that studies the history of nature and not the order of nature

What the Industrial Age knew

- Evolution of the Earth/III
  - Abraham Werner: "On the External Characters of Fossils" (1774)
    - Mineral classification
    - The landscape of the Earth was caused by retreating oceans (“Neptunist” theory)
  - Joseph Priestly (1774):
    - During the day green plants absorb carbon dioxide and produce oxygen (the “carbon cycle”)
  - Antoine Lavoisier:
    - Animals burn materials and release heat just like fire

What the Industrial Age knew

- Evolution of the Earth/III
  - James Hutton: "Theory of the Earth" (1785)
    - The landscape of the Earth was created by volcanic eruptions (“Vulcanist” theory)
    - Heat is a primary agent of change in geology
    - Heat consolidates underwater sediments into rock and then lifts those rocks above sea level
    - The interior of the Earth is very hot

What the Industrial Age knew

- Evolution of the Earth/III
  - James Hutton: "Theory of the Earth" (1785)
    - The landscape was also created by erosion caused by wind, rain and rivers over a long period of time
    - The landscape was also created by many small earthquakes over a long period of time
    - The laws that shaped the Earth are laws that are still active today
    - The Earth is very ancient

What the Industrial Age knew

- Evolution of the Earth/III
  - James Hutton: "Theory of the Earth" (1785)
    - Steady-state world view: the history of the Earth has no direction, as agents of destruction and renewal maintain a steady state

What the Industrial Age knew

- Evolution of the Earth/III
  - Pierre-Simon Laplace: "System of the World" (1796)
    - The solar system was created from a cloud of dust that collapsed because of its own gravity
  - Erasmus Darwin: "Zoonomia" (1796)
    - A theory of evolution
    - The struggle to adapt to the environment causes a gradual progress of life towards higher forms of organization
    - Inheritance of acquired characteristics

What the Industrial Age knew

- Evolution of the Earth/III
  - Georges Cuvier (1796)
    - Fossils are animals that have become extinct
    - Fossils belong to different eras
    - Causes of extinction: geological revolutions (“catastrophism”)
    - Study of fossils and rocks - founder of paleontology
    - "Essay on the Theory of the Earth" (1813): first history of life based on empirical data
    - Catastrophism: catastrophes shape the biosphere

What the Industrial Age knew

- Evolution of the Earth/III
  - Georges Cuvier (1796)
    - Animal kingdom divided in types based on different kinds of organization (parallel not hierarchical) :
      - Vertebrates
      - Mollusks
      - Articulates (insects, spiders, worms)
      - Radiates (circular plan of organization)
    - No type is superior to the others: they are just different kinds of organization

What the Industrial Age knew

- Evolution of the Earth/III
  - Discovery of extinct species:
    - Megatherium in South America (1789)
    - Mammoth in Siberia (1799)
    - Mastodon in North America (1799)

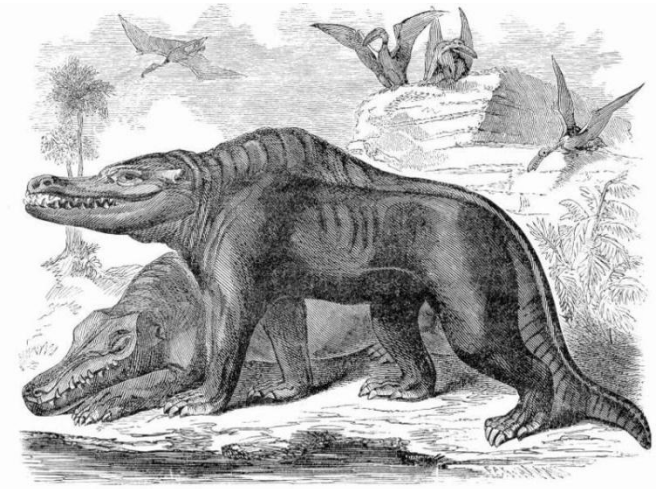
Mammoth

Mastodon

Megatherium
(Muséum d'Histoire naturelle Paris)

What the Industrial Age knew

- Evolution of the Earth/III
  - Discovery of extinct species:
    - 1811: 12-year-old Mary Anning discovers the first fossil of a marine reptile, the Ichthyosaurus
    - William Buckland (1824): first description of a dinosaur (“Megalosaurus”)



“Megalosaurus and Pterodactylus” (Samuel Griswold Goodrich, 1859)

"Country of the Iguanodon" (John Martin 1838)

What the Industrial Age knew

- Evolution of the Earth/III
  - Neptunism: Abraham Werner
  - Vulcanism: James Hutton
  - Catastrophism: Georges Cuvier
  - Creationism: Carl Linnaeus, William Paley
  - Diluvianism: William Buckland (worldwide flood)

What the Industrial Age knew

- William Paley (1802)
  - Teleological argument to prove the existence of God, adapted to Newton's law: the universe exhibits a purposeful behavior
  - The universe is a vast machine operating according to Newton's laws
  - Somebody must have built that machine
  - Intelligent design: a watch can only be built by a watchmaker (“the watch must have had a maker”)

What the Industrial Age knew

- Evolutionism
  - Jean-Baptiste Lamarck: “Système des animaux sans vertèbres” (1801)
    - Distinction between inanimate objects and living beings
    - Distinction between vertebrate and invertebrate animals
    - Need for a separate science for the living matter (“biology”)

What the Industrial Age knew

- Evolutionism
  - Jean-Baptiste Lamarck: “Philosophie Zoologique” (1809)
    - Biology founded on the concept of evolution
    - All living beings were formed through evolution
    - Inherent tendency of life towards complexity
    - Irregularity in evolution due to environmental circumstances

What the Industrial Age knew

- Evolutionism
  - Jean-Baptiste Lamarck: “Philosophie Zoologique” (1809)
    - Changes in the environment cause changes in living beings, both body and habits
    - Bodily changes are inherited
    - Habits are inherited

What the Industrial Age knew

- Evolutionism
  - Jean-Baptiste Lamarck: “Philosophie Zoologique” (1809)
    - The force of life is a natural force that shapes the universe (including the Earth’s crust)
    - Natural spontaneous generation of living beings, but only for the simplest forms of life
    - Use and disuse cause some body parts to develop or wither away
    - The environment causes the organism to use some body parts and not use others, therefore indirectly driving evolution
    - Species are an illusion due to the fact that we have not found yet the intermediary individuals

What the Industrial Age knew

- Evolutionism
  - Alexander von Humboldt (1826)
    - Nature is a single unified organism
    - Everything interacts with everything: the ecosystem
    - Dangers caused by humans messing with the environment (deforestation, irrigation, agriculture)

What the Industrial Age knew

- Friedrich Schelling (1800)
  - The phenomena of the world vary in degree of self-consciousness, from the rocks (will is completely unconscious) to humans (will is conscious)
  - The universe is moving towards a higher consciousness of itself

