

# What the Victorian Age knew Philosophy

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**Science and Philosophy Part II**

# What the Victorian Age knew

## Ideas

- Evolution (Darwin, Mendel, Bergson, Spencer)
- Physics (Thermodynamics, Electromagnetism, Relativity)
- Logic (Frege, Peano, Cantor, Peirce, Saussure)
- Pragmatism (Peirce, James)
- Nietzsche
- Psychology (Wundt, James, Freud, Thorndike, Jung)
- Phenomenology (Husserl)
- World War I

# What the Victorian Age Knew



~~DARWIN'S THEORY IS ABOUT SURVIVAL OF THE FITTEST~~

→ DARWIN'S THEORY IS ABOUT DESIGN ←

# What the Victorian Age Knew



Charles Darwin (1858)

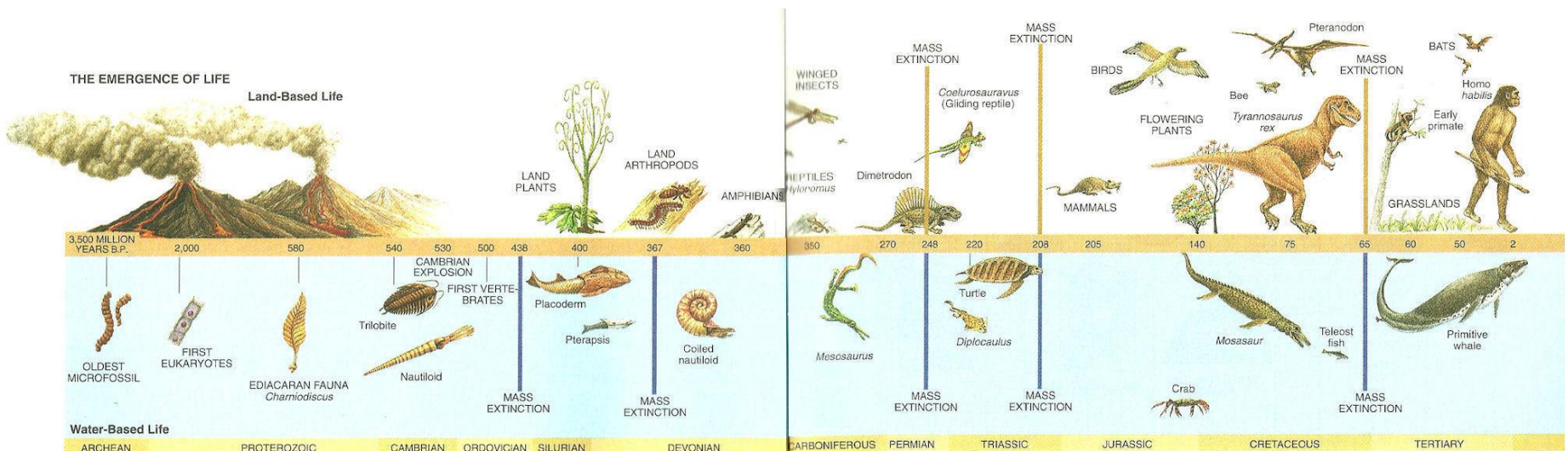
- Evolution=variation+selection
  - Variation is ubiquitous
  - Natural selection is the driving force of evolution
  - New species are created by the action of natural selection on variation
- Adaptation
  - New species are caused by the need to adapt to environmental changes
- Competition

# What the Victorian Age Knew

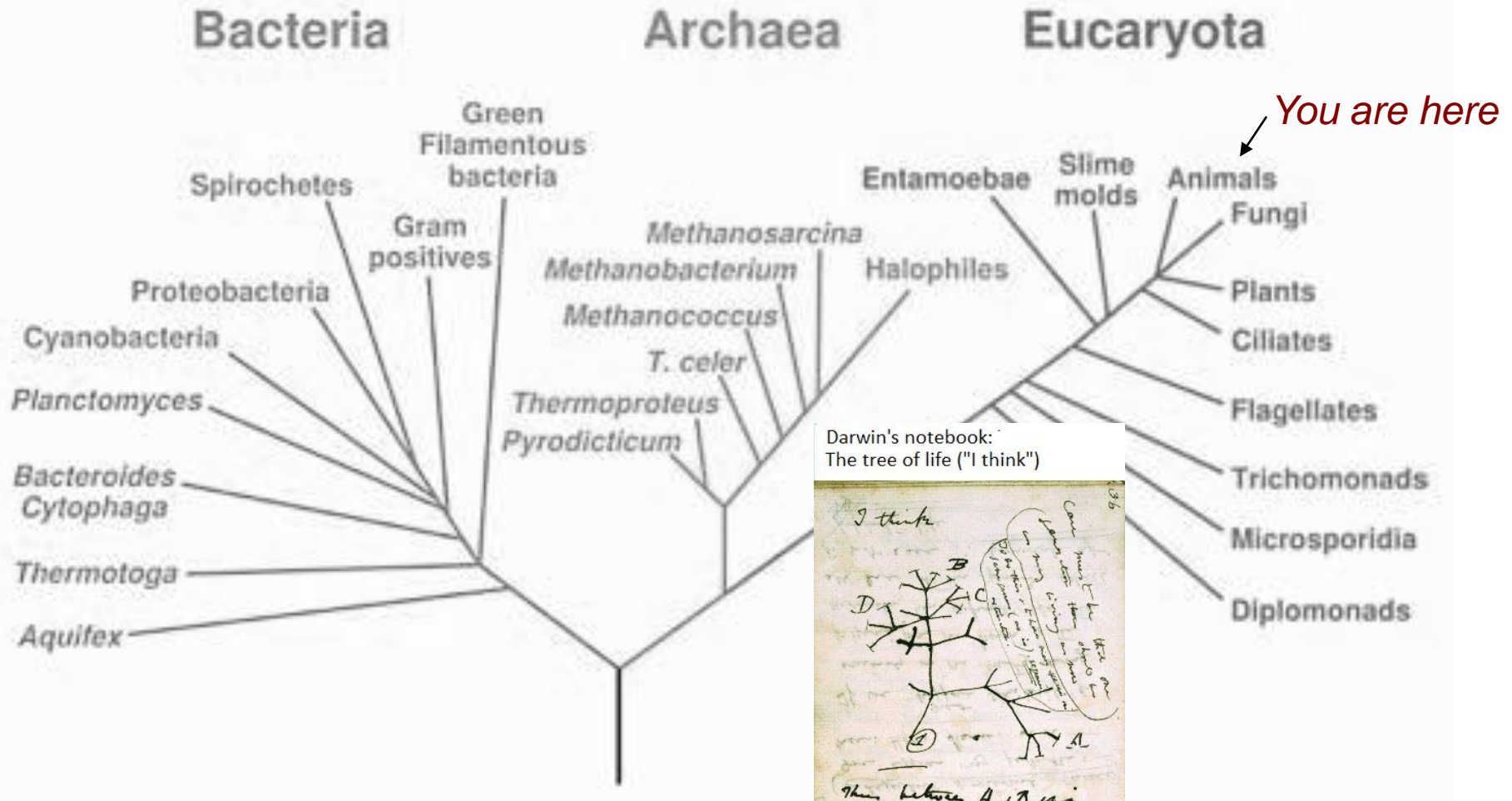


## Charles Darwin

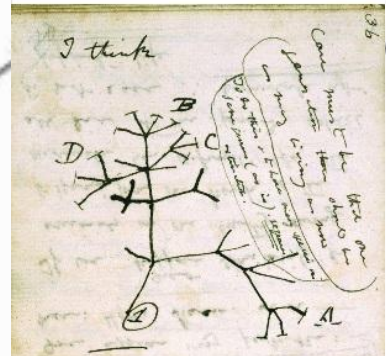
- Evolution is the result of inherited differences that occur between one generation and the next
- All living beings are the descendants of a simple primeval form of life
- The diversity of life and extinct species are explained by evolution



# Phylogenetic Tree of Life

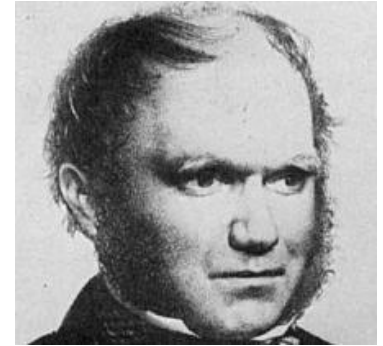


Darwin's notebook:  
The tree of life ("I think")



I think  
 then between A & B. various  
 12 + union. C + B. The  
 first predation, B & D  
 rather greater distinction  
 than genus would be  
 formed. - bearing union

# What the Victorian Age Knew



## Charles Darwin

- 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 Victorian Age Knew



## Charles Darwin

- 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 Victorian Age Knew



## Charles Darwin

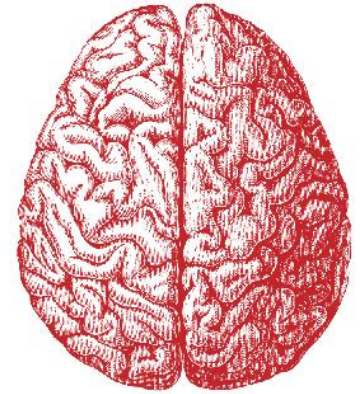
- Natural selection AND Sexual selection  
(competition for survival AND competition for reproduction)
- Sexual selection: males compete for females, females choose males
- Males were the first artists/musicians, females were the first art/music critics

# What the Victorian Age Knew



- Designing by trial and error
  - The offspring is never an exact copy of the parents
  - The environment (e.g., natural selection) indirectly “selects” which variations (which individuals) survive
  - Nobody programs the changes in the species
  - Design emerges spontaneously
  - Selection = environment
  - Variation = randomness

# What the Victorian Age Knew



- Designing by trial and error
  - The environment (e.g., natural selection) indirectly “selects” which variations (which connections) survive
  - Nobody programs the changes in the connections
  - Design emerges spontaneously
  - Selection = environment
  - Variation = randomness

# What the Victorian Age Knew

- Designing by trial and error
  - Natural selection has never produced a clock or even a wheel; but it has produced eyes and brains
  - Humans can easily manufacture clocks, but not eyes or brains
  - Very complex design can emerge spontaneously via an algorithmic process

# What the Victorian Age knew

- Herbert Spencer (1855)
  - Program of a System of Synthetic Philosophy (1862)
    - Attempt at a synthesis of human knowledge
    - Evolution is a universal law
      - Concentration
      - Differentiation
      - Determination
      - Disintegration

# What the Victorian Age knew

- Herbert Spencer (1855)
  - Capitalism rewards the fittest company
  - "Survival of the fittest"
  - Human progress (wealth, power) results from the triumph of more advanced individuals, organizations, societies and cultures over their inferior competitors

# What the Victorian Age knew

- Herbert Spencer (1855)
  - Formation of order is a pervasive feature of the universe
  - The universe evolves towards a more and more complex state
  - Living matter originates from a common state, then it evolves into different kinds
  - Kant's a-priori knowledge is determined by evolution

# What the Victorian Age knew

- Herbert Spencer
  - Ethics: “Social Static” (1851) or the “Conditions Essential to Human Happiness”



# What the Victorian Age knew

- Alexis Tocqueville (1856)
  - USA and Russia will become the superpowers of the future
  - Majority rule can be as oppressive as a totalitarian regime

# What the Victorian Age knew

- Jacob Burckhardt: “The Civilization of the Renaissance in Italy” (1860)

# What the Victorian Age knew

- Evolution of the Earth/ Part V
  - Alfred-Russell Wallace: “On the Tendency of Varieties to Depart Indefinitely from the Original Type” (1858)
  - Charles Darwin: “The Origin of Species” (1859, but ready in 1844)

# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Darwinism
  - Evolution is the result of inherited differences that occur between one generation and the next
  - All living beings are the descendants of a simple primeval form of life
  - The diversity of life and extinct species are explained by evolution
  - Materialism

# What the Victorian Age knew

- Trivia about Charles Darwin
  - Darwin never used the expression "survival of the fittest"
  - The first five editions of the "Origin" didn't use the word "evolution" (the sixth one did because everybody already was)
  - Darwin developed his theory of evolution in 1844 but was afraid to publish it
  - Wallace discovered the theory of evolution via variation and selection in 1858

# What the Victorian Age knew

- Trivia about Charles Darwin
  - Patrick Matthew, a humble gardener, had already discovered it in 1831, but published it in "On Naval Timber and Arboriculture" explains the evolution of species by variation and selection
  - Darwin's "Origin of Species" never discusses the origin of species, only how species become fitter
  - "The Origin of Species" never said that humans descend from apes (Darwin wrote it in the "Descent of Man" after many others had reached the same conclusion)

# What the Victorian Age knew

- Trivia about Charles Darwin
  - Fleeming Jenkin showed that Darwin's theory actually made no mathematical sense (beneficial traits should be diluted in successive generations, not reinforced)
  - Darwin never realized that Mendel's theory was the solution to this paradox, and Mendel never realized that Darwin's theory needed his to be complete
  - Darwin's bestseller was not "The Origin of Species" but a gardening book, "The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits"

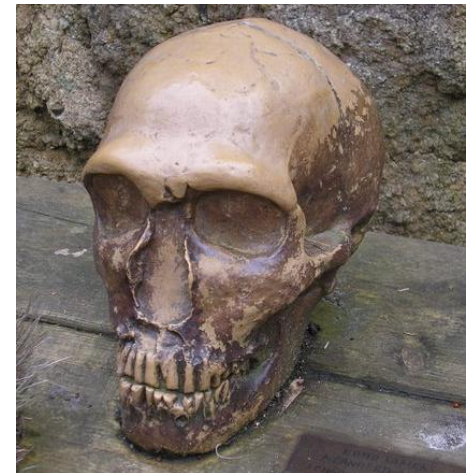
# What the Victorian Age knew

- Trivia about Charles Darwin
  - Darwin's theory was considered only speculation until the 1930s when the fusion with Mendel's theory solved all the outstanding problems



# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Confirmation of Darwinism
  - Hermann von Meyer: fossil of a bird-reptile, “Archaeopteryx” (1861)
  - Boucher de Perthes: axe of ancient humans (1838)
  - Hominid skull from Neander Tal (1856)
  - Eduard Suess: South America, Africa, India, Australia used to make up a supercontinent, Gondwanaland (1861)



# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Confirmation of Darwinism
  - Alfred Russel Wallace: “The Geographical Distribution of Animals” (1876)
  - Pithecanthropus Erectus discovered in Java (1891)

# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Confirmation of Darwinism
  - Humans are part of the process of extinction
  - Humans are not too different from other living beings

# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Critique of Darwinism
  - The fossil record does not offer firm evidence for human evolution

# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Critique of Darwinism
  - St George Mivart:
    - Natural selection cannot possibly account for the incipient stages of useful organs when they are still useless (“The Genesis of Species”, 1871)
    - Life evolved because of a (divinely-imparted) predisposition to evolve in the way it evolved

# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Critique of Darwinism
  - Moritz Wagner: geographic isolation is the cause of new species (1875)
  - Lord Kelvin: the Earth can only be 100 million years old
  - Asa Gray: Darwin could not explain where variation comes from because it comes from God (1876)
  - Darwin himself: what are the causes of variation and of inheritance of variations?

# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Critique of Darwinism
  - Francis Galton
    - Traits and habits acquired by parents during their lifetime cannot be inherited by their offspring at birth (anti-Lamarck)
    - Invented biometrics to study inheritance: statistical methods to study continuous traits (anti-Mendelian)

# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Critique of Darwinism
  - Edward Cope (1867)
    - Consciousness is the guiding force of evolution
    - Divine consciousness spreads to all living beings
    - Species design themselves



# What the Victorian Age knew

- Evolution of the Earth/ Part V
- Critique of Darwinism
  - Theodor Eimer (“Organic Evolution”, 1890)
    - Orthogenesis: variation is not random but is purposeful, selection is pointless as the species progresses due to internal forces controlling variation
  - Richard Owen
    - Emphasis on differences not on similarities: absence of intermediate forms between species (elephant-like species with shorter trunk)

# What the Victorian Age knew

- Evolution of the Earth/ Part V
  - Richard Owen opens the Natural History Museum in London (1881)

# What the Victorian Age knew

- Evolution of the Earth/ Part V
  - James Croll (1864)
    - Changes in the Earth's orbit cause changes in the amount of solar heat that hits the Earth and therefore ice ages at regular intervals, sometimes in the northern and sometimes in the southern hemispheres

# What the Victorian Age knew

- Evolution of the Earth/ Part V
  - Lord Kelvin (1868)
    - Refutation of the steady-state theory: the Earth must cool down because there is no constant supply of new energy
    - But also refutation of Darwin's age of the Earth (the Earth must be no older than 100 million years)

# What the Victorian Age knew

- Social/Ethical theories based on the theory of evolution
  - Herbert Spencer (1860): “survival of the fittest”
  - Thomas Huxley (1863): human behavior is determined by evolution
  - Francis Galton (1869): greatness is derived from this hereditary genius
  - T.H. Green: Prolegomena to Ethics (1883)
  - Samuel Alexander: Moral Order and Progress (1889)
  - Social Darwinism: application of Darwin's theory to human societies

# What the Victorian Age knew

- Materialist theories inspired by the theory of evolution
  - Ernst Haeckel (1866)
    - Genealogy of living beings:
      - inorganic matter evolved into “monera” (still inorganic but equipped with the basic properties of life)
        - » that evolved into single-celled organisms
        - » that evolved into multi-cellular organisms
        - » that evolved into invertebrates
        - » that evolved into fish
        - » that evolved into amphibians
        - » that evolved into reptiles
        - » that evolved into mammals

# What the Victorian Age knew

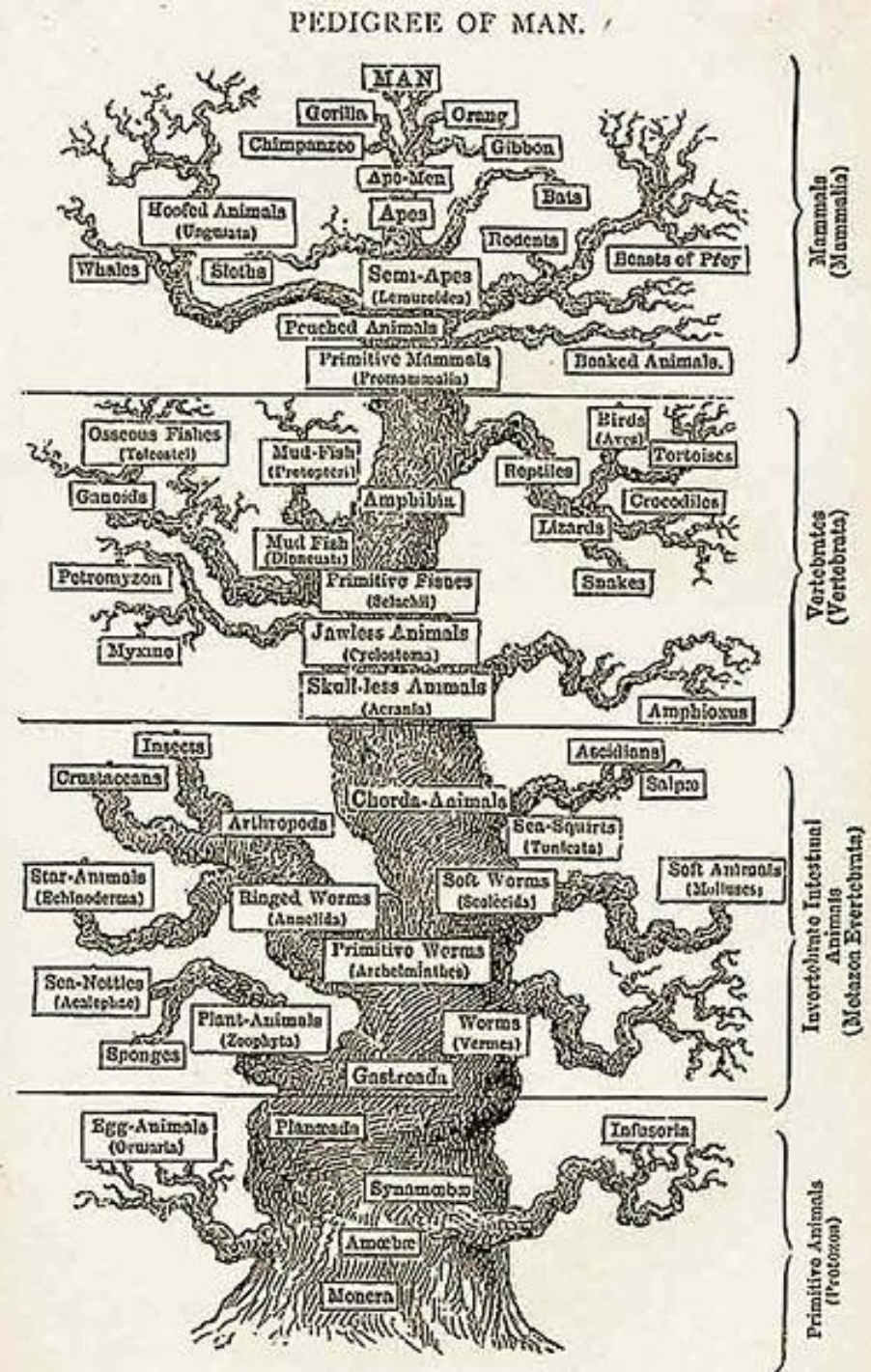
- Materialist theories inspired by the theory of evolution
  - Ernst Haeckel (1866)
    - Hypothesis of the “Pithecanthropus”:  
intermediate between ape and humans

# What the Victorian Age knew

- Materialist theories inspired by the theory of evolution
  - Ernst Haeckel (1866)
    - Lamarck's inheritance of acquired characteristics is more relevant than Darwin's natural selection
    - Biogenetic law: "Ontogeny recapitulates phylogeny" (an embryo's growth recapitulates the evolution of the animal from the common primordial ancestor to differentiated complex species)
    - Mind and matter are aspects of the same substance (monism)



– Ernst Haeckel (1899)



# What the Victorian Age knew

- Materialist theories inspired by the theory of evolution
  - Ernst Haeckel (1866)
    - Only matter exists, driven by mechanical laws
    - No difference between living and nonliving matter
    - Mind is a product of evolution as much as the body
    - Radical materialism ("naturalism")
    - Evolutionary thought applied to history of races
    - "Politics is applied biology"

# What the Victorian Age knew

- Materialist theories inspired by the theory of evolution
  - Wilhelm Dilthey
    - Founds the sciences of society and of history
    - There is no absolute truth, just consensus that changes over time ("historicism")

# What the Victorian Age knew

- Abolition of slavery in the USA (1861)
- Abolition of serfdom in Russia (1861)

# What the Victorian Age knew

- Plastic (1862)
  - 1839: Eduard Simon discovers polystyrene
  - 1856: Alfred Critchlow and Samuel Peck invent shellac
  - 1862: Alexander Parkes demonstrates the world's first plastic at the London International Exhibition
  - 1868: John Wesley Hyatt invents celluloid



# What the Victorian Age knew

- Neurology
  - 1861: Paul Broca resurrects the theory of cortical localization of function
  - 1873: Camillo Golgi's "On the Structure of the Brain Grey Matter"
  - 1891: Santiago Ramon y Cajal discovers the fundamental unit of brain processing, the neuron

# What the Victorian Age knew

- Neurology
  - 1903: Alfred Binet's "intelligent quotient" (IQ) test
  - 1906: Charles Sherrington argues that the cerebral cortex is the center of integration for cognitive life
  - 1911: Edward Thorndike's connectionism (the mind is a network of connections and learning occurs when elements are connected)

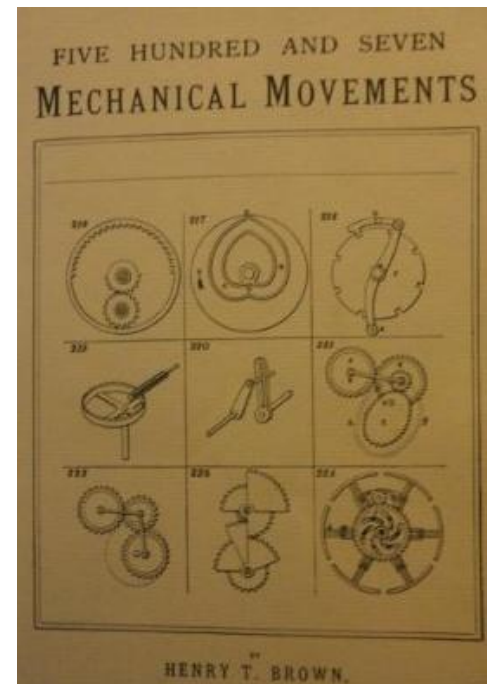
# What the Victorian Age knew

- George Perkins Marsh (1864)
  - “Men and Nature”: first environmentalist book



# What the Victorian Age knew

- Henry Brown: “507 Mechanical Movements“ (1868)
  - How to use water wheels and steam engines to drive machine tools



# What the Victorian Age knew

- Hippolyte Taine (1865)
  - Artistic milieu

# What the Victorian Age knew

- Wilhelm-Max Wundt (1874)
  - Experimental psychology

# What the Victorian Age knew

- Vladimir Solovyov (1874)
  - Russian movement against positivism
  - Rediscovery of Russian mystical traditions
  - Intuition is as important as rationality

# What the Victorian Age knew

- Thermodynamics
  - 1824: Robert Brown (a botanist) 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)
  - James Joule (1849): equivalence of work and heat (energy can be transformed)
  - William “Kelvin” Thompson (1851): physics is the science of energy, not of force
  - Energy is always conserved, heat is not

# What the Victorian Age knew

- Thermodynamics
  - Classical Physics: the world as a static and reversible system that undergoes no evolution, whose information is constant in time
  - Classical physics is the science of being
  - Thermodynamics describes an evolving world in which irreversible processes occurs
  - Thermodynamics is the science of becoming
  - The science of being and the science of becoming describe dual aspects of nature
  - Entropy and irreversibility

# What the Victorian Age knew

- Thermodynamics
  - A macroscopic system in equilibrium is described by global properties (temperature, pressure, volume)
  - Global properties are due to the the motion of its particles (e.g., temperature is the average kinetic energy of the molecules of a system)
  - A macrostate can be realized by different microstates

# What the Victorian Age knew

- Thermodynamics
  - The transition from one state of equilibrium to another is governed by the laws of Thermodynamics:
    - 0. Systems that are in equilibrium with each other share the same temperature
    - 1. Heat is a form of energy, that abides by the law of conservation of energy. If heat is added to a system, this must result in either an increase in energy or some work.
    - 2. An isolated system will inevitably move towards a state of equilibrium.
    - 3. Absolute zero temperature can never be reached





# What the Victorian Age knew

- Thermodynamics
  - Rudolf “Clausius” Gottlieb’s entropy (1850): any transformation of energy has an energetic cost
  - Natural processes generate entropy
  - Heat flows spontaneously from hot to cold bodies, but the opposite never occurs

# What the Victorian Age knew

- Thermodynamics
  - The second law of thermodynamics : entropy (of an isolated system) can never decrease
  - Some processes are not symmetric in time
  - Change cannot always be bi-directional
  - We cannot always replay the history of the universe backwards
  - Some things are irreversible

# What the Victorian Age knew

- Ludwig Boltzmann (1877)
  - Background: most scientists (until Einstein's 1905 paper on Brownian motion) do not believe in atoms
  - Boltzmann: a gas is a collection of many particles



# What the Victorian Age knew

- Ludwig Boltzmann (1877)
  - How the properties of atoms determine the properties of matter
  - Solution: probabilities
  - A statistical description of a system can be made in terms of the distribution  $f(r,v,t)$ 
    - number of molecules =  $f(\text{space range, velocity range, time range})$
  - Statistical Mechanics: statistical description of ensembles of discrete molecules (spheres) obeying classical mechanics and subject to perfectly elastic collisions)

# What the Victorian Age knew

- Ludwig Boltzmann (1877)
  - Relationship between Mechanics (which is reversible in time) and Thermodynamics (which is irreversible)
  - Thermodynamics is both a science of stability (the conservation of energy) and of decay (the law of entropy)

# What the Victorian Age knew

- Ludwig Boltzmann (1877)
  - Many different microscopic states of a system result in the same macroscopic state
  - The entropy of a macrostate is the logarithm of the number of its microstates
  - $S = K * \text{Log}(W)$
  - Entropy = the number of molecular degrees of freedom
  - Entropy is a probability function
  - A system tends to drift towards the most probable state, which happens to be a state of higher entropy

# What the Victorian Age knew

- Ludwig Boltzmann (1877)
  - Entropy is a measure of disorder in a system
  - Entropy can also be interpreted as a measure of randomness
  - Closed systems tend to drift from order to randomness
  - Our world is due to a brief random fluctuation of an otherwise unchanging universe in equilibrium

# What the Victorian Age knew

- Ludwig Boltzmann (1877)
  - Boltzmann's eternal doom: the universe must evolve in the direction of higher and higher entropy
  - The universe is proceeding towards the state of maximum entropy



# What the Victorian Age knew

- Ludwig Boltzmann (1877)
  - First theory that assumes “chunks of energy” (although Boltzmann believed it was merely a methodological device)
  - Thermodynamics, recast in terms of order and chaos/randomness, can now be applied to other domains beyond heat engines

# What the Victorian Age knew

- Thermodynamics
  - Joule: heat can be transformed in work and viceversa
  - Heat is a form of chaotic molecular motion
  - Energy of regular work can be transformed into chaotic molecular motion (and manifests itself as heat); and viceversa
  - Statistical regularities emerge at the macroscopic level even if the microscopic level is chaotic
  - Chaotic fluctuations create deterministic laws for large aggregates

# What the Victorian Age knew



- **James Maxwell (1873)**

- **E** = Electric field
- **p** = charge density
- **i** = electric current
- **B** = Magnetic field
- **E0** = permittivity
- **J** = current density
- **u0** = permeability
- **c** = speed of light

I. [Gauss' law for electricity](#)  $\nabla \cdot E = \frac{\rho}{\epsilon_0} = 4\pi k \rho$

II. [Gauss' law for magnetism](#)  $\nabla \cdot B = 0$

III. [Faraday's law of induction](#)  $\nabla \times E = -\frac{\partial B}{\partial t}$

$$\nabla \times B = \frac{4\pi k}{c^2} J + \frac{1}{c^2} \frac{\partial E}{\partial t}$$

IV. [Ampere's law](#)

$$= \frac{J}{\epsilon_0 c^2} + \frac{1}{c^2} \frac{\partial E}{\partial t}$$

$$k = \frac{1}{4\pi\epsilon_0} = \text{Coulomb's constant} \quad c^2 = \frac{1}{\mu_0\epsilon_0}$$

# What the Victorian Age knew

- James Maxwell (1873)
  - How the electrical and magnetic fields propagate, given the distribution of electrical charges and currents

# What the Victorian Age knew

- James Maxwell (1873)
  - Newton's laws of motion apply to inertial frames and those laws are the same for all inertial frames.
  - But an electric phenomenon in one inertial frame is a magnetic phenomenon in another
  - Maxwell's equations showed that the electromagnetic phenomenon "oscillates" like a wave and all such waves travel at 300 thousand kms/hour (in the vacuum).
  - Light is one particular electromagnetic wave
  - The interaction between distant bodies does not happen instantaneously as Newton thought but is mediated by a "field".

# What the Victorian Age knew



- James Maxwell (1873)
  - Electricity and magnetism are the same phenomenon
  - Electric bodies radiate invisible waves of energy through space (fields)
  - The number of coordinates needed to define a wave is infinite
  - Mathematical relation between electric and magnetic fields (field equations)

# What the Victorian Age knew



- James Maxwell (1873)
  - The equations that predict the values of electric and magnetic fields from a distribution of charges reveal the existence of electromagnetic waves
  - The speed of electromagnetic waves is exactly the speed of light
  - Light is an electromagnetic wave

# What the Victorian Age knew

- James Maxwell (1873)
  - The electric field and electric charge density are related
  - The magnetic field lines must be closed loops (there are no magnetic monopoles)
  - The electric force is created by changes in the magnetic field
  - The magnetic force is created by changes in the electric field



# What the Victorian Age knew

- James Maxwell (1873)
  - Electric and magnetic fields behave like mechanical stresses in a solid medium
  - A solid medium must exist and pervade the whole universe (the “ether”) just like ocean waves propagate in water and sound waves in air
  - The electromagnetic field is caused by the vibrations of an ether
  - Light waves are waves in such a medium

# What the Victorian Age knew

- James Maxwell (1873)
  - The story of “c”
    - The ratio between electrostatic and electrodynamic units of charge: a constant  $c$  with the dimension of a speed
    - $c$  is exactly the speed of light in a vacuum
    - Maxwell’s conclusion: light must be an electromagnetic wave
    - But in what medium does it propagate?

