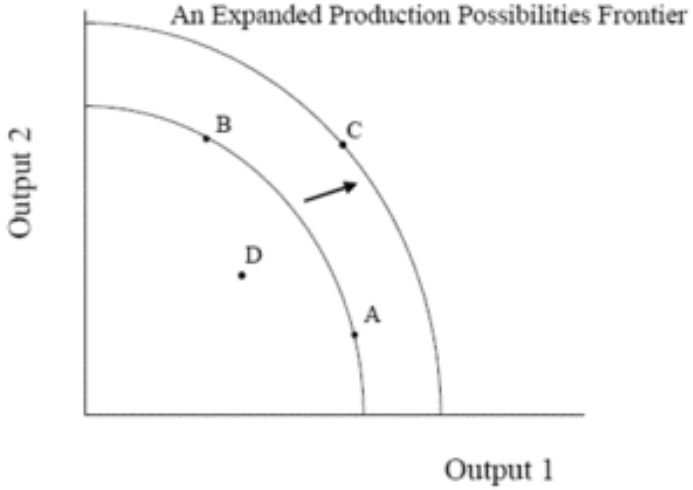
Energy: Industrialism and the Rise of the Masses

I. Capital and Labor
II. What Power ?
III. Impact
IV. Sex, Society and Culture

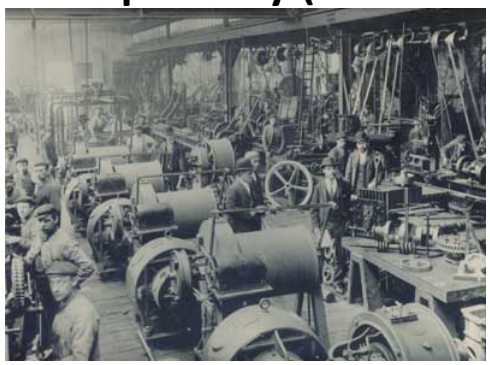
Capital and Labor: An Economics Lesson

- Historical Discontinuity: Real or Illusionary?
- Productions Functions: Q = F (L, K)
  - Definitions of Capital and Labor
  - Short term vs. Long term
- Production Possibilities Frontier (PPF) and its shifts
  - The Effects of Technology
  - Specialization and Mechanization



- A Modern Example:

  Building Mirrors for Large Optical Telescopes
  - 1948- Hale Observatory (5 meters)
  - 1976- Soviet Infamous (6 meter) telescope fiasco
    - What went wrong?
  - 1982- Dr. Jerry Nelson and his elegant solution
  - 2016(?)- Very Large European Telescope Array (42 meters)



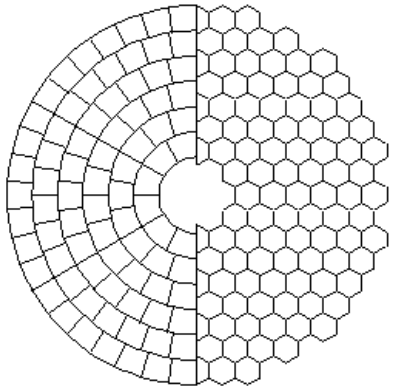


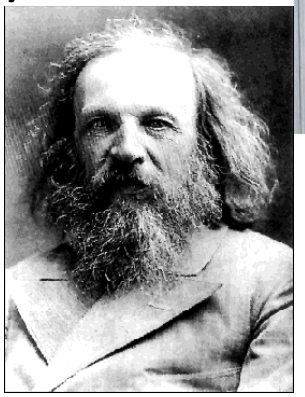
Figure 1 Notional geometries for a large telescope primary mirror, composed of hexagonal segments or sector-shaped segments.

Topics in 19th Century Science

I. Chemistry:

- What came before: Phlogiston Theory

- Antoine Lavoisier (1743-1794):
  - Isolated the composition of water and air
  - Stoichiometry & the formulation the law of conservation of Mass
  - "What do you call twenty eight bureaucrats in chains?" (1794)

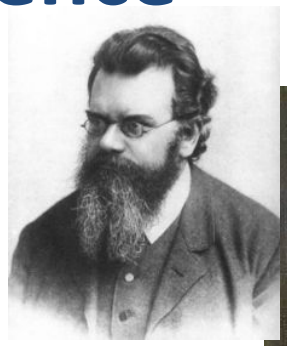


- Dimitri Mendeleev (1834-1907):
  - Weight-ing for Valences: Creation of the Periodic table
  - Hypothesis on the Aether
  - Introduction of the Metric system to Russia