What the Industrial Age knew

- Friedrich Schelling (1800)
  - Dualism creates oppositions of mind/matter, good/evil, subject/object, etc which make philosophical problems insoluble
  - Objective idealism: underlying unity of nature
  - Equilibrium of forces
  - Consciousness is the product of unconscious forces

What the Industrial Age knew

- Friedrich Schelling (1800)
  - The world is created by a universal will that strives to manifest itself (the world is that manifestation)

What the Industrial Age knew

- Friedrich Schelling (1800)
  - There is an “unprethinkable” being that precedes all thought and is the condition of thought
  - Nature precedes Spirit
  - The process of self-organization is the primary creator of reality
  - Consciousness emerges from unconscious matter through stages of self-organization
  - All that exists is continuously being redefined by the process of self-organization
  - The process of self-organization is fundamentally a process of "limiting" (a generalization of Fichte's limiting activity)

What the Industrial Age knew

- Friedrich Schelling (1800)
  - Living organisms interact with the environment to continuously reorganize themselves
  - Eventually "Spirit" emerges, that has both self-consciousness and free will
  - Emergence is a process of constraining activity

What the Industrial Age knew

- Friedrich Schelling (1800)
  - All languages derive from a mother language
  - All myths derive from one primordial mythology

What the Industrial Age knew

- Madness
  - Alexander Crichton: "An inquiry into the nature and origin of mental derangement" (1798)
  - Jean-Baptiste Pussin (a mental-asylum doctor whose method influences Pinel)
  - Philippe Pinel: "Treatise on Insanity" (1801)
  - Johann-Christian Reil: "Rhapsodies about applying the methods of treatment to disorganized spirits" (1803)

What the Industrial Age knew

- Johann-Christian Reil (1803)
  - Pre-Freudian psychiatry
  - Madness is caused by society and industrial society causes more madness
  - There has been an evolution of species towards higher and higher forms
  - and an evolution of individuals towards higher and higher consciouness
  - and this evolution will continue (Schelling-like)

What the Industrial Age knew

- Johann-Christian Reil (1803)
  - The difference between noumena and phenomena is only one of degree, i.e. it's like the difference between the conscious and the unconscious
  - Kant's transcendental is actually a mental issue, and metaphysics is psychology

What the Industrial Age knew

- Psychology
  - Charles Bonnet: "Essay on Psychology" (1754)
  - William Cullen: "First Lines of the Practice of Physic" (1777)
  - Immanuel Kant: "Critique of Pure Reason" (1781)
  - Karl Moritz's Magazine for Empirical Psychology (1783)
  - Johann-Christian Reil's Archive for Physiology (1795)
  - Franz-Joseph Gall's phrenology (1796)
  - Jean-Baptiste Pussin (a mental-asylum doctor whose method influences Pinel)
  - Philippe Pinel: "Treatise on Insanity" (1801)

What the Industrial Age knew

- Psychology
  - Pierre Cabanis: "On the relations between the physical and moral aspects of man" (1802)
  - Johann-Christian Reil: "Rhapsodies about applying the psychological method of treatment to mental breakdowns" (1803)
  - Jean-Etienne Esquirol: "The Passions Considered as Causes, Symptoms and Means of Cure in cases of Insanity' (1805)
  - Johann-Christian Reil coins the word “psychiaterie” (1807)
  - Maine de Biran: "Essay on the Fundamentals of Psychology" (1812)

What the Industrial Age knew

- Psychology
  - Jean-Étienne Esquirol: "The passions considered as causes, symptoms and means of cure in cases of insanity' (1805)
  - Immanuel Kant: "Critique of Pure Reason" (1781)
  - Johann-Christian Reil: "Rhapsodies about applying the psychological method of treatment to mental breakdowns" (1803)
  - Maine de Biran: "Essay on the Fundamentals of Psychology" (1812)
  - Johannes Mueller: “Handbook of Human Psychology” (1840)
  - Biophysics Movement of 1847 in Germany
  - Johann Heinroth’s Psychikers vs Somatikers

What the Industrial Age knew

- Jakob Fries (1807)
  - How to prove the existence of synthetic a priori knowledge
  - Paradox: such a proof either rests on premises that are synthetic a priori themselves or are synthetic a posteriori and empirical, thus reducing synthetic a priori knowledge to posteriori knowledge

What the Industrial Age knew

- Jakob Fries (1807)
  - Distinction between object language and meta-language ("system" and "critique“)
  - Object languages: metaphysics, ethics, etc
  - Their first principles consist of synthetic a priori propositions
  - Meta-language: the actual content of Kant's "critique" (posteriori knowledge)
  - Kant’s a posteriori critique is psychological in nature ("anthropological")

What the Industrial Age knew

- Georg-Wilhelm-Friedrich Hegel (1807)
  - Knowledge is possible even beyond Kant's antinomies
  - Spiritual nature of all reality
  - The Absolute is pure being
  - Only the Absolute exists, everything else is an illusion (eg space and time, objects, any division of the Absolute)
  - The Absolute is both the infinite universe and infinite pure mind

What the Industrial Age knew

- Georg-Wilhelm-Friedrich Hegel (1807)
  - Metaphysics is logic ("what is rational is real and what is real is rational")
  - Dialectical method (progress is the result of the conflict of opposites)

What the Industrial Age knew

- Hegel (1807)
  - Any attempt to state the reality of something (thesis) results in a contradiction (antithesis) that can only be resolved (synthesis) at a higher level, where both are true, which yields a new thesis, for which there exists an anti-thesis, which can be resolved in a synthesis, etc. All the way to the highest level, the absolute
  - Reality (nature as well as human history) is the dialectical unfolding of the absolute
  - As we understand more of the absolute, the absolute knows more of itself

What the Industrial Age knew

- Hegel (1807)
  - Art investigates the absolute through forms of beauty
  - Religion investigates the absolute through symbols
  - Philosophy investigates the absolute through logic
  - The dialectical process progresses towards the absolute's full self-knowledge, which is the ultimate goal of everything (”God is God only in so far as he knows himself")
  - The absolute is thought that thinks itself

What the Industrial Age knew

- Hegel (1807)
  - History is due to the conflict of forces/nations
  - An entity lays down a challenge, which becomes a thesis
  - An antithesis arises
  - A synthesis resolves the two on a higher plane
  - (eg, “revolution” is opposed by “reaction” and the synthesis is a new social order)
  - History is the unfolding of the world spirit

What the Industrial Age knew

- Hegel (1807)
  - The state is the most “divine” object on Earth
  - Individual rights are secondary to the state’s interests

What the Industrial Age knew

- Hegel (1807)
  - The human condition is one of alienation, because the individual sees herself as being distinct, instead of being united with the absolute
  - Philosophy's mission: to emancipate people from millennia of alienation

What the Industrial Age knew

- Hegel (1807)
  - Kant's absolute "I" is impossible
  - The "I" arises as the result of evolution from sense-data to self-awareness Language precedes the self