# What the Victorian Age knew

- James Maxwell (1873)
  - Newton: the world is made of (localized) bodies and bodies interact via forces
  - Maxwell: the world also contains (distributed) fields; fields and bodies interact; fields change depending on their velocity (an electric charge in motion generates a magnetic field; a magnet in motion generates an electric field)
  - Electric and magnetic fields determine how body behave, but bodies generate the fields, i.e. fields and bodies co-determine each other
  - Light consists of waves in the electromagnetic field
  - Electromagnetic waves spread in the all-pervading “ether”

# What the Victorian Age knew

- **Franz Brentano (1874):**
  - **The mental and the physical are different substances**
  - **Intentionality (esse intentionale, directedness)**
  - **Causal relationship between phenomena**

# What the Victorian Age knew

- Rudolf Lotze (1874):
  - Arithmetic propositions are not synthetic a-priori, but simple analytic judgements: they can be demonstrated without any recourse to intuition

# What the Victorian Age knew

- Georg Cantor (1879)
  - Set Theory: emancipates Mathematics from its traditional domain (numbers)
  - Transfinite numbers
  - Zeno's Paradoxes: “if space is infinitely divisible in finite points, then...”

# What the Victorian Age knew

- Georg Cantor (1879)
  - Previous solutions to Zeno's Paradoxes
    - Hume: space and time are composed of indivisible units having magnitude
    - Kant: contradictions are immanent in our conceptions of space and time, so space and time are not real
    - Hegel: all reasoning leads to contradictions which can only be reconciled in a higher unity

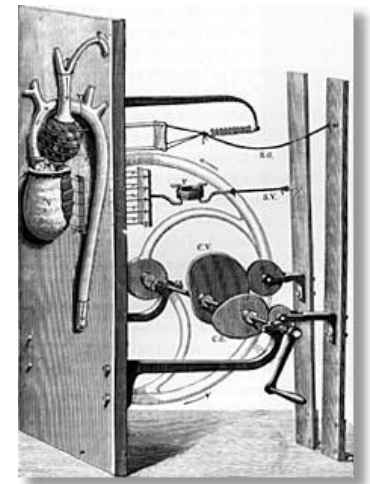
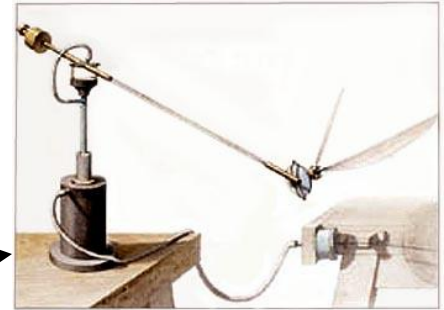
# What the Victorian Age knew

- Georg Cantor (1879)
  - Cantor's solution to Zeno's Paradoxes
    - A one-dimensional line is not a sum of an infinite number of infinitely small points, but a set-theoretic union of an infinite number of unit-sets of zero-dimensional points
    - What Zeno proved is a general property of space...
    - **There is no point next to any other point:** between any two points there is always an infinite number of points
    - The non-denumerable infinity of points in space and of events in time is much larger than the merely denumerable infinity of integers.
    - An infinite series of numbers can have a finite sum



# What the Victorian Age knew

- Etienne-Jules Marey
  - 1864: Cardiographic devices
  - 1869: an artificial insect
  - 1871: Artificial heart
  - “La Machine Animale” (1873)
  - 1882: Chronophotography
  - “Le Vol des Oiseaux” (1890)
  - “Le Mouvement” (1894)
  - 1901: aerodynamic wind tunnel

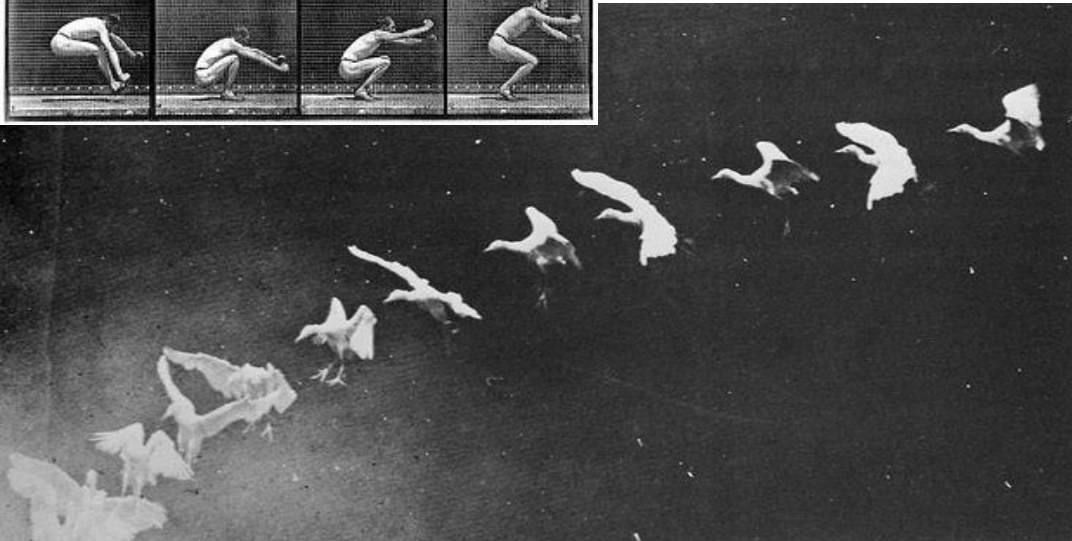
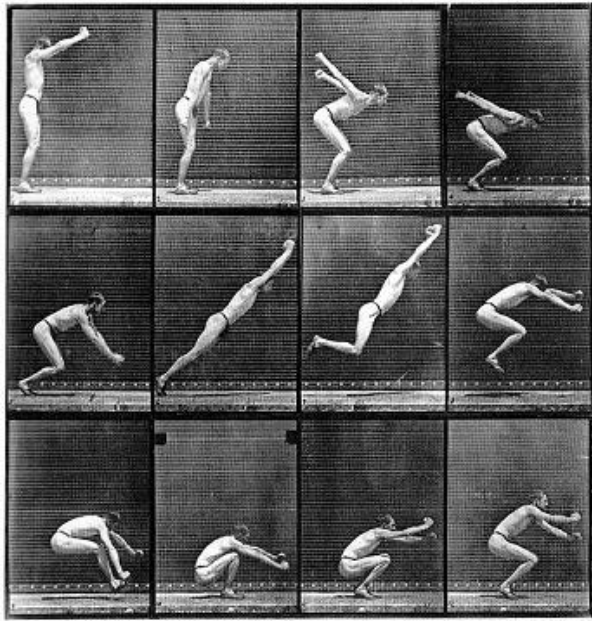


Photography to represent movement (chronophotography):

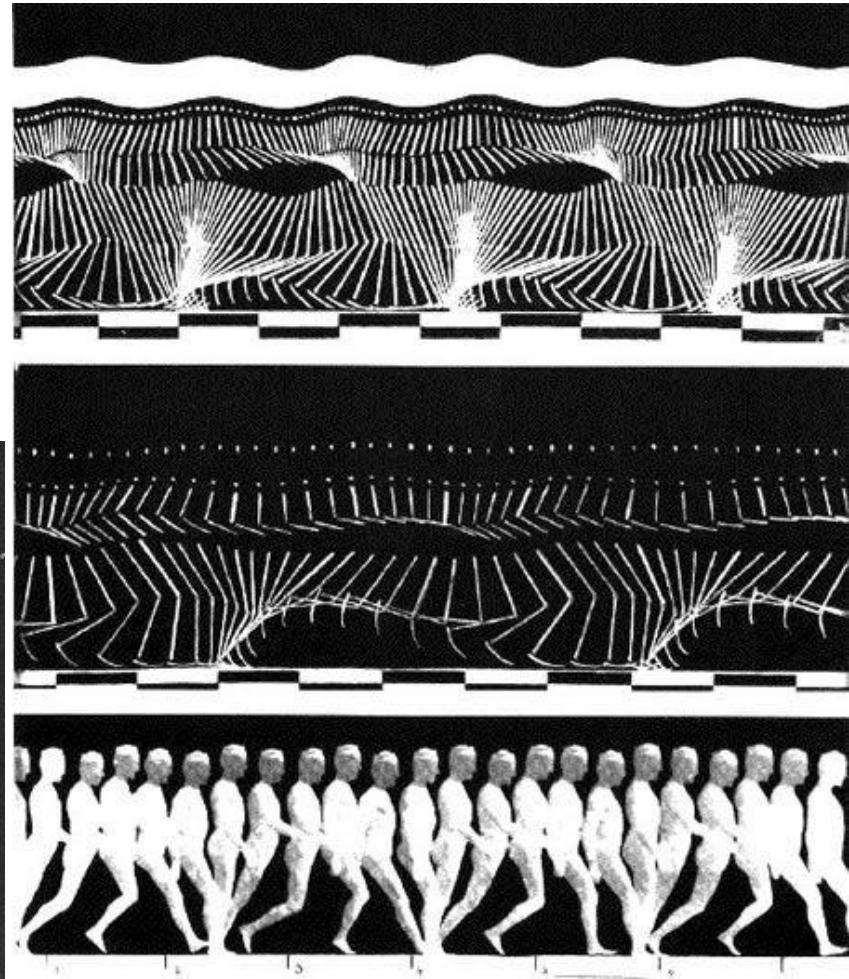


# What the Victorian Age knew

- Etienne-Jules Marey



Geometric Chronophotograph of the Man in the Black Suit (1883)



# What the Victorian Age knew

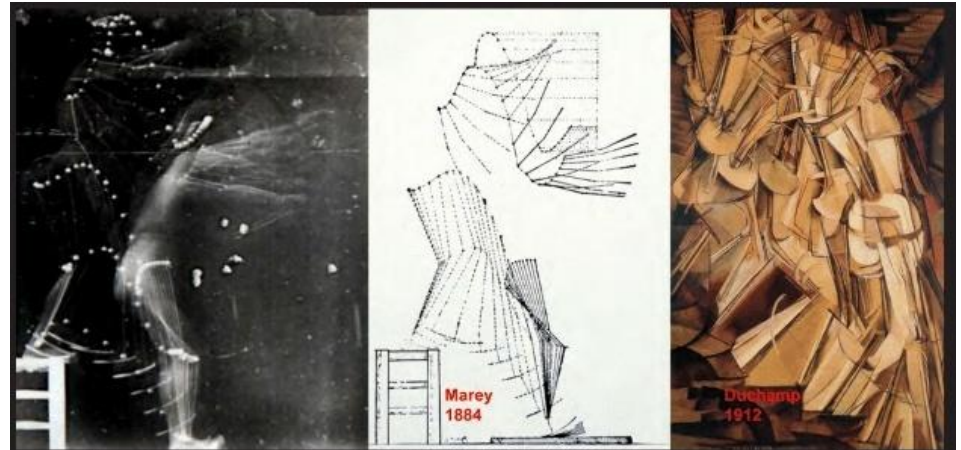
- Etienne-Jules Marey

Chronophotograph of Pole Vaulting



Adapted from *Movements in Pole Vaulting*, Étienne-Jules Marey ca. 1890, Courtesy of the Museum of the Arts, Houston

## Chronophotography & Duchamps

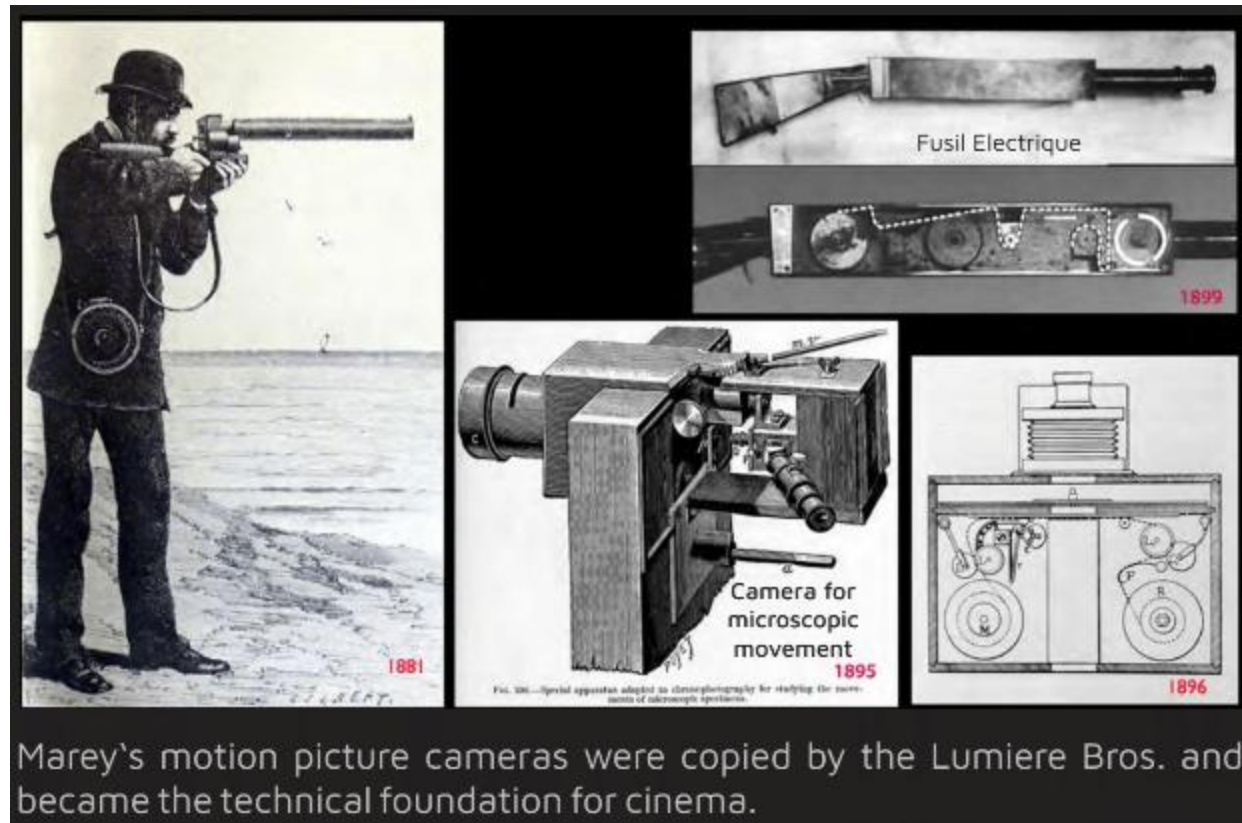


Marey's photographic image from *Picturing Time*. Line drawing from *Movement*, 1895

# What the Victorian Age knew

- Etienne-Jules Marey

From motion picture camera to cinema



# What the Victorian Age knew

- **Gottlob Frege (1884)**
  - **Lotze's theory: arithmetic propositions can be demonstrated without any recourse to intuition**
  - **Removing intuition from arithmetic requires replacing natural language with logic (Boole's program)**
  - **Quantifiers and variables allow for "predicate calculus"**
  - **Mathematics becomes a branch of Logic (Cantor's program)**

# What the Victorian Age knew

- Gottlob Frege (1884)
  - "Sense" (intension) vs "reference" (extension): "the star of the morning" and "the star of the evening" (same extension/referent, but different intensions/senses)
  - Propositions of Logic can only have one of two referents, true or false, but many senses
  - Logic as an objective (not subjective) discipline
  - Search for purely objective realm, for absolute truth

# What the Victorian Age knew

- Gottlob Frege (1884)
  - Cardinal numbers constructed by a purely logical method (not relying on intuition: Kant was wrong)

# What the Victorian Age knew



- Giuseppe Peano (1889)
  - Axiomatization of natural numbers:
    1. Zero is a natural number.
    2. Zero is not the successor of any natural number.
    3. Every natural number has a successor, which is a natural number.
    4. If the successor of natural number  $a$  is equal to the successor of natural number  $b$ , then  $a$  and  $b$  are equal.
    5. Suppose (induction axiom):
      - (i) zero has a property  $P$ ;
      - (ii) if every natural number less than  $a$  has the property  $P$  then  $a$  also has the property  $P$ .Then every natural number has the property  $P$ .