- Marie Sklodowska-Curie (1867-1934):
  - Discovery of Radioactivity
    - What the hell is radioactivity?
  - Two New Elements: Polonium & Radium
    - Applications of Radioactive elements: Medical & X-rays
  - Nobel Prize & Philanthropy (1903)
  - Illness and Death (4 July 1642)

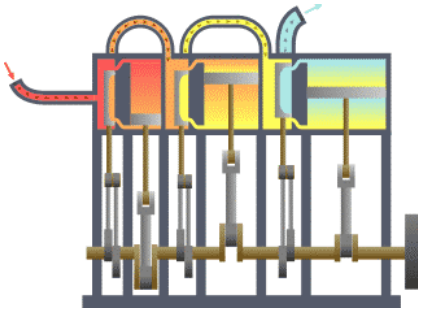
Topics in 19th Century Science

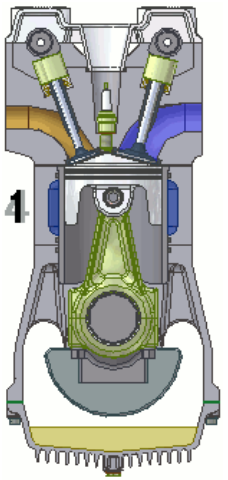
II. Thermodynamics & Heat Engines:



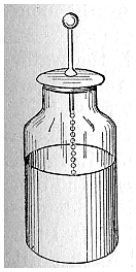
- ❖**What came before: Heat as a fluid**
- ❖**Statistical Mechanics & Ludwig Boltzmann (1844-1906)**
- ❖**Laws of Thermodynamics**
    1. **Zeroth Law:** If A, B, and C are in tact with each other, then if A and C have the same temperature, A and B will have the same temperature.
    2. **First Law:** Energy can be transformed (changed from one form to another), but it can neither be created nor destroyed
    3. **Second Law:** Without outside intervention, heat generally cannot spontaneously flow from a material at lower temperature to a material at higher temperature.
    4. **Third Law:** As a system approaches absolute zero, all processes cease and the entropy of the system approaches a minimum value

- ❖**Heat Engines: Driving force of the industrial revolution**
    - ❖**Making things go boom for fun and profit**
    - ❖**Principle of a heat engine**
        - ❖**Sadi Carnot (1796-1832)**
    - ❖ **Applications, Productivity, and Efficiency**



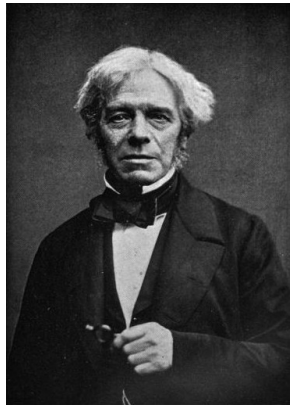


Topics in 19th Century Science

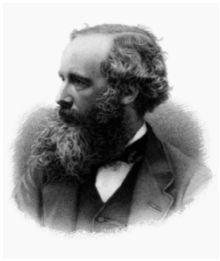


III. Electricity:

- What came before: Leyden Jars, Kites, and Fluids. Oh, my!
- Basis of electricity: Plusses and Minuses
- Michael Faraday (1791-1867):
  - Electromagnetic Induction
- J. J. Thompson (1856-1940):
  - Cathode Rays and Electrons
  - The Plum Pudding/ Chocolate Chip Cookie Model
  - A Look Ahead: Television sets



- Heinrich Hertz (1857-1894)
- James Clark Maxwell (1831-1879) and his equations:

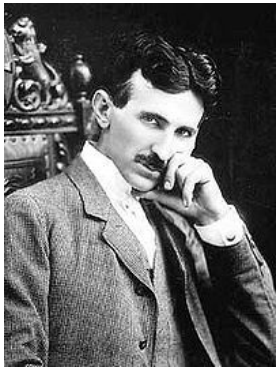


$$\oint \mathbf{E} \cdot d\mathbf{A} = q / \varepsilon_0$$

$$\oint \mathbf{B} \cdot d\mathbf{A} = 0$$

$$\oint \mathbf{E} \cdot d\mathbf{S} = -d\Phi_B / dt$$

$$\oint \mathbf{B} \cdot d\mathbf{S} = \mu_0 i + \mu_0 \varepsilon_0 d\Phi_E / dt$$



  - An uneasy answer to a nagging question
- Practical Applications:
  - The AC /DC (Not the band) debate & dynamos
    - Thomas Edision and Nikola Tesla (1856-1943)
  - Radios (1896), Telegraph (1875), and Telephones (1876)