What the Industrial Age knew

- Hegel (1807)
  - Nationalistic and racist politics
    - Idealization of the Prussian state
    - Distortion of historical facts to justify his theory of history
    - “The Orientals have not attained the knowledge that Man is free”
    - “The East knows only that the One is free; the Greek and Roman world that some are free; the German world knows that all are free”.
  - “America is the land of the future”

What the Industrial Age knew

- Hegel (1807)
  - The end of history
    - History was due to the struggle of humans to be free
    - Freedom is what makes humans human
    - A human being is, first and foremost, a moral agent
    - History is driven by a moral value before any economic or political value
    - They became free after the French revolution
    - The liberal democratic state represents the end of history because there will be no more struggle

What the Industrial Age knew

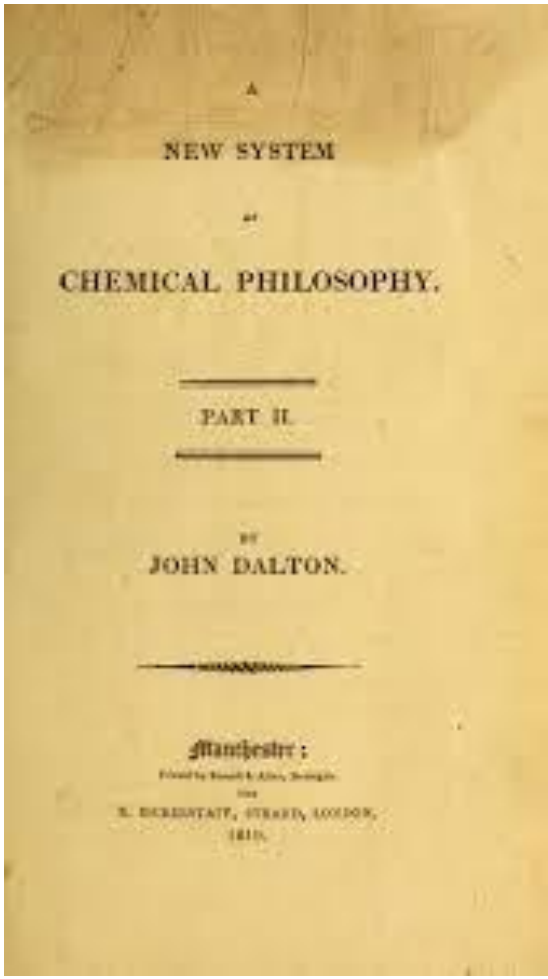
- Post-Hegel radicals
  - David Strauss' "The Life of Jesus"
  - August von Cieszkowski : it is not enough to study history, we need to use history to change the world
  - Lorenz von Stein: industrialization enslaves the proletariat
  - Arnold Ruge: man expresses himself through work
  - Moses Hess: private property must be abolished

What the Industrial Age knew

- Futuristic literature
  - Pierre-Marc-Gaston de Lévis: “Voyage de Kang-Hi” (1810)
  - Mary Shelley: “Frankenstein” (1818)
  - Mary Shelley: “The Last Man” (1826)
  - Jane Webb: “The Mummy” (1827)
  - Auguste-François Creuzé De Lesser: “Le Dernier Homme” (1832)
  - Felix Bodin: “Le Roman De L'avenir” (1834)
  - Louis Geoffrey: “Napoleon et La Conquete Du Monde” (1836)
  - Émile Souvestre: “Le Monde Tel Qu'il Sera” (1846)
  - Jules Verne: "Voyage Au Centre de la Terre" (1864)
  - Jules Verne: "De la Terre a' la Lune " (1865)
  - Jules Verne: "Vingt Mille Lieues Sous les Mers" (1870)
  - Charles Renouvier: “Uchronie” (1876)
  - Camille Flammarion: “La fin du Monde” (1894)

What the Industrial Age knew

- John Dalton (1808)
  - Atomic theory
    - Elements are made of atoms
    - Atoms of a given element are identical in size, mass, and other properties; atoms of different elements differ in size, mass, and other properties.
    - Atoms of different elements combine in simple whole-number ratios to form chemical compounds.
    - Chemical reactions are due to the combination or separation of atoms


A

NEW SYSTEM

OF

CHEMICAL PHILOSOPHY.

PART II.

BY

JOHN DALTON.

Manchester:

What the Industrial Age knew

- Amedeo Avogadro (1811)
  - Equal volumes of all gases, at the same temperature and pressure, have the same number of molecules

What the Industrial Age knew

- Canned food
  - Nicolas Appert (France), the “father of canning”: "The Art of Preserving all Kinds of Animal and Vegetable Substances for Several Years" (1810)
  - 1810: Peter Durand (England) patents a similar process
  - 1813: Bryan Donkin, John Hall and John Gamble set up the world's first canning factory
  - Appert prefers glass jars whereas in England the tin can becomes more popular (lighter and it doesn't break)
  - Canned food becomes popular because of wars (easy to carry by soldiers in the Crimean War and in the Civil War of the USA) and the cattle disease of the 1860s in England.

What the Industrial Age knew

- Arthur Schopenhauer (1819)
  - The inner nature of all phenomena is “will”, the will to survive
  - The universe is will, that permeates both living and nonliving matter
  - Life is simply an expression of that will

What the Industrial Age knew

- Arthur Schopenhauer (1819)
  - A human being is both knowing and willing
    - As knowers, humans experience the world in terms of space, time and causality (the “view from without”, the world as representation, cognitive view)
    - As free-willing beings, humans are also provided with a “view from within” (the world as will, conative view)
    - The knowing intellect only knows the surface, while the will is able to grasp the ultimate meaning

What the Industrial Age knew

- Arthur Schopenhauer (1819)
  - Kant + Buddha
  - We can know reality in itself, but only from within, via self-knowledge, via the realization that we are “will” (striving nature of conscious beings)
  - Mind (conscious and unconscious) is will, which assumes the idea of the body in space and time
  - Will is the inner force of human life
  - “Will and acting are one”
  - Will is the true substance of the body
  - We do not really will, but are “willed” by the unconscious force

What the Industrial Age knew

- Schopenhauer (1819)
  - Will is the inner reality of every natural phenomenon
  - Everywhere there is will: “impulse, persistence, determination”
  - All reality is will; there is one universal will

What the Industrial Age knew

- Schopenhauer (1819)
  - The will's constant urge for achievement of ever more ambitious goals causes human unhappiness
  - We are victims of our insatiable will
  - We are either bored (because we are not letting our will act) or frustrated (because we can’t achieve what our will wills)
  - The will is the origin of our sufferings: the less you "will", the less you suffer
  - The endless cycle of willing and suffering can be broken only by ceasing the striving, i.e. Buddhist-like resignation/contemplation
  - Salvation requires an “euthanasia of the will”

What the Industrial Age knew

- Schopenhauer (1819)
  - The Will does not die with our body
  - The Will survives in new forms
  - Palingenesis