# What the Victorian Age knew

- Charles Peirce (1883)
  - An object is defined by the effects of its use: a definition that works well is a good definition ("pragmatism")
  - An object "is" its behavior
  - The meaning of a concept lies in its practical effects on our daily lives: if two ideas have the same practical effects on us, they have the same meaning
  - The meaning of a concept is a function of the relations among many concepts: a concept refers to an object only through the mediation of other concepts



# What the Victorian Age knew

- Charles Peirce (1883)
  - Truth is usefulness and validity: something is true if it can be used and validated
  - Truth is defined by consensus. Truth is not agreement with reality, it is agreement among humans (reached after a process of scientific investigation)
  - Truth is “true enough”
  - Truth is not eternal: it is decided by the situation
  - Truth is a process, a process of self-verification
  - Beliefs become fixed through experience/verification
  - Beliefs lead to habits that get reinforced through experience

# What the Victorian Age knew

- Charles Peirce (1883)
  - Abduction, deduction and induction
  - Abduction: the process of generating a hypothesis that would account for the facts
  - The scientific method begins with abduction (a hypothesis about what actually is going on)
  - Deduction draws conclusions from the hypothesis about other things that must be true if the hypothesis is true
  - Experiments determine if the hypothesis holds and can be generalized from sample to population

# What the Victorian Age knew

- Charles Peirce (1883)
  - The process of habit creation is pervasive in nature
  - All matter acquires habits
  - Matter is mind whose “beliefs” have been fixed to the extent that they can’t be changed anymore
  - Habit is what makes objects what they are
  - An object is defined by the set of all its possible behaviors
  - I am my habits

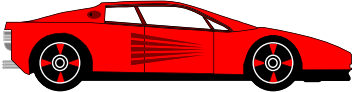
# What the Victorian Age knew

- Charles Peirce (1883)
  - Randomness is absence of identity
  - The laws of Physics describe the habits of matter, because what we observe is the habits of nature (eg, heavenly bodies have the habit of attracting each other, thus the law of gravitation)

# What the Victorian Age knew

- Charles Peirce (1883)
  - Systems evolve because of chance, which is inherent to the universe (“tychism”)
  - Habits progressively remove chance from the universe
  - The universe is evolving from absolute chaos (chance and no habits) towards absolute order (all habits are fixed)
  - Darwinian evolution of systems towards stronger and stronger habits
  - Beliefs are a particular case of habits, that also get fixed through experience

# What the Victorian Age knew

- Charles Peirce (1883)
  - Semiotics
    - Signs:
      - index (a sign which bears a causal relation with its referent),
      - icon (which bears a relation of similarity with its referent),
      - symbol (whose relation with its referent is purely conventional)
    - Eg:
      - [broooooom...],
      - 
      - and “CAR”

# What the Victorian Age knew

- Charles Peirce (1883)
  - A sign consists of a signifier and a signified
  - The relation between signifier and signified (eg CAR and the car) is arbitrary
  - A sign refers to an object only through the mediation of other signs (interpretants)



# What the Victorian Age knew

- Charles Peirce (1883)
  - There is an infinite regression of interpretants from the signifier to the signified (the signified is a representation of a representation of a representation of a .... of the signifier)
  - A dictionary defines a word in terms of other words, which are defined in terms of other words, which are defined in terms of...
  - Knowing is semiosis (making signs)
  - Semiosis is an endless process
  - The universe “is” those signs

# What the Victorian Age knew

- Charles Peirce (1883)
  - Existential (“at least one/ some”) and universal (“for every/ all”) quantifiers

# What the Victorian Age knew

- **Josiah Royce (1885)**
  - **There are absolute truths: denying the existence of any absolute truth is an assertion of an absolute truth**
  - **Truth is due to consensus of the community, but that consensus relies on preexisting truth, all the way back to a universal mind (idealism)**

# What the Victorian Age knew



- Ernst Mach (1886)
  - Scientific phenomena can only be understood in terms of sensory experience
  - The domain of science is the abstractions constructed by the scientist on the bases of her sensory perceptions
  - Only empirical statements are valid scientific statements
  - The task of the scientist is to describe the world, not to explain it
  - (e.g., causality, which is a way to explain a phenomenon, should be replaced by the concept of relation, which is mere description)

# What the Victorian Age knew



- **Ernst Mach (1886)**
  - **Absolute time and space are explanations, not descriptions, and thus should be removed from science**
  - **Physics should be reformulated in terms of the relationships of a body to other bodies (e.g. motion relative to fixed stars) with no reference to background space**

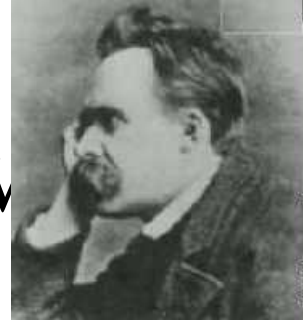
# What the Victorian Age knew

- Ernst Mach (1886)
  - Newton's inertia: a fundamental property of matter
  - Mach's inertia: a local property that arises from the global distribution of matter in the universe
  - Inertia (the tendency of a body at rest to remain at rest and of a body in motion to continue in motion in the same direction) results from a relationship of that object with all the rest of the matter in the universe

# What the Victorian Age knew

- Ernst Mach (1886)
  - All motion is “relative” motion (relative to all other masses)
  - Newton: rotation produces centrifugal forces, which are distinct from gravitational forces
  - Mach: centrifugal forces are gravitational (caused by the action of mass upon mass)

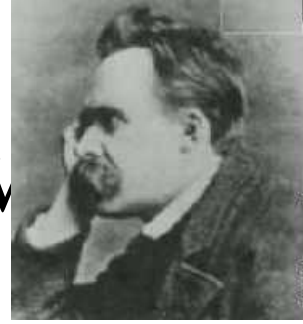
# What the Victorian Age knew



- Friedrich Nietzsche (1886)
  - Greek tragedy exhibits two complementary aesthetic principles: Apollonian (the plot) and Dionysian (the chorus)
  - The Apollonian plot creates the illusion that the hero's will determines actions
  - The Dionysian chorus reveals the reality that the hero is only part of a primordial universal design
  - Apollonian: visions, physical, civilization, individualistic
  - Dionysian: intoxication, symbolic, savagery, holistic



# What the Victorian Age knew



- **Friedrich Nietzsche (1886)**
  - **Dionysian pessimism:**
    - **The Dionysian insight into nature helps us understand the ultimate meaning of life, but it would destroy us if not tempered by the Apollonian illusion of order**
    - **Dionysian pessimism: The Dionysian is key the overcoming the limits of the human condition, but we still won't be able to overcome our fate**
    - **We can only learn to accept and love our fate**

# What the Victorian Age knew

- Friedrich Nietzsche (1886)
  - Human behavior is caused by the will to power (urge to order the course of one's experiences)
  - All living beings strive for a higher state of their living condition to overcome their present state's limitations
  - Will to power: an extension of Schopenhauer's will to live
  - It is a consequence of the Dionysian insight

# What the Victorian Age knew

- Friedrich Nietzsche (1886)
  - Philosophy, art and history have an infinite scope
  - Science has a finite scope
  - Science is interpretation/exegesis of the world
  - There are no facts, only interpretations
  - Truth is an illusion
  - Knowledge is an illusion
  - Truth and knowledge are only relative to how useful they are to our “will to power”
  - The will to knowledge/truth inevitably leads to the will to power

# What the Victorian Age knew

- **Friedrich Nietzsche (1886)**
  - **Morality is a device invented by the weak to assert their will to power over the strong**
  - **Christian values are a "slave morality", a morality of the weak ones**
  - **Christian values are obsolete ("God is dead")**
  - **Christianity is an expression of the will the power, but only the will to power of the weak who are full of resentment**
  - **The new morality is the morality of the "uebermensch" ("superman"), who is above the masses and is interested in solving the problems of this world, not of the otherworld**<sup>108</sup>

# What the Victorian Age knew

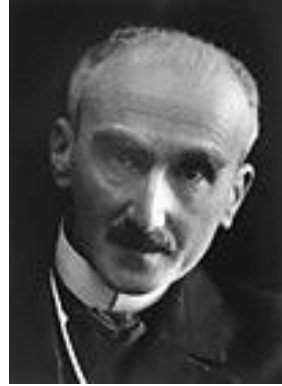
- Friedrich Nietzsche (1886)
  - The demise of God is the most important event in modern history (God had been the prime mover of history for centuries)

# What the Victorian Age knew



- **German physicist Heinrich Hertz discovers Radio Waves (1887)**

# What the Victorian Age knew



- Henri Bergson (1889)
  - Reality is an endless flow of change of the whole
  - The upward flow is life, the downward flow is inert matter
  - The universe is like a cable railway on a steep incline, with simultaneously ascending and descending cars
  - There is an “elan vital” (vital force) that causes life despite the opposition of inert matter

# What the Victorian Age knew

- **Henri Bergson (1889)**
  - In human beings Intellect and Intuition have become separated faculties
  - Intellect is life observing inert matter
  - Intuition is life observing life
  - Intellect is related to space (inert matter is located in space)
  - Intuition is related to time (life is located in time)
  - Intellect can only understand inert matter, not life
  - Intuition can grasp life
  - We join (flow with) inert matter when habits take over the intellect



# What the Victorian Age knew

- **Henri Bergson (1889)**
  - **Intellect is simply the contemplation of inert matter**
  - **Space appears to exist to the intellect (space is a practical way to organize inert matter)**
  - **The intellect divides reality into objects**
  - **The “time” coordinate of Newtonian physics is (like space) an artifice to represent inert matter (Newtonian time is a form of space)**
  - **Matter is the lowest degree of mind**

# What the Victorian Age knew

- Henri Bergson (1889)
  - “Time” (not Newton’s time) appears to exist to intuition (time is a practical way to organize life)
  - Intuition does not divide reality into objects: it grasps the flow of the universe as a whole
  - Time is the sequence of conscious events
  - We have a memory for habits and a memory for events
  - Time is our memory of events

# What the Victorian Age knew

- Henri Bergson (1889)
  - Dreaming is a selectionist process
  - When awake, the brain selects the thoughts that make sense
  - When asleep, the brain is flooded with uncontrolled thoughts
  - The brains tries to arrange the proliferating memory images into some kind of narrative
  - The rational center of the brain "selects" bits and pieces for the dream narrative

# What the Victorian Age knew

- Statistics
  - Initially in the service of Darwin's theory of evolution
  - Francis Galton (1889): "Natural Inheritance"
  - Ronald Fisher (1925): "Statistical Methods for Research Workers"
  - Karl Pearson (1896): "Mathematical contributions to the theory of evolution"
  - William Sealy Gosset (1908): "The probable error of a mean"

# What the Victorian Age knew

- Sex
  - Paolo Mantegazza: "Gli amori degli uomini/ Sexual Relationships of Mankind" (1885)
  - Patrick Geddes: "The Evolution of Sex" (1889)
  - Havelock Ellis: "Studies in the Psychology of Sex" (1897)
  - Otto Weininger: "Sex and Character" (1903)
  - Iwan Bloch: "Das Sexualeben Unserer Zeit/ The Sexual Life of our Time" (1907)

# What the Victorian Age knew

- Sexual Revolution
  - 1839: Ann Lohman (“Madame Restell”) opens a practice to perform abortions in New York
  - 1863: Karl Heinrich Ulrichs defends the rights of homosexuals in Germany
  - 1870: Victoria Woodhull advocates free love in her “Weekly” magazine
  - 1892: Clelia Mosher's survey of 45 women in the USA proves that women can have orgasms
  - 1897: "La Fronde" feminist newspaper debuts in France
  - 1903: First nudist colony opens in Germany
  - 1916: Margaret Sanger opens the first birth control clinic and founds Planned Parenthood

# What the Victorian Age knew

- Feminist treatises
  - Margaret Fuller: “Woman in the Nineteenth Century” (1843)
  - John Stuart Mill: “The Subjection of Women” (1869)
  - August Bebel: “Die Frau und der Sozialismus” (1883)
  - Friedrich Engels: “The Origin of Family, Private Property and the State” (1884)
  - Articles by Anna Kuliscioff (Italy, 1880s)
  - Charlotte Perkins: “Women and Economics” (1898)

*“Woman is the last thing to be civilized by man”*  
(Meredith, 1859)

# What the Victorian Age knew

- Condition of Women
  - Paris 1880:
    - Women can walk unaccompanied in the streets
    - Schooling mandatory for girls
    - Universities begin to accept women



# What the Victorian Age knew

- Gynecology
  - 1797: First medical journal of the USA (Medical Repository)
  - 1836: Southern Medical Surgical Journal
  - Most medical schools are in the north and in Europe, but a lot of research takes place in the south, where it's easier to experiment on black slaves
  - Medical research easier in the plantations of the south than in the cities of the north
  - Men increasingly involved in reproductive medicine
  - Gynecology, a man-led profession, takes over midwifery, which is traditionally a woman-led profession

# What the Victorian Age knew

- Gynecology
  - Implied: women are inferior to men and black women are inferior to white women
  - Implied: black women are hypersexual beings
  - 1808: USA bans importation of African slaves
  - US slave owners motivated to increase slave births in their plantations
  - Doctors motivated by the desire to experiment new methods
  - The future of slavery in the USA now depends on black women's fecundity

# What the Victorian Age knew

- Gynecology
  - 1840s: Plantation physician James Marion Sims (the "father of gynecology") conducts research in Alabama on enslaved black women without anesthesia (based on his misguided belief that Black people didn't experience pain like white people did)
  - 1854: Jackson Street Hospital in Augusta (Georgia) serves exclusively black slaves
  - Henry Campbell (founder of Jackson Street Hospital) performs gynecological surgery on female slaves

# What the Victorian Age knew

- Puritanism
  - 1865: The “Salvation Army”
  - 1873: Anthony Comstock founds the Society for the Suppression of Vice
  - 1874: The Woman's Christian Temperance Union is founded

# What the Victorian Age knew

## Lesbians of the Victorian Era

- Natalie Barney
- Virginia Woolf (Britain)
- Gertrude Stein
- Djuna Barnes
- Colette (France)
- Sarah Bernhardt (France)
- Eleonora Duse (Italy)

# What the Victorian Age knew

## Occultism

- Paschal Beverly Randolph & Fraternitas Rosae Crucis (USA, 1858)
- Helena Blavatsky & Theosophical Society (USA, 1875)
- Max Theon & The Hermetic Brotherhood of Luxor (Britain, 1884)
- Order of the Golden Dawn (Britain, 1887)
- Ordo Templi Orientis (1895)
- Aleister Crowley (Britain, 1907)
- Pyotr Ouspenskii's "Tertium Organum" (1912)
- Georges Gurdjieff establishes the "Institute for the Harmonious Development of Man" (1919)

# What the Victorian Age knew

- Republican Revolts and Independence Movements
  - Adam Mickiewicz (in exile)
  - Giuseppe Mazzini (in exile) and “Risorgimento”
  - Jan 1848: Sicilian Revolution against Spain
  - Feb 1848: Second revolution in France and end of the monarchy
  - Feb 1848: Tuscany, Piedmont and the Pope grant constitutions
  - Mar 1848: Milano revolution against Austria and Italy’s first independence war
  - 1861: Garibaldi unifies Italy

# What the Victorian Age knew

- Giuseppe Mazzini
  - 1831: Giovine Italia/ Youth Italy ("Union, Strength, Liberty")
  - Patriotism as a new religion
  - Invokes a revolution started in Italy that would spread to the whole of Europe
  - Youth Italy spreads to Germany, Poland, Turkey, Serbia
  - 1848: Failed insurrection in Milano against Austria
  - 1849: Failed insurrection in Roma against the Pope
  - Followers: Giuseppe Garibaldi, Errico Malatesta (anarchist), Carlo Cattaneo



# What the Victorian Age knew

- Mazzini's influence
  - Vinayak Savarkar and Hindu nationalism
  - Liang Qichao and Chinese nationalism
  - Jamal al-Afghani and Arab nationalism
  - A Mazzini-inspired Serbian nationalist assassinates Austria's archduke and starts World War I

# What the Victorian Age knew

- Anarchism
  - William Godwin
  - Pierre-Joseph Proudhon
  - Errico Malatesta
  - Mikhail Bakunin
  - Pyotr Kropotkin
  - First International (1864)
  - Anarchist Congress in London (July 1881)

# What the Victorian Age knew

## Mikhail Bakunin

1844-47 lives in Paris where he meets Karl Marx and Pierre-Joseph Proudhon

1847 expelled by France for a speech against Russia

1848 participates in the Prague insurrection and publishes “Appeal to the Slavs”