What the Industrial Age knew

- Schopenhauer (1819)
  - Aids to salvation:
    - Philosophy
    - Art
    - Compassion

What the Industrial Age knew

- Schopenhauer (1819)
  - Moral virtue is a way to reduce the evil power of will
  - Moral virtue is a way to realize that individuals are an illusion, that only Will (one shared will) exists

What the Industrial Age knew

The "Savannah" completes the first transatlantic crossing by a steamboat (1819)

What the Industrial Age knew

- The Indoeuropean hypothesis
  - 1786: William Jones, chief magistrate of Calcutta, learns Sanskrit and shows the strong affinity of Sanskrit and Greek
  - 1822: Jakob Grimm discovers how sounds are consistently modified from one Indoeuropean language to another

What the Industrial Age knew

- Maine de Biran (1812)
  - All knowledge is acquired through experience
  - But sense-experience does not determine the inner life: it is inner life that determines sense-experience
  - Will is always in relation to action
  - To act is to know, and viceversa
  - Perception is not passive, but active: perception is action
  - Psychology cannot be reduced to physiology because they study fundamentally different phenomena
  - They are equivalent descriptions of the same event

What the Industrial Age knew

- Physics
  - Thomas Young's double-slit experiment (1805) proves that light is a wave
  - Robert Brown (1824) discovers that microscopic particles in water exhibit an irregular and perpetual motion (“Brownian motion”) even if no force is exerted on them (this is due to the chaotic motion of water molecules)
  - Sadi Carnot (1824) generalizes the steam engine as a heat engine and proves that perpetual motion is impossible (prelude to the second law of thermodynamics)

What the Industrial Age knew

- Carl Friedrich Gauss (1824)
  - Mathematical creativity
  - The study of numbers as a science in itself
  - Prime numbers (and polygons with prime number of sides)
  - Imaginary numbers
  - Non-Euclidean geometry
  - Invention of the telegraph (with Wilhelm Weber in 1833)

What the Industrial Age knew

- Pierre Simon LaPlace (1825)
  - The universe is a set of particles interacting with each other according to Newton's laws
  - The future is fully determined (Given the initial conditions, every future event in the universe can be calculated)
  - Gravitational astronomy
  - Nebular hypothesis of stellar evolution

What the Industrial Age knew

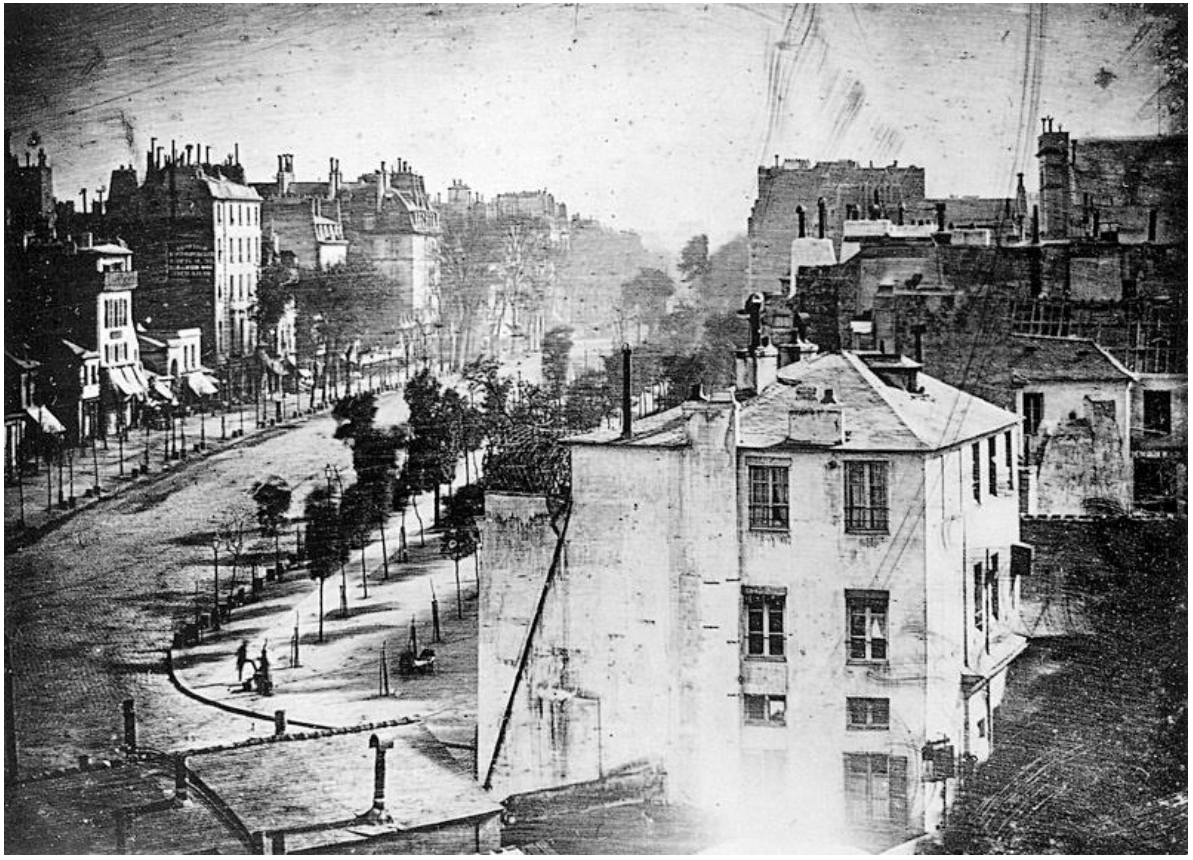
- Pierre Simon LaPlace (1825)
  - “Philosophical Essay on Probabilities” (1819): subjective probability (the world is fully determined but humans assign probabilities to events)

What the Industrial Age knew

- Joseph Nicephor Niépce (1826)
  - The first photograph

What the Industrial Age knew

- Louis Daguerre (1838) takes a picture of the Boulevard du Temple from a window of the Diorama



What the Industrial Age knew

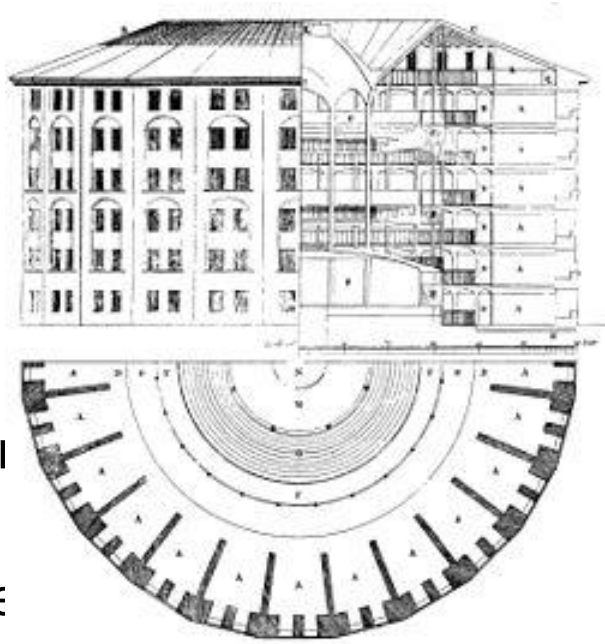
- Auguste Comte (1826):
  - “Positive Philosophy” (Positivism)
  - Three stages of human development, corresponding to three stages of the human mind
    - Theological stage (events are explained by gods, kings rule)
    - Abstract stage (events are explained by philosophy, democracy rules)
    - Scientific ("positive") stage (there is no absolute explanation, but empirical science provides useful generalizations or “laws”)

What the Industrial Age knew

- Auguste Comte (1826):
  - Sociology: Science of society
  - Society undergoes the same three stages as Science
  - Scientists will rule countries in the last stage
  - Study the future, not the past

What the Industrial Age knew

- The Prison System
  - Philadelphia: isolation
  - Auburn, New York (1821): modeled after the monastic rules (silence, communal activities)
  - The prison as an instrument for the modulation of the penalty
  - Bentham's Panopticon becomes the reference model for prisons
  - Vidocq's memoirs (1828)
  - Mettray prison (1840)



Panopticon penitentiary (1791)

What the Industrial Age knew

- Joseph Fourier (1827)
  - Any periodic function can be represented as the sum of a series of sinusoidal and cosinusoidal waves
  - Any periodic function can be decomposed into since and cosine functions

$$f(x) = \frac{A_0}{2} + \sum_{m=1}^{\infty} A_m \cos(mkx) + \sum_{m=1}^{\infty} B_m \sin(mkx),$$

where k is the function's frequency and is related to the period via $k = 2\pi/\lambda$. The coefficients A_m and B_m are given by

$$A_m = \frac{k}{\pi} \int_{-\lambda/2}^{\lambda/2} f(x)\cos(mkx)dx, \quad m \geq 0,$$

$$B_m = \frac{k}{\pi} \int_{-\lambda/2}^{\lambda/2} f(x)\sin(mkx)dx, \quad m \geq 1.$$

What the Industrial Age knew

- Joseph Fourier (1827)
  - The Fourier Transform turns a function into the sum of its frequencies, so that engineers can manipulate each frequency individually. In a sense, the Fourier Transform reveals the ingredients of a signal: how much of any given frequency it contains. A sound, for example, is typically made of several frequencies that merge together. The Fourier Transform tells us which ones. The Fourier Transform contains the same information of the original function, and it can be turned back into the original function by simply adding all its constituent frequencies; but it usually represents an easier representation of the information contained in the original function. For example, noise reduction consists in using the Fourier Transform of a sound to find out which high frequencies are present and then in removing them. When you adjust the frequencies on your amplifier's equalizer, you are manipulating the Fourier Transform of your sound system.

What the Industrial Age knew

- Joseph Fourier (1827)
  - Everything that is continuous can be represented as a sum of waves

What the Industrial Age knew

- Friedrich Woehler (1828)
  - Organic compounds can be made from inorganic constituents
  - Living beings are made of the same stuff as non-living beings

What the Industrial Age knew

- James Mill (1829)
  - Feelings come in patterns of associations

What the Industrial Age knew

- Biology and Neurology:
  - 1664: Thomas Willis' "Cerebral Anatomy" (1664) describes the different structures in the brain and coins the word "neurology"
  - 1771: Luigi Galvani discovers that nerve cells are conductors of electricity
  - 1796: Franz-Joseph Gall begins lecturing on phrenology, holding that mental faculties are localized in specific brain regions (of which 19 are shared with animals and 8 are exclusive to humans)

What the Industrial Age knew

- Evolution of the Earth/IV
  - Karl von Baer: "Ueber Entwickelungsgeschichte der Thiere" (1828)
    - The human embryo does not recapitulate the history of life on Earth
    - Embryo development is a process of specialization in many different directions, not a linear process towards Homo Sapiens

What the Industrial Age knew

- Charles Lyell (1830)
  - Gradual change: normal events can have great effects if they keep occurring over a long period of time
  - Geological events extend far back in time (I.e., the world is much older than the Bible claims)
  - As the geology changes, so does the biology
  - The Earth tends to maintain an equilibrium via a balance of destructive and constructive forces

What the Industrial Age knew

- Charles Lyell (1830)
  - Evolution has no special direction
  - As the environment changes, old species become extinct and new species are born
  - Extinction and creation are processes that contribute to the Earth's state of equilibrium (Hutton's steady-state theory)

What the Industrial Age knew

- Charles Lyell (1830)
  - Fluctuating climate accounts for the changes in living beings at different times
  - All classes of animals have always existed
  - There has been no progression from reptiles to mammals but only a change in the relative proportion of the two classes

What the Industrial Age knew

- Evolution of the Earth/IV
  - John Phillips (1841)
    - Three major geological eras:
    - Palaeozoic ("old life"), dominated by fish fossils,
    - Mesozoic ("middle life"), the age of reptile fossils,
    - Caenozoic ("new life"), the age of mammals.

What the Industrial Age knew

- Evolution of the Earth/IV
  - Louis Agassiz (1844)
    - Simultaneous creation of multiple individuals in each species, all distributed over the ranges God meant for them to inhabit (“parallelism”)
    - Creationism
    - The human embryo recapitulates the history of life on Earth: invertebrate to repite to human
    - A linear hierarchy towards Homo Sapiens
    - Most of Europe used to be buried in ice (1837)

What the Industrial Age knew

- Evolution of the Earth/IV
  - Conclusions from the study of fossils and rocks
    - Life began with invertebrates, followed by fish, reptiles and finally mammals
    - Each geological era has been inhabited by its own unique population of living beings
- Richard Owen: "On the Archetype and Homologies of the Vertebrate Skeleton" (1848)
  - Homology is more than analogy
  - Homology: the same structure is used by different species for different purposes
  - Sophisticated version of Intelligent Design

What the Victorian Age knew

- Electricity
  - 1800: Alessando Volta stores electricity in a battery
  - Hans Christian Oersted (1819): an electric current generates a magnetic field (there is a scientific method to measure electricity)
  - 1820: Johann Schweigger ‘s galvanometer
  - AndreMarie Ampere (1820): electromagnetic reaction (two parallel conductors carrying currents traveling in the same direction attract each other; if traveling in opposite directions, repel each other)

What the Victorian Age knew

- Electricity
  - 1825: William Sturgeon's electromagnet (a permanent magnet as long as current flows through it)
  - Georg Ohm (1827): the relationship among voltage, current, and resistance V=R*I

What the Victorian Age knew

- Michael Faraday (1831)
  - Interaction between bodies is transmitted through a field
  - The interaction via fields is not instantaneous
  - Electricity is transmitted through an electrical field
  - Magnetism is transmitted through a magnetic field (first observed by Hans Christian Oersted in 1819)
  - Identity of electricity and magnetism