1849 joins the Dresden insurrection (fighting alongside Richard Wagner)

1849 arrested by Prussia

1850 sentenced to death in Prussia but then extradited to Austria

1851 sentenced to death in Austria too but then deported to Russia

1857 released from prison in Russia but sentenced to exile in Siberia

1861 escapes Siberia and reaches London via Japan and the USA

1864-67 lives in Italy

1864 founds the journal *Libertà e Giustizia*

1866 founds the International Brotherhood

# What the Victorian Age knew

## Mikhail Bakunin

1867 moves to Switzerland and attends the inaugural Congress of the League for Peace and Freedom

1867 writes “Federalism, Socialism and Anti-Theologism”

1868 founds the International Alliance of Socialist Democracy

1869 attends the Congress of the International in Basel

1870-71 writes “The Knouto-Germanic Empire” (later “God and the State”)

1871 writes “The Paris Commune and the Idea of the State” and “The Political Theory of Mazzini and the International”

1872 expelled from the International

1873 publishes “Statism and Anarchy”

1876 dies

# What the Victorian Age knew

## Pyotr Kropotkin

- 1872 joins the socialist Circle of Tchaikovsky
- 1874 arrested
- 1876 escapes from prison to England
- 1878 Writes for the revolutionary newspaper Le Révolté in Switzerland
- 1881 expelled from Switzerland, attends the Anarchist Congress in London
- 1882 arrested in France
- 1886 released from prison and joins the newspaper The Anarchist in London
- 1886 co-founds the newspaper Freedom Press
- 1888-90 publishes essays in Nineteenth Century and Forum (later collected in the book “Fields, Factories, and Workshops”)
- 1890-96 publishes essays in The Nineteenth Century (later collected in the book “Mutual Aid: A Factor of Evolution”)
- 1892 publishes the book “The Conquest of Bread” in France
- 1898-99 publishes “Memoirs of a Revolutionist” in The Atlantic Monthly
- 1917 returns to Russia after 40 years of exile
- 1918 dies of pneumonia

# What the Victorian Age knew

- Marxism
  - Karl Marx's "Das Kapital" (1867)
  - Georges Sorel's "Les Illusions du Progres" (1908)

# What the Victorian Age knew

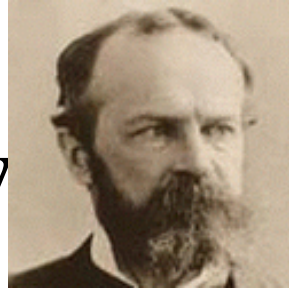
- Anarchic terrorism
  - 1881: Assassination of czar Alexander II
  - 1886: Haymarket bombing in Chicago (7 dead)
  - 1893: Teatro Liceo bombing in Barcelona (22 dead)
  - 1894: Assassination of French president Sadi Carnot
  - 1897: Assassination of Austrian empress Elizabeth and Spanish prime minister Antonio Canovas
  - 1900: Assassination of Italian king Umberto I
  - 1901: Assassination of USA president William McKinley
  - 1906: Assassination attempt against Spanish king Alfonso XIII (20 dead)
  - 1920: Assassination of Spanish prime minister Eduardo Dato
  - 1920: Bartolomeo Vanzetti and Nicola Sacco
  - 1936: Spanish civil war

# What the Victorian Age knew

- James Frazer (1890)
  - Study of world myths
  - Myth-making as a way of imposing order on the universe



# What the Victorian Age knew



- William James (1890)
  - Both matter and mind are constructed out of experience: the same reality is both in the mind and in the world, it is both an event of a person's biography and of the history of the world
  - Minds are made of experience (experienced events)

# What the Victorian Age knew

- William James (1890)
  - The function of mind is to help the body live in an environment
  - The brain is an organ that evolved because of its usefulness for survival
  - Consciousness is a sequence of conscious mental states, each state being the experience of some content
  - Consciousness is not a substance, it is a process ("the stream of consciousness")
  - Unitary and continuous consciousness (analogous to Newton's unitary and continuous space)

# What the Victorian Age knew

- William James (1890)
  - Perception leads to action in the environment (not necessarily conscious)
  - The awareness of fear follows (not precedes) the body's physical reaction to danger

# What the Victorian Age knew

- **William James (1890)**
  - **The brain is organized as an associative network, and associations are governed by a rule of reinforcement**
  - **Long-term and short-term memory**

# What the Victorian Age knew

- **William James (1890)**
  - **Habits as built of stimulus-response patterns**
  - **Beliefs are rules for action**
  - **The function of thinking is to produce habits of action**
  - **Beliefs and habits are equivalent**
  - **A belief/habit gets reinforced as it succeeds**

# What the Victorian Age knew

- **William James (1890)**
  - **The intelligence of a human or an animal is the outcome of the interplay of many instincts**

# What the Victorian Age knew

- William James (1890)
  - Free will exists: a combination of chance (that creates alternative possibilities) and choice (that selects one of them)

# What the Victorian Age knew

- Christian Ehrenfels (1890)
  - The mind “intends” gestalt qualities



# What the Victorian Age knew

- Hans Driesch (1892)
  - A mutilated embryo will still develop into a fully-functioning living organism
  - A “life force”, or “entelechy”, yields life

# What the Victorian Age knew

- The Fourth Dimension
  - the physicists Balfour Stewart and Peter Tait’s “The Unseen Universe” (1875): the ether is a fourth dimension of space
  - Edwin Abbott’s novel “Flatland” (1884)
  - The mathematician Charles Hinton’s “A New Era of Thought” (1888): the realm of God
  - the theologian Arthur Willink’s “The World of the Unseen” (1893)
  - The mystic philosopher Pyotr Ouspenskii, a follower of George Gurdjieff, publishes “The Fourth Dimension” (1909)
  - the architect Claude Bragdon’s “A Primer of Higher Space” (1913)
  - the symbolist poet Maurice Maeterlinck’s “The Life of Space” (1928)

# What the Victorian Age knew



- Henri Poincaré (1892)
  - The three-body problem cannot be solved (1890): the class of nonlinear problems
  - "Chaos" theory: a slight change in the initial conditions results in large-scale differences
  - Eternal return: every isolated system returns after a finite time to its initial state
  - Topology

# What the Victorian Age knew

- Henri Poincaré (1892)
  - The speed of light is the maximum speed
  - Mass depends on speed
  - No experiment can discriminate between a state of uniform motion and a state of rest
  - The combined equations of Newton and Maxwell do not satisfy Galilean relativity but another kind of relativity
  - Lorentz transformations (named by Poincaré after Lorentz)
  - Non-Euclidean geometries have the same logical and mathematical legitimacy as Euclidean geometry

# What the Victorian Age knew



- Hendrik Lorentz (1892)
  - Unify Newton's equations for the dynamics of bodies and Maxwell's equations for the dynamics of electromagnetic waves in one set of equations (Lorentz transformations)
  - Equations of motion of a charged particle in an electromagnetic field
  - The combined Newton and Maxwell equations do not satisfy Galileo's relativity (equations should be unchanged in the transition from a stationary to a moving frame of reference)

# What the Victorian Age knew

- Hendrik Lorentz (1892)
  - Transformations (1897): the equations of electromagnetism admit a group of transformations which enables them to have the same form when one passes from one frame of reference to another
  - Contraction of bodies
  - The contraction of bodies in the direction of motion explains why the speed of light is the same in every direction

# What the Victorian Age knew

- **Hendrik Lorentz (1897)**

$$t_1 = \gamma \left( t_2 - \frac{v x_2}{c^2} \right)$$

$$x_1 = \gamma (x_2 - v t_2)$$

$$y_1 = y_2$$

$$z_1 = z_2$$

where

$x_1$  is the **x component** in  $S_1$  of the position of an **event**,

$x_2$  is the **x component** in  $S_2$  of the position of the same **event**,

$t_1$  is the time since time zero in  $S_1$  of the **event**,

$t_2$  is the time since time zero in  $S_2$  of the **event**,

$y_1$  and  $y_2$  are both the **y component** of the position of the event in **both** reference frames (same with  $z_1$  and  $z_2$ ),

$\gamma \equiv \frac{1}{\sqrt{1 - v^2/c^2}}$  is called the **Lorentz factor**,

$c$  is the **speed of light** in a vacuum, and

$v$  is the relative velocity between the two observers.

# What the Victorian Age knew

- Genetics
  - Gregor Mendel (1865)
    - Phenotype vs genotype
    - Units of transmission of traits

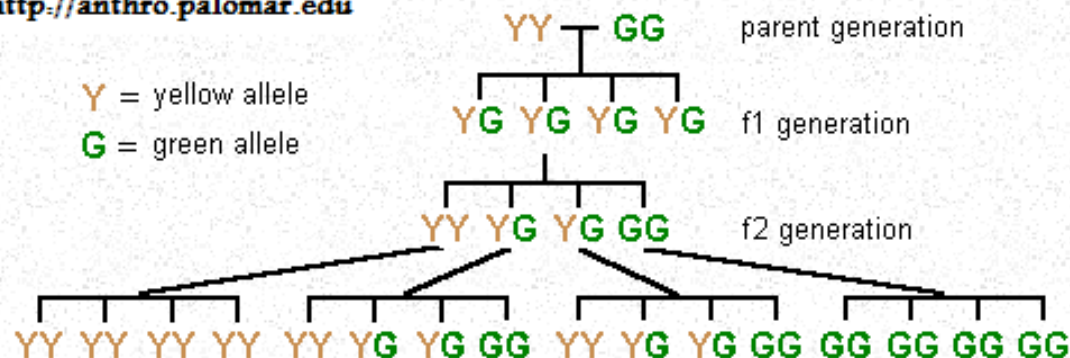


# What the Victorian Age Knew



- Gregor Mendel (1865)
  - Traits are inherited as units, not as "blends"
  - Each trait is represented by a "unit" of transmission, by a "gene"
  - Traits are passed on to the offspring in a completely random manner: any offspring can have any combination of the traits of the parents.
  - There is a unit of inheritance, later named "gene"

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# What the Victorian Age knew

- Genetics
  - August Weismann (1892)
    - Microscopy applied to biology
    - Heredity is about the transmission of information
    - The transmission of information from one generation to the next one takes place via a chemical
    - Theory of mitosis (how cells divide and reproduce)

# What the Victorian Age knew

- Genetics
  - August Weismann (1892)
    - Darwin's theory of heredity replaced by a theory of "germ plasma"
    - Germ plasma is a mixture of the parents' germ plasmas, which supplies information about how to construct the "soma" or structure of the body
    - The plasma is located in the chromosomes
    - The germ plasma is a substance that encodes information about reproduction
    - The germ plasma is transmitted from one generation to another
    - Each body is only a vehicle

# What the Victorian Age knew

- Genetics
  - August Weismann (1892)
    - Distinction between germ cells (cells that pass information to the offspring) and somatic cells (cells that build the organism)
    - Information can pass from germ line to soma but not from soma to germ line (i.e., Lamarck was wrong)

# What the Victorian Age knew

- Genetics
  - William Bateson (1894)
    - “Variation is the essential phenomenon of evolution”
    - Mendelian (opposed to biometrics)
    - Science of heredity (“genetics”)

# What the Victorian Age knew

- Genetics
  - Hugo de Vries (1901)
    - There are atoms of heredity (“pangenes”)
    - Hereditary units for different traits are independent
    - General law for the transmission of hereditary traits: rediscovery of Mendel
    - Process by which new species originate, i.e. genetic discontinuities arise (“mutation”)
    - Natural selection is not the driving force of evolution, mutation is

# What the Victorian Age knew

- Genetics
  - Wilhelm Johannsen (1901)
    - “Genotype”: the set of all genes of an organism
    - “Phenotype”: the set of traits of an organism
    - Organisms with the same genotype may exhibit different phenotypes because of environmental pressures

# What the Victorian Age knew

- Genetics
  - Mendelians emphasize discontinuous variation
  - Biometrics emphasizes continuous variation
  - Udny Yule (1902): Mendel's laws are not incompatible with continuous variation (the interaction of many genetic factors on the same characteristic produces the illusion of a continuous range of variation)



# What the Victorian Age knew

- Genetics
  - Darwinism predicts irregular and undirected evolution
  - Lamarckism and orthogenesis predict linear evolution

# What the Victorian Age knew

- **Genetics**
  - **Spontaneous generation is still the prevailing theory on the origin of life**

# What the Victorian Age knew

- Rudolf Steiner (1892)
  - The world is an indivisible whole and the human brain divides it into parts so that it can deal with it
  - There is no contradiction between spiritual and scientific knowledge: they are dual descriptions of the same world
  - Truth is both an objective discovery and a subjective creation
  - Understanding the world is an act of creation
  - The natural world is continuously created by the spiritual world
  - Anthroposophy: human consciousness, properly trained, can access the spiritual world

# What the Victorian Age knew

- **Francis-Herbert Bradley (1893)**
  - **Absolute idealism: the world is the product of the mind**
  - **The categories of science (e.g., space and time) can be proven to be contradictory, which proves that the world is a fiction**
  - **The only reality has to be a unity of all things, the absolute**

# What the Victorian Age knew

- **Emile Durkheim (1893)**
  - **Sociology: a science of social facts**
  - **The psychology of the individual has a sociological dimension**
  - **For example, suicide is a social fact**
  - **History of societies instead of history of individuals**
  - **The historian becomes a sociologist working in the past**

# What the Victorian Age knew

- Émile Durkheim (1912)
  - What all religions have in common is the concept of sacred objects
  - Religions originate from forms of totemism
  - Totemism yields a collective consciousness:
  - "The totality of beliefs and sentiments common to the average members of a society forms a determinate system with a life of its own. It can be termed the collective or creative conscience."
  - The function of religion is the cohesion of society, achieved through the collective conscience

# What the Victorian Age knew

- **German Sociology**
  - **Ferdinand Tonnies: “Community and Civil Society” (1887)**
    - **The “natural” will produces a self among selves, whereas the “rational” will produces a subject that treats other selves as objects**
    - **The organic community is held together by history whereas “society” is held together by interacting self-interests**

# What the Victorian Age knew

- German Sociology
  - Georg Simmel: “The Philosophy of Money” (1900)
    - The money economy is a form of prostitution
    - The money economy leads to alienation and “the tragedy of culture”
    - The money economy creates the crowd, in which individuals don’t care about other individuals



# What the Victorian Age knew

- Civil Disobedience
  - Henry David Thoreau: "Civil Disobedience" (1849)
  - Lev Tolstoy: "The Kingdom of God is Within You" (1894)
  - Mahatma Gandhi: "Satyagraha" (1896)
  - Martin Luther King: "I Have A Dream" (1963)

# What the Victorian Age knew

- Mohandas Karamchand "Mahatma" Gandhi (1896)
  - Nonviolence (ahimsa)
  - Satyagraha (truth and firmness)
  - Jesus + Thoreau + Tolstoy
  - The West justifies crimes no less barbaric than its enemies in the name of a divine mission to create a better world

# What the Victorian Age knew

- Utopia
  - John Francis Bray: "A Voyage from Utopia" (1842)
  - Etienne Cabet: "The Voyage to Icaria" (1839)
  - Edward Bulwer-Lytton: "The Coming Race" (1871)
  - Edward Carpenter: "Civilisation" (1889)
  - William Morris: "News from Nowhere" (1890)
  - Edward Bellamy: "Looking Backward" (1888)
  - Theodor Herzka: "Freiland" (1890)
  - Ebenezer Howard: "To-morrow" (1898)
  - Edward Bulwer-Lytton: "The Coming Race" (1871)
  - Edward Carpenter: "Civilisation" (1889)
  - William Morris: "News from Nowhere" (1890)
  - Edward Bellamy: "Looking Backward" (1888)
  - Theodor Herzka: "Freiland" (1890)

# What the Victorian Age knew

- Dystopia
  - Jack London's "The Iron Heel" (1907)
  - Franz Kafka's "The Trial" (1915)
  - Yevgeny Zamyatin's "We" (1921)
  - Aldous Huxley's "Brave New World" (1932)
  - Ayn Rand's "Anthem" (1938)