What the Victorian Age knew

- Michael Faraday
  - Electromagnetic induction
  - The dynamo (that converts mechanical energy into electrical energy), electric motor, electric generator

What the Industrial Age knew

- Karl von Clausewitz (1833)
  - A science of warmaking
  - The relationship between state and army
  - War is the continuation of politics by other means
  - It presupposes the existence of a state
  - Difference between the lawful/civilized warrior (disciplined and subordinate to the political leader) and the unlawful/savage warrior

What the Industrial Age knew

- John Stuart Mill (1836)
  - Utilitarianism
  - Laws of nature control the universe and the mind
  - The environment controls the body
  - The mind is only an organ

What the Industrial Age knew

- John Stuart Mill (1836)
  - Ethics
  - The moral value of an action depends on its outcome: a good action is one that has a good outcome
  - The best action is the one that pleases the greatest number of people
  - "Pleasure and freedom from pain are the only things desirable as ends" and viceversa (the only desirable things are those that promote pleasure and prevent pain)

What the Industrial Age knew

- John Stuart Mill (1836)
  - Phenomenalism: an object is the set of all the possible ways it can be perceived
  - Knowledge is limited to the objects revealed by perception

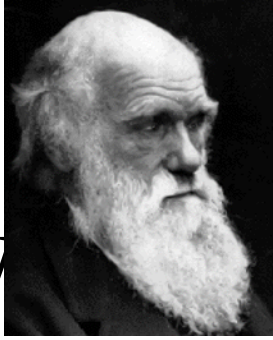
What the Industrial Age knew

- Ralph Waldo Emerson (1836)
- Transcendentalism
  - Critique of materialism
  - Critique of Calvinism
  - Freedom of the individual

What the Industrial Age knew

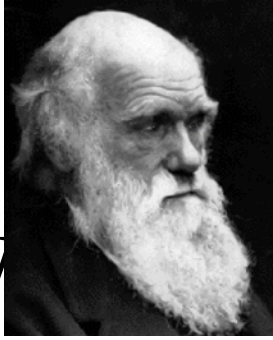
- Bernhard Bolzano (1837)
  - Critique of Kant
  - Intuition is always empirical, never pure
  - Mathematics must be grounded on logic, not intuition
  - revives Leibniz's program of a "universal characteristic"

What the Industrial Age knew



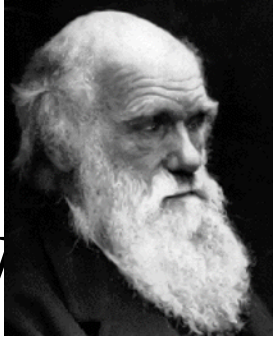
- Charles Darwin (1839 although published in 1859)
  - Animals evolved
    - New species evolved from pre-existing species
  - Evolution=variation+selection
    - Variation is ubiquitous
    - Natural selection is the driving force of evolution
    - New species are created by the action of natural selection on variation
  - Adaptation
    - New species are caused by the need to adapt to environmental changes

What the Industrial Age knew



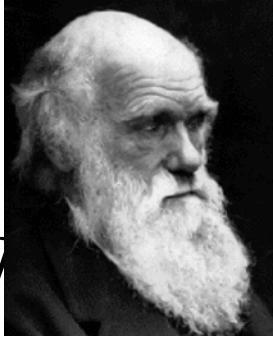
- Charles Darwin (1839 although published in 1859)
  - Mystery of variation, that appears to be random
  - Variation can only be treated as a statistical quantity and described statistically
  - Populations, not individuals

What the Industrial Age knew



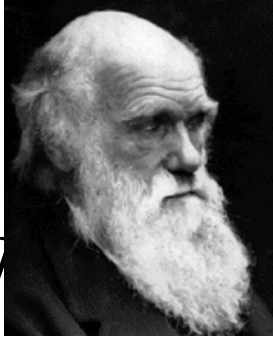
- Charles Darwin (1859)
  - Darwin's theory was three theories in one
    - A theory of natural selection (the environment selects species)
    - A theory of heredity (wrong - later replaced by Mendel's)
    - A theory of variation (randomness)

What the Industrial Age knew



- Charles Darwin (1859)
  - Evolution is a branching process by which one species gives rise to a number of new species mainly under the influence of geographic isolation
  - The branching process leads to endless specialization
  - Evolution has been a very slow process that required a virtually unlimited amount of time

What the Industrial Age knew



- Charles Darwin (1859)
  - Adam Smith's economics transferred to nature
  - Darwin lived in a bourgeois society that was increasingly obsessed with competition as the driving force of economic progress
  - Design without a designer

What the Industrial Age knew

- Charles Darwin (1859)
  - Natural selection AND Sexual selection (competition for survival AND competition for reproduction)
  - Sexual selection: males compete for females, females choose males
  - Males were the first artists/musicians, females were the first art/music critics

What the Industrial Age knew

- Charles Darwin (1859)
  - Not only individual selection
    - Group selection (altruism) operates among social insects (ants, bees)
    - Kin selection: an individual can influence the outcome of selection not only by breeding himself but also by helping his genetic relatives to breed

What the Industrial Age knew

- Charles Darwin (1859)
  - Origin of life
    - The first forms of life were created by God

What the Industrial Age knew

- Charles Darwin (1859)
  - Language is an instinct
  - Other animals also have that instinct

What the Industrial Age knew

- Charles Darwin (1859)
  - Africa will turn out to be the cradle of the human species
  - The upright posture freed human hands which led to a much broader use of tools which led to higher intelligence

What the Industrial Age knew

- Charles Darwin (1859)
  - Descartes indirectly brokered a truce between religion and science, by assigning sentient life to religion and matter to science.
  - Darwin indirectly unleashed a devastating attack by science against religion, by showing that every property of life is the result of a material process.

What the Industrial Age knew

- Nationalist revolutions
  - The legacy of the French revolution
  - Right of peoples/nations to self-determination
  - Latin American countries (succeed)
  - Serbia from Ottomans (1804, fails)
  - Greece from Ottomans (1830, succeeds)
  - Belgium from Netherlands (1830, succeeds)
  - Poland from Russia (1831, fails)
  - Italy from Austria (1848, fails)
  - Hungary from Austria (1848, fails)
  - Czechs from Austria (1848, fails)

What the Industrial Age knew

- Social revolutions
  - France has multiple revolutions: 1824 (succeeds: constitution), 1830 (fails), 1848 (fails) and 1870 (socialist, fails)
  - Austria has multiple revolutions: nationalist (all fail), social (abolition of serfdom) and liberal (fails)
  - USA: Civil war (fails)

What the Industrial Age knew

- Immune to revolutions
  - Britain
    - 1832: Great Reform Bill
    - 1867: Representation of the People Act
  - Russia
  - Prussia
  - They benefit from turmoil in continental Western Europe and in the Balkans

What the Industrial Age knew

- Constitutional revolutions
  - Iran (1905-09)
  - Turkey (1908-09)

What the Industrial Age knew

- Utopias
  - Jean-Jacques Rousseau "Discourse on the Arts and Sciences" (1750)
  - Louis-Sebastien Mercier's "The Year 2440" (1771), first science-fiction novel
  - William Hodgson's "The Commonwealth of Reason" (1795)
  - John Lithgow's "Equality" (1802)
  - G. A. Ellis' "New Britain" (1820).
  - William Godwin: "An Enquiry Concerning Political Justice and Its Influence on General Virtue and Happiness" (1793).
  - Robert Owen’s New Lanark (1800) in Scotland and New Harmony (1825) in Pennsylvania
  - Henri de Saint-Simon's "The New Christianity" (1825)
  - Charles Fourier: “The New Industrial World" (1829)

What the Industrial Age knew

- Utopias
  - George and Sofia Ripley's Brook Farm near Boston (1841-47)
  - Charles Sears' and Nathan Starks' Colts Neck in New Jersey (1843-54)
  - Humphrey Noyes' Oneida near New York (1848-81)
  - John Minter Morgan's "The Revolt of the Bees" (1826)
  - Michael Angelo Garvey's "The Silent Revolution - The Future Effects of Steam and Electricity upon the Condition of Mankind" (1852)

What the Industrial Age knew

- Utopian socialism
  - Charles Fourier (1808)
    - Reorganization of society around phalanxes
  - Henri de Saint-Simon (1825)
    - Scientists to lead society (“positivism”)
    - Christianity to inspire industrialization
    - Industrialization to improve lives
  - Pierre Proudhon (1843)
    - Anarchy: elimination of government
    - Property is theft
    - Educate people so that government and police would become unnecessary
  - Eugene Sue's serialized novel "The Mysteries of Paris" (1843)

What the Industrial Age knew

- Utopian socialism
  - Mikhail Bakunin
  - Pyotr Kropotkin

What the Industrial Age knew

- Charles Mackay (1841)
  - Madness of the crowds
    - Alchemy
    - Witch-hunts
    - Crusades
    - Duels
    - Financial bubbles
      - the South Sea Company bubble of 1711–1720
      - the Mississippi Company bubble of 1719–1720
      - the Dutch tulip mania of 1637

What the Industrial Age knew

- Ludwig Feuerbach (1843)
  - Hegel mistakenly inverted the relationship between individuals and the Absolute
  - Religion is an unconscious projection of human experience (“species being”) onto the concept of God
  - Religion takes human experience and turns it into the concept of God
  - God is made in man’s image, not viceversa
  - Theology can be reduced to anthropology

What the Industrial Age knew

- Ludwig Feuerbach (1843)
  - Worshipers worship an ideal abstraction of themselves
  - Salvation consists in demystifying religion
  - We should focus on mutual well-being not on a non-existent paradise
  - Human dignity emerges through denial of immortality

What the Industrial Age knew

- Ludwig Feuerbach (1843)
  - Humanistic philosophy (a philosophy that cares for the ordinary man) is the logical successor of all religious philosophy
  - ”The new philosophy is the complete and absolute dissolution of theology into anthropology"
  - Anthropology and Physiology are the fundamental sciences

What the Industrial Age knew

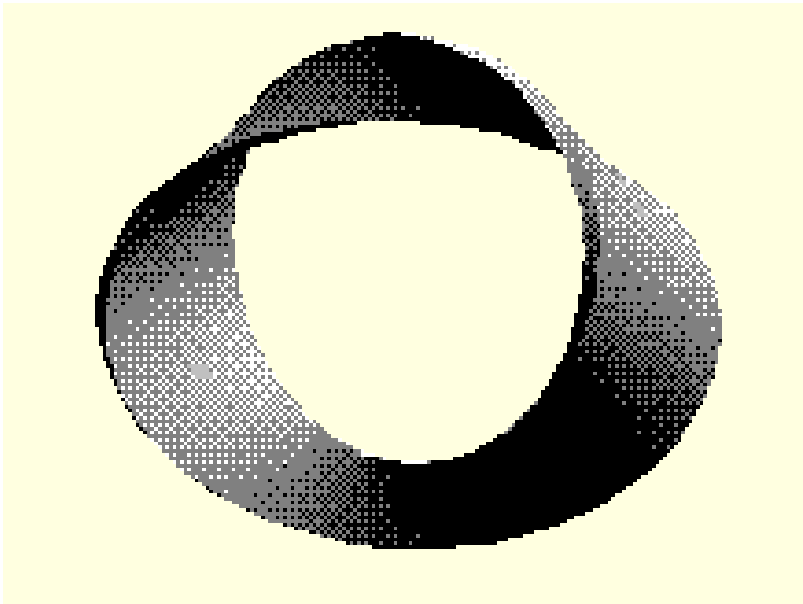
- Thomas Carlyle (1843)
  - Hatred and fear of democracy
  - Praise of feudal society
  - Critique of material wealth
  - Concern with the living conditions of the working class
  - "The history of the world is but the biography of great men."

What the Industrial Age knew

- August Moebius (1843)
  - There must exist a fourth dimension
  - The Möbius Strip has only one side and one edge

$$x = \left[R + s\cos\left(\frac{1}{2}t\right)\right]\cos t$$
$$y = \left[R + s\cos\left(\frac{1}{2}t\right)\right]\sin t$$
$$z = s\sin\left(\frac{1}{2}t\right),$$

for $s \in [-w, w]$ and $t \in [0, 2\pi)$.



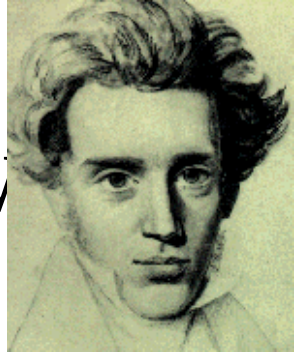
What the Industrial Age knew

- Robert Chambers (1844)
  - Evolutionary account of the origin of the stars, the solar system, the Earth and life over geological time via repeated acts of spontaneous creation of order
  - The Earth was born from a nebula
  - The Earth has changed over time (unlike in Lyell)
  - Change has been gradual (as in Lyell)
  - Life was created by spontaneous generation
  - Creation by purely natural causes
  - God has only created the law of progression/evolution, with Homo Sapiens as the ultimate goal

What the Industrial Age knew

- Robert Chambers (1844)
  - Life evolved by gradual anatomical changes
  - The human embryo recapitulates the evolution of life (as in Agassiz): evolution consists of a slow process of extension in the period of gestation (the longer the period the further the organism in the hierarchy of living beings)

What the Industrial Age knew



- **Soren Kierkegaard (1846)**
  - **Hegel's metaphysical program is impossible because the philosopher cannot be a detached, objective, external observer: the philosopher is someone who exists and is part of what is observed (an "existing subjective thinker")**
  - **The very reason that we are interested in philosophy (in understanding our existence) is because we exist**
  - **Existence is both the thinker's object and condition**
  - **The truth that matters is the pathos of existing, not the truth of Logic**
  - **Logic is defined by necessity, but existence is dominated by possibility**