# Olympics



# Olympics

Gold, silver, bronze medals

## Athens 1896

1. USA	11	7	2
2. Greece (GRE)	10	18	17
3. Germany (GER)	6	5	2
4. France (FRA)	5	4	2
5. Great Britain (GBR)	2	3	2

## Berlin 1936

1. Germany (GER)	33	26	30
2. USA	24	20	12
3. Hungary (HUN)	10	1	5
4. Italy (ITA)	8	9	5
5. Finland (FIN)	7	6	6

## Rome 1960

1. USSR (URS)	43	29	31
2. USA	34	21	16
3. Italy (ITA)	13	10	13
4. Germany (EUA)	12	19	11
5. Australia (AUS)	8	8	6

## Montreal 1976

1. USSR (URS)	49	41	35
2. East Germany	40	25	25
3. USA	34	35	25
4. West Germany	10	12	17
5. Japan (JPN)	9	6	10

## Barcelona 1992

1. Former USSR	45	38	29
2. USA	37	34	37
3. Germany (GER)	33	21	28
4. China	16	22	16
5. Cuba (CUB)	14	6	11

## Sidney 2000

1. USA	40	24	33
2. Russia	32	28	28
3. China	28	16	15
4. Australia (AUS)	16	25	17 <sup>17</sup>
5. Germany (GER)	13	17	26

# What the Victorian Age knew

- K'ang Yu-wei (1898)
  - Neo-confucianism
  - The world is a One (“heaven, earth, and the myriad things are all of one substance with myself”)
  - All things are part of the “ch’i” from which the world emanates
  - This world is a world of misery and grief
  - Release from suffering is through “progress”

# What the Victorian Age knew

- K'ang Yu-wei (1898)
  - Human history progresses from the age of disorder to the age of order to the age of peace
  - Progress to remedy suffering includes nine obstacles to be removed (nations, races, classes, gender bias, etc)
  - Jen would then be universal love for all creatures
  - Competition is not the engine of progress, but the biggest obstacle to true progress



# What the Victorian Age knew

- The subconscious
  - Schopenhauer's will
  - Nietzsche's covert instinct
  - Johann Herbart's "Textbook of Psychology" (1816): the mind arises from the dialogue between conscious and unconscious processes
  - Pierre Janet's "psychological analysis" (hypnosis + automatic writing)

# What the Victorian Age knew

- The subconscious
  - Eduard von Hartmann's "Philosophy of the Unconscious" (1868)
    - The absolute subconscious permeates the universe
    - The physiological subconscious is inherited biologically by each individual
    - A study that mixed biology, anthropology, linguistics, art, poetry
  - Max Dessoir's "Double Ego" (1890)

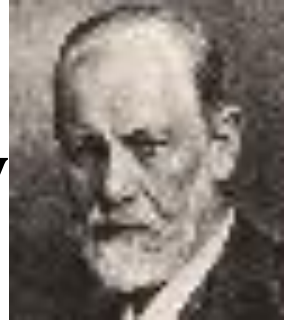
# What the Victorian Age knew

- **Prehistory of psychoanalysis**
  - **Josef Breuer' talking cure for “Anna O” (1880)**

# What the Victorian Age knew

- **Classical world of psychology (Wilhelm-Max Wundt, 1874)**
  - **Actions have a motive**
  - **Motives are mental states, hosted in our minds and controlled by our minds**
  - **Motives express an imbalance in the mind, between desire and reality**
  - **Action is an attempt to regenerate balance by changing the reality to match our desire**
  - **Assumption: human action is rational**
  - **Dreams? (Human action, yet irrational)**
- **Classical view of dreams**
  - **Dreams are about the future (oracles)**

# What the Victorian Age knew



- Sigmund Freud (1900)
  - The mind is divided in conscious (rational motives) and unconscious mind (reservoir of unconscious motives)
  - There is a repertory of motives that our mind, independent of our will, has created over the years, and they participate daily in determining our actions
  - Separation of motive and awareness
  - Repulsive picture of the human soul

# What the Victorian Age knew

- Freud (1900)
  - Libido (sexual desires)
    - A child is a sexual being
    - Parents repress the child's sexuality
    - The child undergoes oral, anal and phallic stages before entering the latency stage
    - Boys desire sex with their mother and are afraid their father wants to castrate them
    - Girls envy the penis and are attracted to their father

# What the Victorian Age knew

- Freud (1900)
  - “ *When a boy enters the phallic phase... he becomes his mother's lover. He wishes to possess her physically... and he tries to seduce her by showing her the male organ... seeks to take his father's place with her... His father now becomes a rival... whom he would like to get rid of... The boy's mother has understood quite well that his sexual excitation relates to herself... she threatens to take away from him the thing he is defying her with... she delegates its execution to the boy's father, saying that she will tell him and that he will cut the penis off...*”

# What the Victorian Age knew

- Freud (1900)
  - A dream is only apparently meaningless: it is meaningless if interpreted within the context of conscious motives.
  - The dream is perfectly logical if one considers also the unconscious motives
  - Meaning of dreams are hidden and reflect memories of emotionally meaningful experience
  - “Latent content” of the subconscious yields “manifest content” of the dream
  - Dreams are fulfillment of infantile wishes
  - Dreams rely on memories and are assembled by the brain to deliver a meaning
  - Dreams are not prophecies but memories
  - Free associations are evoked during the dream



# What the Victorian Age knew

- Freud (1900)
  - Mental life is originally unconscious. It becomes (potentially) conscious through perception (of the external world)
  - The ego perceives, learns and acts (consciously)
  - The super-ego is the (largely unconscious) moral conscience which originates during childhood through conflicts with the parent figures, and which is the principal instrument of repression
  - The id is the repertory of unconscious memories (created by libido)
  - The most unconscious memory is the “death wish”, the impulse to annihilate one’s own existence

# What the Victorian Age knew

- Freud (1900)
  - Neurosis involves a process of denial of emotionally painful memories
  - Overcoming these defenses is easier while in a waking rather than hypnotic state (hence free associations)
  - The causes of neurosis are largely sexual

# What the Victorian Age knew

- Freud (1900)
  - Not a scientific discipline, more like a new religion
  - Freud the prophet has apostles and heretics (Jung) and infidels (Havelock Ellis)
  - Vague theories that are impossible to test
  - Continuous revisions to accommodate facts that don't fit
  - Patriarchal psychology (women psychology is neglected)
  - A storyteller, not a scientist

# What the Victorian Age knew

- Freud (1920)
- Death instinct vs survival instinct (1920)
- Freud (1929)
  - Civilization requires repression which causes neurosis: the more civilization the more neurosis

# What the Victorian Age knew

- David Hilbert (1900)
  - Hilbert’s “Second Problem”
    - Is mathematics complete?
    - Is mathematics consistent?
    - Is mathematics decidable?
  - Entscheidungsproblem (1928): does a general algorithmic procedure for resolving all mathematical problems exist?



# What the Victorian Age knew

- **The Victorian Age**
  - **No major wars between the European powers**
  - **The French geographer André Siegfried is able to travel all over the world carrying only his visiting card for identification**
  - **Globalization on a scale never seen before and not seen again for a century**
  - **Sense of security not felt since the days of the Roman empire**
  - **but...**
  - **...Arms race on a scale that the world never had seen before**

# What the Victorian Age knew

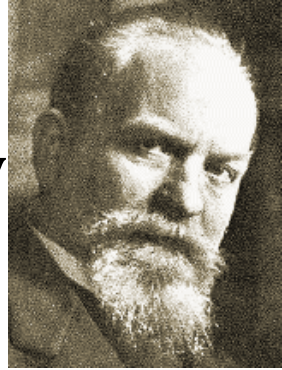
- Wilhelm Dilthey (1900)
  - Founder of Hermeneutics
  - Human knowledge can only be understood when the knower's life (lived in a historically-conditioned culture) is taken into consideration
  - Understanding a text implies understanding the relationship of expression to what is expressed, a “holistic” process that involves the “spirit of the age” (the overall historical context)
  - All cultural products are analogous to written texts

# What the Victorian Age knew

- Wilhelm Dilthey (1900)
  - The human sciences differ from the natural sciences (objective study of nature) because they depend on the human experience
  - The human sciences introduce three categories: value, purpose and meaning



# What the Victorian Age knew



- Edmund Husserl (1901)
  - The essence of something is not its physical constituents or physical laws, but the way we experience it
  - "Phenomenology" is the science of phenomena
  - Science caused a crisis by denying humans the truth of the reality that they experience (by proving that phenomenon and being are not identical)
  - Advocates a return to the primary experience of the world

# What the Victorian Age knew

- Edmund Husserl (1901)
  - Phenomena and being are one and the same

# What the Victorian Age knew

- Edmund Husserl (1901)
  - Consciousness is intentional: consciousness is “consciousness of” (“intentional” as in “refers to”)
  - The intentionality of consciousness correlates the act of knowing (noesis) by the subject with the object that is known (noema)
  - The phenomenon is intuitively known to the subject
  - The essence (eidos) of the phenomenon is the sum of all possible “intuitive” ways of knowing the phenomenon
  - This has to be achieved after “bracketing out” (“einklammerung”) the physical description of the phenomenon (the description given by the natural sciences)

# What the Victorian Age knew

- Edmund Husserl (1901)
  - What is left is a purely transcendental knowledge of the phenomenon
  - Subject and object are not separated

# What the Victorian Age knew

- Alexius Meinong (1902)
  - Some objects do not exist but have subsistence
  - It is true both that the round square is round and also that it is square

# What the Victorian Age knew

- **The cakewalk**



(American Mutoscope & Biograph, 1903)

# What the Victorian Age knew

- **George Moore (1903)**
  - **Naturalistic fallacy: trying to define a moral concept on the basis of non-moral concepts (happiness, pleasure, utility)**
  - **Good is a primitive concept**
  - **The concept of good is learned by intuition**
  - **Good is not an experimental quantity**
  - **Good is not a noun, but a predicate used in ethical judgements**
  - **Rehabilitation of common sense**

# What the Victorian Age knew

- **George Moore**
  - **Sense-data: what we perceive of an object (e.g., the texture of the surface of a table)**
  - **How do we derive knowledge of an object from our sense-data?**



# What the Victorian Age knew

- Richard Semon: "Die Mneme" (1904)
  - Evolution is a kind of memory that preserves the effects of experience across generations
  - Human memory and evolution work the same way
  - Mneme: the fundamental process that subsumes both processes
  - Engram: the unit of memory, or, better, the pattern used to encode it (in the case of the brain, the "memory trace")
  - Ecphoric stimulus: the cue that helps retrieve a memory

# What the Victorian Age knew

- **Richard Semon: "Die Mneme" (1904)**
  - **The likelihood of finding a memory depends also on the cue that is used to retrieve it (the pattern used to decode it)**
  - **A cue is only a fraction of the memory (of the engram), but it is enough to retrieve the whole memory (engram)**

# What the Victorian Age knew

- Peking to Paris Motor Challenge (1907)



Scipione Borghese, winner of the challenge, and photographer Luigi Barzini

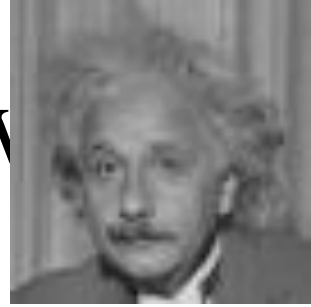
# What the Victorian Age knew

- Pierre Duhem (1906)
  - No scientific statement can be refuted, as one can always tweak the scientific theory that the statement belongs to so that the statement becomes true
  - The certainty that a proposition is true decreases with any increase of its precision

# What the Victorian Age knew

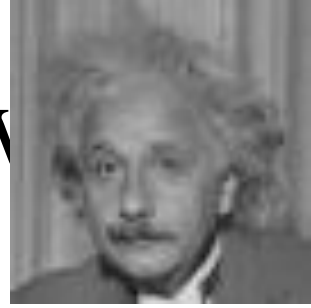
- **George Santayana (1906)**
  - Human beings are physical systems that can be explained by the laws of Physics
  - Minds are caused by bodies (mind is an emergent property of matter)
  - Minds cannot influence bodies

# What the Victorian Age knew



- **Albert Einstein (1903)**
  - The photoelectric phenomenon is due to the fact that light is a stream of finite “photons” (energy quanta).
  - Photons appear when electrons emit light.
  - Photons disappear when electrons absorb light.
  - The energy of the photon is a multiple of Planck’s constant: the quantum is universal

# What the Victorian Age knew



- **Albert Einstein (1905)**
  - **Axioms:**
    - **The laws of nature must be the same (invariant) in all frames of reference that are inertial (Galileo's old principle of relativity)**
    - **The speed of light is the same in all directions**
  - **Then space and time cannot be absolute**

# What the Victorian Age knew

- **Albert Einstein (1905)**
  - **Consequences:**
    - **The combined equations of Newton and Maxwell do not satisfy Galilean relativity but another kind of relativity**
    - **Lorentz transformations to preserve relativity (invariance)**
    - **The length of an object and the duration of an event are relative to the observer**
    - **All quantities must have four dimensions, a time component and a space component (e.g., energy-momentum)**
    - **Equivalence of mass and energy ( $E=mc^2$ )**



# What the Victorian Age knew

- **Albert Einstein (1905)**
  - **Space and time are not absolute**
  - **"Now" is a meaningless concept**
  - **The past determines the future**
  - **Nothing can travel faster than light**
  - **Time does not flow (no more than space does), it is just a dimension**

# What the Victorian Age knew

- **Albert Einstein**
  - **1911: Why the sky is blue**

# What the Victorian Age knew

- **Hermann Minkowski (1908)**
  - **Space and time are different dimensions of the same space-time continuum**
  - **Each observer has a different perspective on the events in the space-time continuum (e.g., length or duration)**
  - **Past and future are segments of space-time continuum**
  - **Each observer's history is constrained by a cone of light within the space-time continuum**
  - **Each observer's history is a "world line", the spatio-temporal path on which the observer is actually traveling through space-time**
  - **"Proper" time is the spacetime distance between two points on a world line (the time experienced by the observer as she travels along her world line)**

# What the Victorian Age knew

- **Margaret Murray performs autopsy on an Egyptian mummy at the Manchester Chemical Theater (1908)**

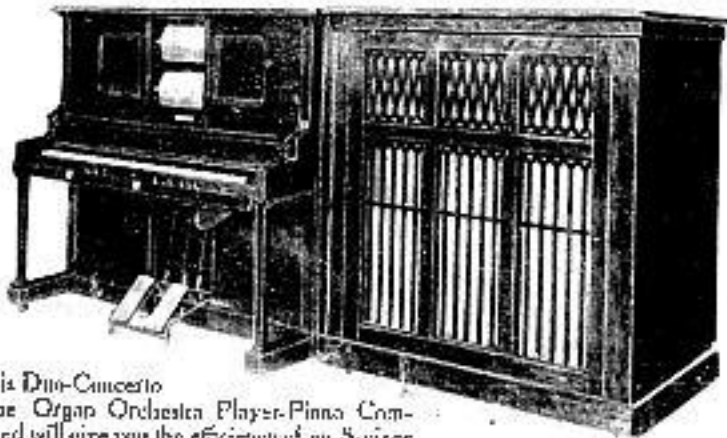


# What the Victorian Age knew

- **Defiance of conventions**
  - Negation of aesthetic and moral values
  - Futurism (1909): machines
  - Dadaism (1916): chance, irrationality
  - Surrealism (1924): unconscious, dreams

# What the Victorian Age knew

- **Fotoplayer for movie theaters**



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# What the Victorian Age knew

- Max Weber (1905)
  - Rationalization, bureaucratization and alienation associated with capitalism
  - Capitalism originates from religious ideals (Calvinism)
  - The state claims a monopoly on the legitimate use of violence
  - Stahlhartes Gehäuse/ Iron Cage: increasing rationalization of human life, which traps individuals in over-bureaucratized social order

# What the Victorian Age knew

- Max Weber (1905)
  - Science can improve the material conditions of the individual but not provide meaning
  - Science/technology demystifies life and makes it less exciting to live



# What the Victorian Age knew

- Norman Angell (1911)
  - World economies are so interdependent that war cannot have any victor anymore

# What the Victorian Age knew

- The Mona Lisa becomes a world icon (1911)

**Le Petit Parisien**  
5 centimes    Le plus fort tirage des journaux du monde entier    5 centimes

**LA « JOCONDE » EST RETROUVÉE**  
Le célèbre tableau, proposé à un antiquaire, a été saisi à Florence et sera restitué à la France.

**Menaci de destitution en cas d'erreur, M. Ricci, directeur des Beaux-Arts d'Italie, garantit solennellement l'authenticité de l'œuvre antique.**



**MALADIES SALUTAIRES**  
L'été est la saison des maladies salubres...  
**La Fin d'une Conquête**  
L'œuvre de l'homme est la fin d'une conquête...  
**LA JOCONDE EST RETROUVÉE**  
Le célèbre tableau, proposé à un antiquaire, a été saisi à Florence et sera restitué à la France. Menaci de destitution en cas d'erreur, M. Ricci, directeur des Beaux-Arts d'Italie, garantit solennellement l'authenticité de l'œuvre antique.