What the Industrial Age knew

- Kierkegaard (1846)
  - Necessity is a feature of being, possibility is a feature of becoming
  - Existence is choice
  - Possibility (choice) causes angst
  - There are no universal, objective standards to decide one's behavior: the choice is subjective
  - Each possible existence cannot be described, it can only be lived

What the Industrial Age knew

- Kierkegaard (1846)
  - Communication: a contradiction in terms because the message is deformed by the experience of the messenger
  - Christianity is a communication of existence (what it is to exist)
  - The Christian God is an “absolute paradox” , “something that thought cannot think”, which requires a leap of faith
  - “Man is a synthesis of the infinite and the finite”
  - Each individual struggles to maintain that synthesis/unity, and the struggle causes unhappiness (“man is not yet a self”)

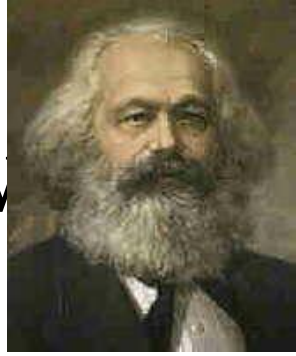
What the Industrial Age knew

- Kierkegaard (1846)
  - Stages of life
    - Untruth (aesthetic stage): the individual lives immediately (in the moment)
    - Ethical stage: the individual lives according to principles (family, society, etc)
    - In the truth (religious stage): the individual lives according to faith in God

What the Industrial Age knew

- Kierkegaard (1846)
  - The only possible interpretation of Kierkegaard's philosophy is the different styles of his works (not the contents)
  - Aut-aut: aesthetic being (whose life is paralyzed by multiple possibilities/choices) and ethic being (whose life is committed to one possibility/choice)
  - The anguish of Abraham: is it really an angel, and am I really Abraham? What proof do I have?

What the Industrial Age knew



- Karl Marx (1847)
  - Human nature is not fixed
  - We are natural beings that have to interact with nature in order to survive
  - Labor converts raw materials into products for human use
  - Production is a social phenomenon: the mode of production determines the social, political and intellectual context

What the Industrial Age knew

- Karl Marx (1847)
  - What is the value of a product
    - time/cost of producing it vs price people are willing to pay for it
  - The capitalist class (bourgeoisie) exploits the working class (proletariat) by keeping the "surplus value" produced by the working class
  - By reinvesting the “surplus value” the capitalist class increases its control of society

What the Industrial Age knew

- Karl Marx (1847)
  - The working class is “alienated” because producer and product are separated
  - Private property is the result of the process of alienation, and viceversa
  - The working class is further alienated because the capitalists own the production system

What the Industrial Age knew

- Karl Marx (1847)
  - The interest of capitalists is to maximize profits
  - Society is divided into two antagonistic classes: proletariat (workers) and bourgeoisie (owners of production)
  - The division of labor alienates workers from the product of their labors
    - Workers do not own the product of their work
    - Workers give more than they receive

What the Industrial Age knew

- Karl Marx (1847)
  - Socialism: all citizens own the means of production
    - Just distribution of wealth and services
    - Human needs, not profits
  - Communism: full equality, class-less society

What the Industrial Age knew

- Karl Marx (1847)
  - The economic system of a civilization (the way the civilization produces goods) determines the organization of its society
  - Society is organized in social classes that struggle for power
  - Hegel's dialectics must be applied to classes instead of nations
  - Hegel's idealistic dialectics recast as “materialistic” dialectics (historical/dialectic materialism)
  - The history of humanity is the history of class struggles

What the Industrial Age knew

- Karl Marx (1847)
  - All nations go through five economic stages, whose character is determined by the relations of production: slavery, feudalism, capitalism, socialism (collective ownership of property), communism (rule of the people)
  - The ultimate goal of history is a class-less society of peers (Hegelian synthesis = communism)
  - Society with government (as a separate institution) will evolve into communism
  - The working-class shall overthrow the capitalist class

What the Industrial Age knew

- Karl Marx (1847)
  - Political, religious and economic institutions are united in supporting the dominant class
  - Over historical times power has shifted from one class to another class
  - The next shift will be from the capitalist class to the working class

What the Industrial Age knew

- Karl Marx (1847)
  - Not a moral theory, but a scientific theory about the unfolding of the future
  - Communism is not good or bad: it is inevitable
  - The character of a millenarian religion

What the Industrial Age knew

- Karl Marx (1847)
  - All elements of a society (artistic, intellectual, religious, …, political) are merely reflections of its underlying economic foundations

What the Industrial Age knew

- Karl Marx (1847)
  - Hegel: The end of history because liberal democracy has removed alienation that comes from not being free
  - Marx: liberal democracy is inherently capitalistic which is inherently unequal which caused a new kind of alienation
  - Hegel: citizens of liberal democracy don't have anything to struggle for anymore because they are free
  - Marx: most citizens of liberal democracy (the proletariat) still have to struggle in order to achieve real freedom

What the Industrial Age knew

- Karl Marx (1847)
  - History of capitalism
    - Capitalism arose in the 16th century due to the expansion of trade during the age of exploration (America, Far East)
    - Overseas markets increase demand for goods and profit opportunities
    - To exploit those profit opportunities the capitalist institutions replace the feudal institutions
    - The capitalist society greatly needs to improve productivity to profit from those new opportunities
    - Competitive pressure from other capitalists pressures to reinvest profit in technology, leading to further increases in productivity

What the Industrial Age knew

- Karl Marx (1847)
  - History of capitalism
    - Economy drives technology to maximize the output from the labor force
    - It is not industrialization that created capitalism, but capitalism (created by the growth of international trade) that led to industrialization

What the Industrial Age knew

- Karl Marx (1847)
  - Ironically, socialist revolutions will take place in countries with primitive capitalism and not in the countries of advanced capitalism
  - Marx did not believe that it was possible to bypass capitalism on the road to socialism: it was capitalism's mission to create the high productivity necessary to maintain a socialist state

What the Industrial Age knew

- Hermann von Helmholtz (1847)
  - Sense data from the senses are turned by the mind into percepts which are conscious experiences of the environment
  - The physiological states of animals are due to physical and chemical forces (not to vital energy)
  - Perception and action are mediated by a process in the brain
  - Perceptions are derived from unconscious inference on sense data

What the Industrial Age knew

- Hermann von Helmholtz (1847)
  - Perceptions are mere hypotheses about the world
  - All knowledge comes from experience
  - Perceptions are hypotheses based on our knowledge.
  - Knowledge is acquired from perceptions

What the Industrial Age knew

- Richard Owen (1849)
  - The skeletons of all vertebrates follow the same fundamental pattern
  - 1841: coins the name "dinosauria" for the giant animals described by William Buckland (1815) and Gideon Mantell (1825)

What the Industrial Age knew

Piero Scaruffi