# What the Victorian Age knew

- **Frederick Winslow Taylor (1911)**
  - **Scientific management**
  - **The production process must be subdivided into tasks that unskilled workers can perform with the help of machines**
  - **Minimize training of workers**
  - **Minimize dependence on specialized workers**

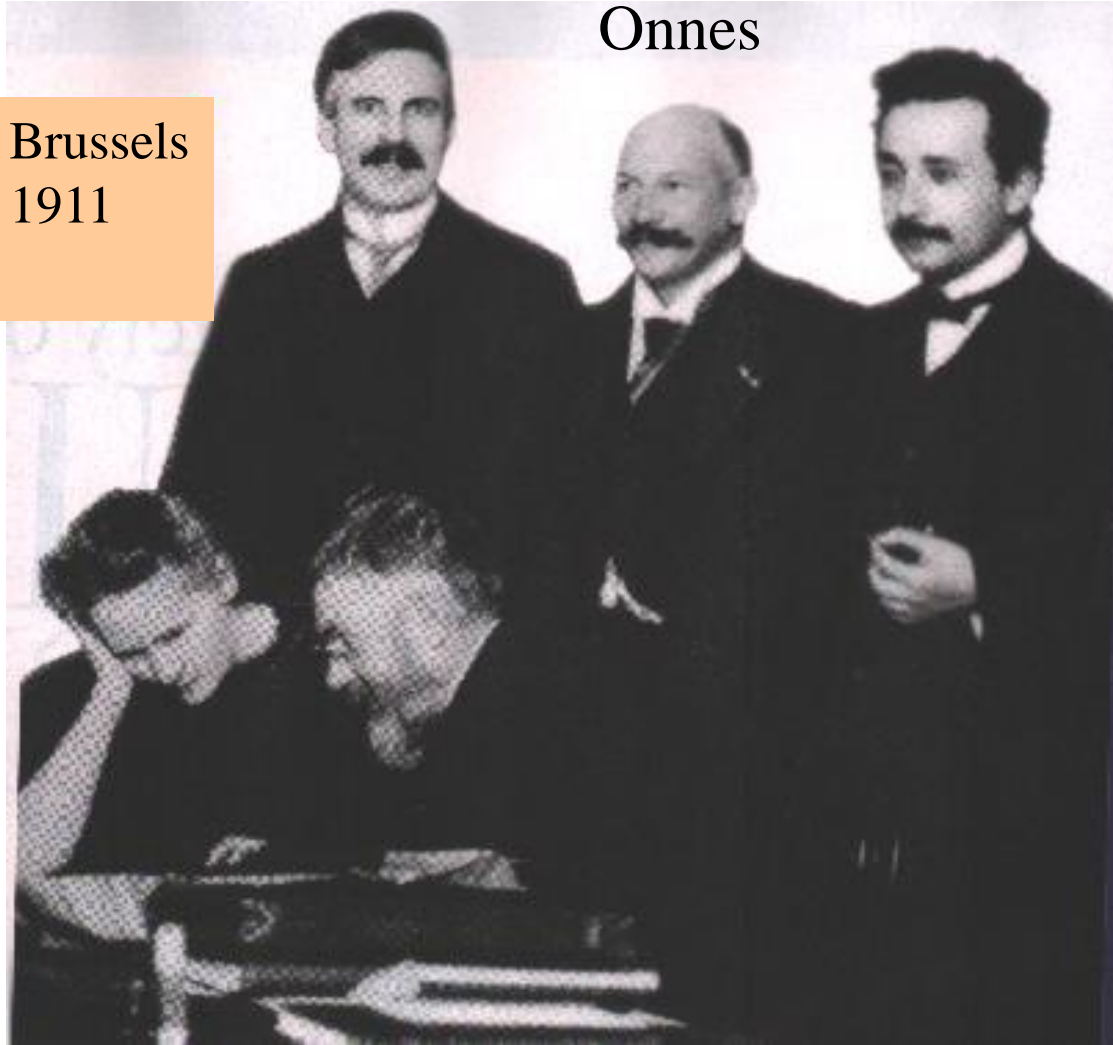
# What the Victorian Age knew

Rutherford

Onnes

Einstein

Brussels  
1911



Curie

Poincare'

# What the Victorian Age knew

- Nishida Kitaro (1911)
  - Symbiosis between European rationalism and Zen Buddhism
    - Western Rationalism provides the rational foundations (a robot without feelings or ethics), Zen provides the feelings and the ethics
    - "We don't exist because we think, but we think because we exist."
    - "To know is to love and to love is to know"
    - Action-intuition: discovering the self in creative activity and realizing the place of this personal creativity in the historical context

# What the Victorian Age knew

- **Nishida Kitaro (1911)**
  - **Eternal now**
    - **The "eternal now" contains one's whole being and also the being of all other things**
    - **The infinitesimal brief presence of the "here-and-now" creates past, present, and future.**
    - **"Mu" (nothingness) creates a spacetime topology**
    - **Mu = unmeasurable moment in spacetime ("less than a moment") that has to be "lived" in order to reach the next "mu"**
    - **Mu also creates the time-experience, self-consciousness and free will**

# What the Victorian Age knew

- **Nishida Kitaro (1911)**
  - The present is merely an aspect of the eternal
  - "We do not feel the past: to feel something in the past is a feeling in the present"
  - The eternal generates all the time a self-determining present (at every mu)
  - "Mu no basho ronri" (place of nothingness): nothingness as field, place or topos
  - Unifies "pure experience" and field of force

# What the Victorian Age knew

- **Nishida Kitaro (1911)**
  - **Unity of subjective and objective reality**
    - **"Only one reality exists in the universe"**
    - **"Phenomena of consciousness are the sole reality"**
    - **"Objective reality does not exist apart from subjective consciousness"**
    - **"That which Newton and Kepler observed and took to be the order of natural phenomena is actually the order of our phenomena of consciousness"**
    - **"Subject and object do not exist separately, for they are the two relative sides of one reality"**
    - **"The self does not exist apart from the world that it sees"**



# What the Victorian Age knew

- **Nishida Kitaro (1911)**
  - **Unity of subjective and objective reality**
    - **Each self and each thing is an expression of the only reality of the world (see Leibniz's monad)**
    - **The self is not a substance: it is nothingness (“to study the self is to forget the self”)**

# What the Victorian Age knew

- **Nishida Kitaro (1911)**
  - **The historical world**
    - **The creative now not only creates time, but also space**
    - **Each present is a unique combination of space and time**
    - **Time can be viewed as both linear and cyclical, but converges in both states at the same space point**
    - **This point is the historical world**
    - **History is an ascending self-realization of the absolute**

# What the Victorian Age knew

- **Nishida Kitaro (1911)**
  - **Ethics**
    - **"Morality is not a matter of seeking something apart from the self: it is simply the discovery of something within the self"**
    - **"There is only one true good: to know the true self"**
    - **"Our true self is the ultimate reality of the universe, and if we know the true self we not only unite with the good of humankind in general but also fuse with the essence of the universe and unite with the will of God"**

# What the Victorian Age knew

- **Nishida Kitaro (1911)**
  - **Ethics**
    - **"We individuals are entities which have developed as cells of one society. The essence of the nation is the expression of the communal consciousness that constitutes the foundation of our minds"**
    - **"At present, the nation is the greatest expression of unified communal consciousness. But the expression of our personality ... demands something even greater: a social union that includes all human kind."**

# What the Victorian Age knew

- Nishida Kitaro (1911)
  - God
    - "God transcends time and space, is eternal and indestructible, and exists everywhere"
    - "God is none other than the world and the world is none other than God"
    - "The universe is not a creation of God but a manifestation of God"
    - "To love God is to know God"
    - "Religion is the culmination of knowledge and love."
    - "Religion is not to be sought for the sake of spiritual peace. Religion is a goal, not a means to something else."

# What the Victorian Age knew

- **Nishida Kitaro (1911)**
  - **"Zettai mujunteki jikodoitsu" ("absolute contradictory self-identity", unity of opposites)**

# What the Victorian Age knew

- **Gyorgy Lukacs (1911)**
  - **Epic stage: system of meaning in which human alienation does not exist, the soul does not perceive any separation from the world, object and subject are not divided, history and nature are one**
  - **People are made into things and therefore lose their identity (commodification of everyday life)**

# What the Victorian Age knew

- **Gyorgy Lukacs (1911)**
  - **A style of thought might be imputed to a social class**
  - **“Development in history is neither random nor chaotic, nor is it a straightforward linear progression, but rather a dialectic development. In every social organization, the prevailing mode of production gives rise to inner contradictions which are expressed in class struggle”**



# What the Victorian Age knew



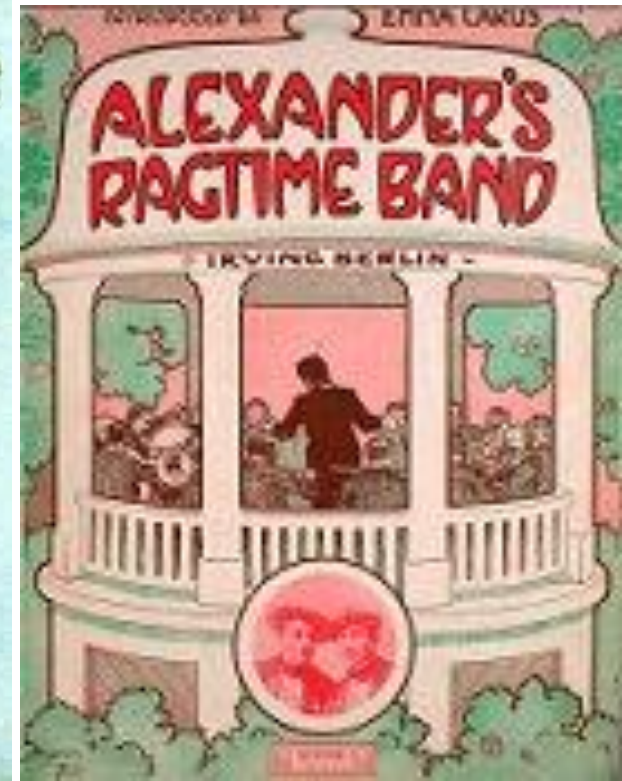
- **Edward Thorndike (1911)**
  - **Animals learn based on the outcome of their actions ("law of effect")**
  - **The mind as a network**
  - **Learning occurs when elements are connected**
  - **Behavior is due to the association of stimuli with responses that are generated through those connections**
  - **A habit is a chain of “stimulus-response” pairs**

# What the Victorian Age knew

- **USA: Popular music**

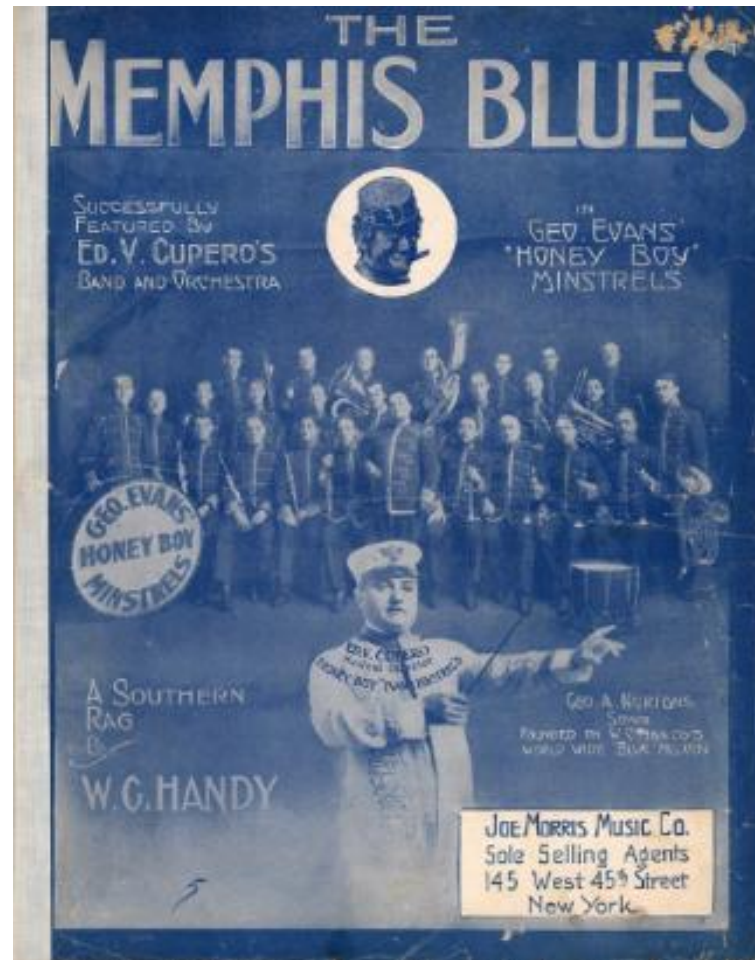


Irving Berlin's first hit  
(1911)



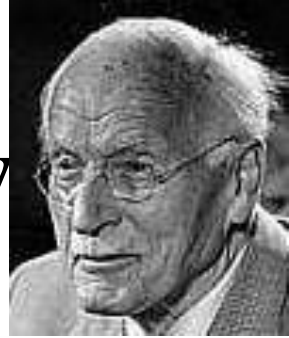
# What the Victorian Age knew

- **USA: Blues music**



The first blues, 28 Sep 1912

# What the Victorian Age knew



- Carl Jung (1912)
  - Parallels between ancient myths and psychotic fantasies
  - Motives are not in the history of the individual but in the history of the entire human race
  - Unconscious as a repertory of symbols
  - Unconscious: Freud's personal unconscious (repressed memories) + collective unconscious (inherited motives shared by all humanity)
  - Collective unconscious: a shared repertory of archaic experience represented by "archetypes" which spontaneously emerge in all minds

# What the Victorian Age knew

- **Carl Jung (1912)**
  - **Mythology is the key to understanding the human mind**
  - **Predispositions by all human brains to create some myths rather than others**
  - **Humans are born with an extensive knowledge of the world.**

# What the Victorian Age knew

- Carl Jung (1912)
  - Libido is not just sexual
  - Dreams reflect the collective unconscious
  - Dreams connect the individual with the rest of humankind
  - Mandala as the archetypical symbol of the self
  - Trance (“active imagination”) helps the self become one with the archetypes and achieve immortality
  - The goal of psychoanalysis is spiritual renewal
  - Self-deification through the mystical connection with our primitive ancestors (“We must dig down to the primitive in us”... “a new experience of God”)
  - A race is identified by the archetypes that bind all individuals of the race together with their ancestors

# What the Victorian Age knew

- Carl Jung (1912)
  - Self: the whole psyche, conscious and unconscious
  - Ego: the conscious part of the psyche
  - Persona: identity
  - Shadow: the unconscious part that the Ego does not want to make conscious
  - Anima: the unconscious psyche relating to the opposite gender

# What the Victorian Age knew

- Precursors of Gestalt
- Vittorio Benussi (1912)  
“Stroboscopic Apparent Motion and Geometric Optical Gestalt Illusions”
- Max Wertheimer (1912)
- "Experimental Studies on Motion Vision“



# What the Victorian Age knew

- Carl Jung (1933)
  - Psychoanalysis has replaced the soul with the psyche, but it can only “cure” one psyche at a time instead of the millions of souls that religion used to “cure”

# What the Victorian Age knew

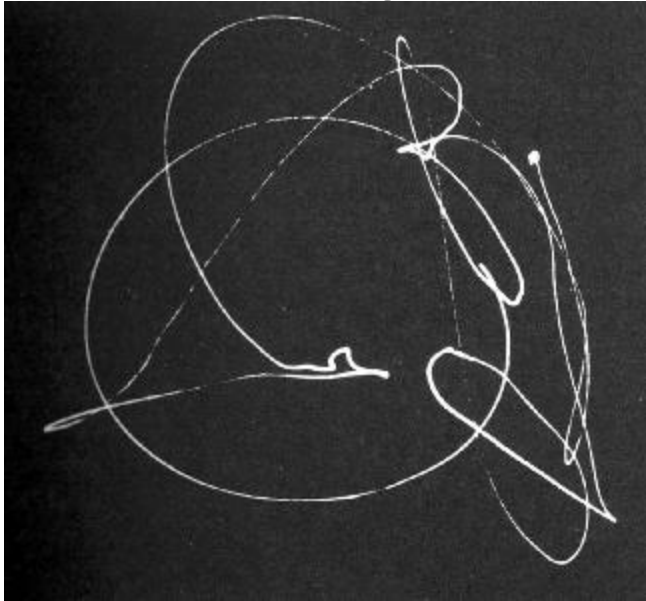
- The Evolution of the Earth/ Part VI
  - Svante Arrhenius (1896): increases in atmospheric carbon dioxide cause global warming through a greenhouse effect

# What the Victorian Age knew

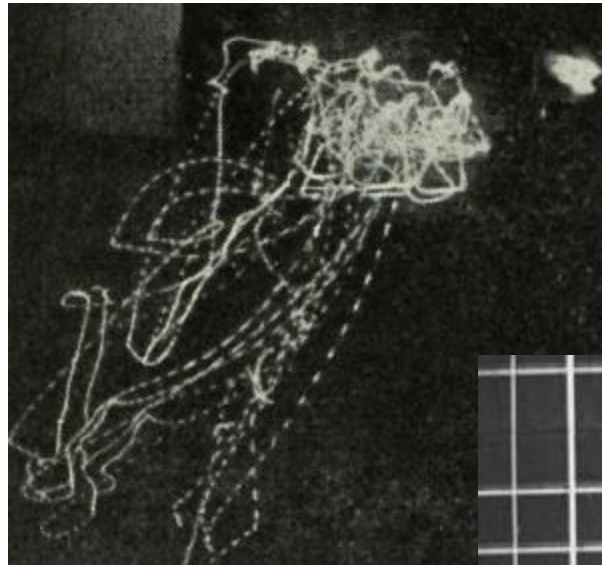
- The Evolution of the Earth/ Part VI
  - Alfred Wegener (1912):
    - Continental drift (the landscape of the Earth has changed not only vertically but also horizontally)
    - In ancient times the Earth only had one giant continent, Pangaea)

# What the Victorian Age knew

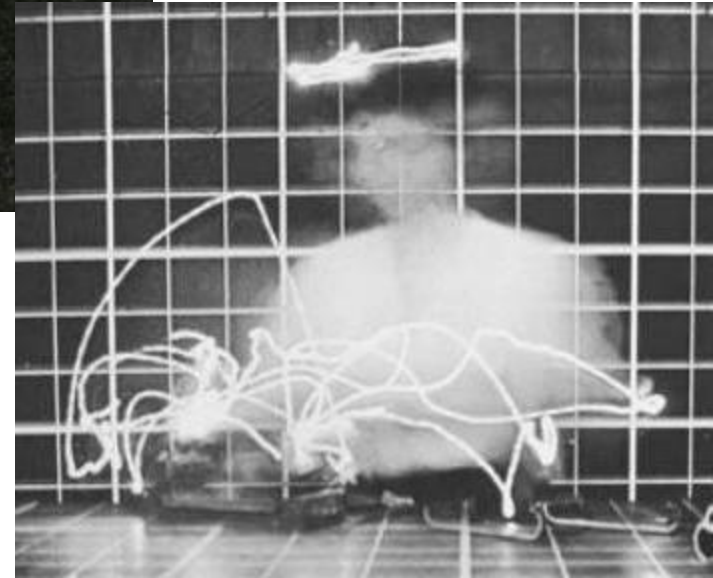
- Frank Gilbreth
  - Cyclograph or motion recorder (1912)



Fencer

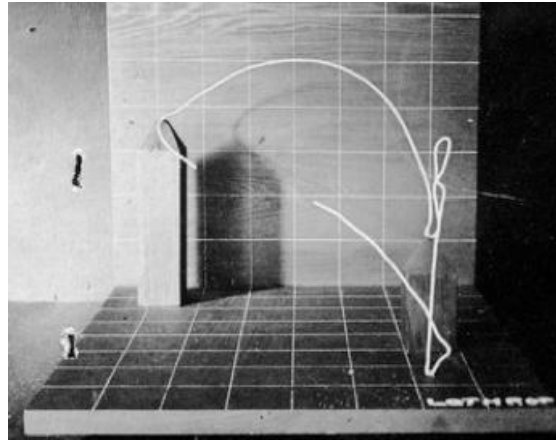
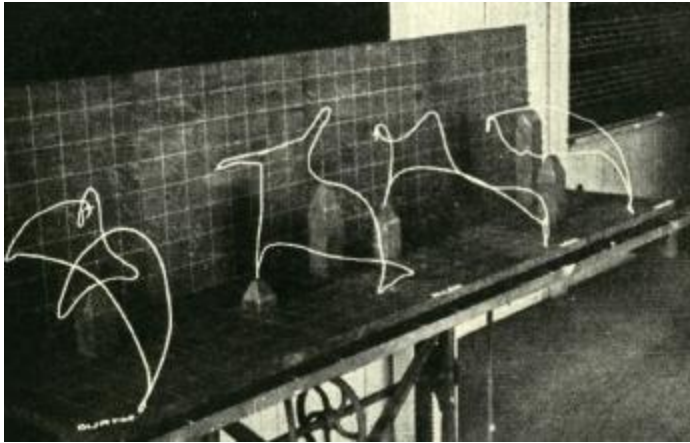


Bricklaying

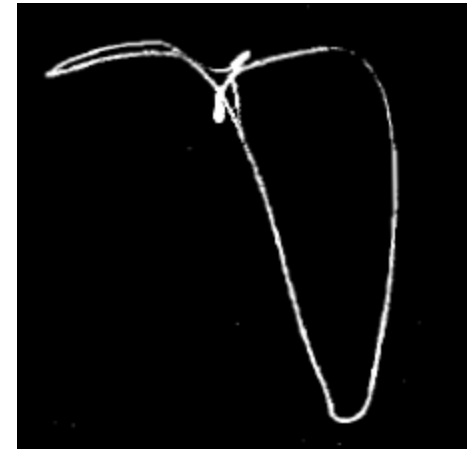


# What the Victorian Age knew

- **Frank Gilbreth**
  - **Wire models (1912)**



Wire model of foreman on drill press.



Perfect movement

# What the Victorian Age knew

- Ferdinand Saussure (1913)
  - "parole" (a specific utterance in a language, performance) vs "langue" (the entire body of the language, competence)
  - Structuralism: the phenomena of human life (e.g, language) are intelligible only inasmuch as they are part of a network of relationships
  - A sign is meaningful only within the entire network of signs
  - The meaning of a sign is its relationship to other signs ("Strictly speaking, there are no signs but only differences between signs")

# What the Victorian Age knew

- Ferdinand Saussure (1913)
  - Language is a field
  - Meaning is generated through differences between linguistic elements
  - If one word were removed from a language, the meanings of all other words would be changed

# What the Victorian Age knew

- Ferdinand Saussure (1913)
  - A sign requires both a signifier and a signified (a concept in the mind)
  - The relation between a signifier and a signified is arbitrary (the meaning of a sign is totally arbitrary)
  - The relations between signifier and signified form a sign
  - The structure of language is the negative relation among signs: one sign is what it is because it is not another sign
  - It is the difference between signifiers that matters, not the signified
  - Semiotics: science of signs



# What the Victorian Age knew

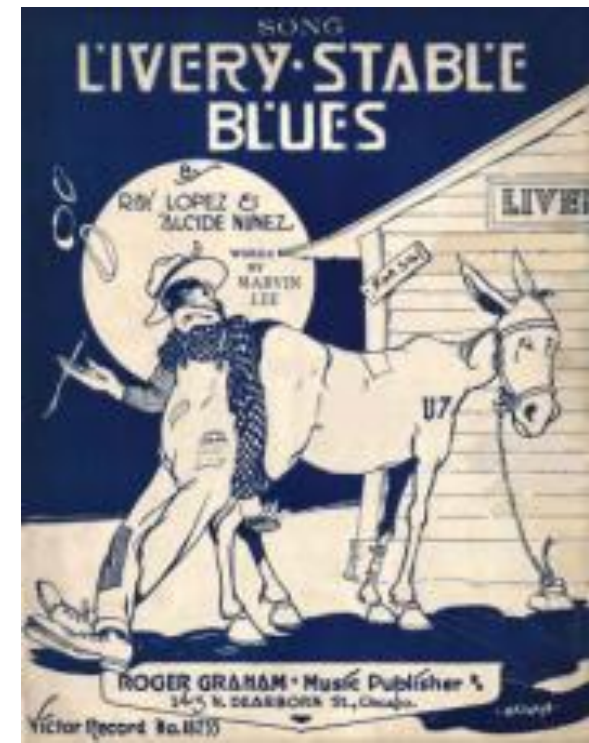
- Ferdinand Saussure (1913)
  - Linguistic sign: the signifier is the sound and the signified is the thought
  - A linguistic sign is a link between a sound and a concept (not the link between a name and a thing)
  - Phoneme: the basic unit of language
  - Morpheme: the basic unit of signification
  - Mytheme: the basic unit of myth
  - Phonemes can stand in two kinds of relationship: diachronic ("horizontal") and synchronic ("vertical")

# What the Victorian Age knew

- Structuralism
  - Language is a system of signs having no reference to anything outside itself

# What the Victorian Age knew

- **Jazz**





# What the Victorian Age knew

- Albert Einstein (1915)
  - Gravitation
    - Finite speed of light is incompatible with Newton's instantaneous gravitational attraction
    - Need for a theory of gravitation that is consistent with Relativity
    - Planets don't fall in a straight line, they move in curved lines.

# What the Victorian Age knew

- Albert Einstein (1915)
  - The problem is light again
    - Light is made of particles (photons)
    - Photons are subject to gravity
    - Light is affected by gravity
    - Then space and time must look different from inside and from outside a gravitational field

# What the Victorian Age knew

- Albert Einstein (1915)
  - Galileo's principle: all bodies fall equally fast in a gravitational field
  - Acceleration of a body under gravity must be independent of the body's mass
  - Thus gravitational mass and inertial mass must be the same (Newton postulated it but it did not prove it)
  - The effect of a gravitational field is just like the effect of an acceleration (of an "accelerating reference frame")
  - It is no possible to distinguish between gravitational and accelerational forces by experiment (e.g, an acceleration of  $9.8 \text{ m/sec}^2$  in outer space is "equivalent" to gravitational force on the Earth)

# What the Victorian Age knew

- Albert Einstein (1915)
  - The principle of relativity for systems accelerated with respect to one another
  - Principle of Equivalence: Forces produced by gravity are in every way equivalent to forces produced by acceleration
  - All forces (gravitational or not) are due to acceleration
  - Free-fall motion is natural motion
  - If space-time is curved, free fall is a straight line: planets do fall in a straight line, but space is not flat
  - No need for gravitational forces



# What the Victorian Age knew

- Albert Einstein (1915)
  - If all accelerated systems are equivalent, then Euclidean geometry cannot hold in all of them
  - Masses do not attract each other: they curve spacetime

# What the Victorian Age knew

- Albert Einstein (1915)
  - Newton's hypothesis that every object attracts every other object is unnecessary
  - Newton postulated the existence of a gravitational force and the equivalence of gravitational and inertial mass: Einstein used the equivalence of gravitational and inertial mass to get rid of the gravitational force

# What the Victorian Age knew

- Albert Einstein (1915)
  - Masses curve spacetime
  - Spacetime's curvature determines the motion of masses
  - Einstein's equivalent of the law of gravity: Every object, which is not subject to external forces, moves along a geodesic of spacetime (the shortest route between two points on a warped surface), its “world line” (the equivalent of a straight line in flat space)
  - Spacetime “is” the gravitational field

# What the Victorian Age knew

- Albert Einstein (1915)
  - When an object appears (in 3D space) to be "at rest" but under the effect of gravitational attraction, it is actually being "accelerated" (attracted) towards the center of the earth along its world-line (in 4D spacetime) which happens to be curved by the spacetime curvature caused by the Earth's mass
  - It is spacetime that is curved, not the geodesic.

# What the Victorian Age knew

- Albert Einstein (1915)
  - Gravitation is not a force
  - Physics = Geometry of space-time
  - Gravitation = space-time curvature
  - Relativity theory is ultimately about the nature of gravitation
  - Relativity explains gravitation in terms of curved space-time, i.e. Geometry
  - "Gravitational force" becomes an effect of the geometry of space-time

# What the Victorian Age knew

- Albert Einstein (1915)
  - The curvature of space-time is measured by a “curvature tensor” (Riemann’s geometry)
  - Each point is described by ten numbers (metric tensor)
  - Euclid's geometry is one of the infinite possible metric tensors (zero curvature)
  - Other geometries describe spaces that are not flat, but have warps
  - What causes the “warps” is energy-mass
  - Clocks slow down in a gravitational field
  - Light is deflected in a gravitational field

# What the Victorian Age knew

- Albert Einstein (1915)
  - Trivia: he was competing with Hilbert (who in fact submitted his paper 5 days before Einstein's)

*The Drama of November (1915)* – four papers submitted to the Royal Prussian Academy of Science

*“On the General Theory of Relativity”*, Nov. 4th

“...fatal prejudice”, “...key to the solution”

*“On the General Theory of Relativity (Addendum)”*, Nov. 11th

“...an even more concise and logical structure”

*“Explanation of Perihelion Motion of Mercury from the General Theory of Relativity”*, Nov. 18th

“...an important confirmation of this most fundamental theory..”

*“The Field Equations of Gravitation”*, Nov. 25th





# What the Victorian Age knew

## 100 YEARS OF GENERAL RELATIVITY

**“The Formative years” (H.G. and Jurgen Renn)** from 1915 roughly until the late 1920s and early 1930s, when more and more of the leading physicists turned their attention to the booming field of quantum mechanics to debate its meaning and explore its consequences.

**“The Low-water mark period” (Jean Eisenstadt)** immediately following it, in which, also due to the WWII, faded into the background, being largely considered as irrelevant to mainstream physics and limited to the explanation of some minor adjustments of Newton’s otherwise well-confirmed theory of gravitation.

**“The Renaissance” (Clifford Will)** of relativity begins after the war and makes its prominent mark only more than a decade later in connection with new astrophysical discoveries in the 1960s such as those of quasars.

**“The Golden Age” (Kip Thorne)** of relativity bringing new conceptual insights such as those into the nature of black holes and turning the theory into the foundation of modern astrophysics and observational cosmology.

# What the Victorian Age knew

- Albert Einstein (1915)
  - Cosmological constant to counterbalance the effect of gravity, so as to retain a static universe
  - God: Spinoza's pantheism
  - A new idea of science:

*"I have learned something else from the theory of gravitation: no collection of empirical facts, no matter how comprehensive, can ever lead to the formulation of such complicated equations ... [they] can only be found through the discovery of a logically simple mathematical condition that completely or almost completely determines the equations. Once one has those sufficiently strong formal conditions, one requires only little knowledge of facts to set up a theory."*

*Einstein, Autobiographic Notes, 1949*

# What the Victorian Age knew

- Albert Einstein (1915)
  - Newton's Physics leads to the Enlightenment
  - Darwin's Biology leads to Communism, Fascism, Capitalism
  - Einstein's Relativity leads to self-determination movements (Western civilization is not the center of the world, just one of the many parts of it)

# What the Victorian Age knew

- Benedetto Croce (1917)
  - Only spirit exists, the world is an illusion
  - Spirit manifests itself in four forms: Aesthetics (individual thought), Logic (collective thought), Economics (individual practice) and Ethics (collective practice).
  - Human creative power is better represented by Art than Science
  - History is philosophy in motion, an interpretation of the past in terms of the present

# What the Victorian Age knew

- Oswald Spengler (1918)
  - Cyclical theory of the rise and decline of civilizations
  - Cultures are organisms
  - Becoming is a primary concept, being is what has “become”, so secondary
  - Culture is the becoming, Civilisation is the become
  - Muslims, Jews and Christians are Magian: cavern-like world, mosques/cathedrals

# What the Victorian Age knew

- Oswald Spengler (1918)
  - Ancient Greece and Rome are Apollonian: focus on the the human body, the local and the present, opposition of form and matter (classical buildings begin from the outside)
  - Post-medieval Western Europe is Faustian: focus on infinite space, opposition of force and mass (modern buildings begin from the inside)

# What the Victorian Age knew

- Oswald Spengler (1918)
  - Democracy is driven by money through media
  - Democracy inevitably leads to dictatorship, in which money is no longer important
  - Man makes history, Woman is history (and cannot comprehend politics)

# The Victorian Age

Piero Scaruffi

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