Initial Remarks

Nature of light? a) Particles  
            b) Wave motion (in which medium it propagates?)

* Ancient Greeks (Empedocles, Euclid, Democritus, ...) already speculated about nature of light, rectilinear propagation, law of reflection, burning glass, etc

* Snell (1580 - 1626) experimentally discovered the law of refraction

* Late 1500's & early 1600's:  
  - Refracting telescope (Lippershey, Galileo)  
  - Microscope (Janssen, 1588 - 1632)

* Grimaldi (1618 - 1663): presence of light in geometrical shadow

* Newton (1642 - 1727): - while light could be split up into colors  
  - corpuscular theory of light

* Römer (1644 - 1710): estimated speed of light from observations of the eclipses of Jupiter's satellites

* Huygens (1629 - 1695): - secondary waves determine evolution (wave theory of light)  
  - derivation of laws of reflection & refraction  
  - explained double refraction  
  - polarization
* Young (1773 - 1823): - principle of interference
  - presence of colors in thin films
  - light wave as transverse vibration based on experiment made by Arago & Fresnel

* Fresnel (1788 - 1827): - rectilinear propagation and diffraction based on wave theory
  - diffraction caused by several objects
  - amplitude of reflected and transmitted light

* Fizeau (1819 - 1896): terrestrial determination of speed of light

* Maxwell (1831 - 1879): - electricity & magnetism were combined into a system of 4 equations that express the interplay of electric and magnetic phenomena
  - prediction of electromagnetic waves with speed derived from electrical/magnetic properties of the medium (stationary aether)

* Hertz (1857 - 1894): experimental verification of Maxwell’s prediction for EM waves

* Michelson (1852 - 1931): proved impossible to demonstrate the existence of the aether

* Planck (1858 - 1947): - blackbody radiation = discrete amount of energy (hν) exchanged between matter & light
* Einstein (1879 - 1955):
  - special relativity, no need for "aether"
  - photo-electric effect ⇒ light as stream of light - quanta (photon)

* de Broglie (1924): matter also behave as wave

* Schrödinger (1926): wave theory matter (Quantum Mechanics)
  Heisenberg (1925)

* Dirac (1927): quantum theory of radiation

* Schwinger, Feynman, Tomonaga (1947): quantum electrodynamics

* Townes & Schawlow (1958): optical amplification by
  stimulated emission of radiation

* Maiman (1960): invention of laser

* Pekr Franken (1961): second harmonic generation

* Nic Bloembergen (1962): formalism of non-linear
  of light-matter interaction

* Kapron, Kack, Mauer (1970): low-loss (20 dB) glass fiber
* Charles Shank + Eric Ippek (1979): - ultra short laser pulses
  femtosecond = $10^{-15}$ s


  - coherent matter waves (atom lasers)

* Hänsch, Hall (1999): - Frequency comb locking for measuring optical frequencies

* Lene Haas + Steve Harris (1999): - light slowed to bike speed

* and more (today): - metamaterials, negative refractive index,
  cloaking (invisible), super lens
  - photonic crystal materials, supercontinuum generation
Rays Optics: - energy (power) propagation
  (Geometrical Optics) - object, space \( \gg \lambda \)
  - reflection (direction of light prop.)
  - refraction (direction of light prop.)
  - mirrors, lenses, prisms, ...

Wave Optics: - amplitude and phase
  - interference
  - diffraction

Electromagnetic Optics: - \( \vec{E} + \vec{B} \) (electric & magnetic fields)
  - \( c \) = speed of light in vacuum
  - polarization
  - intensities of reflected & refracted light

Quantum Optics: - photons
  - light/matter interaction
  - spectrosopies
  - lasers
  - detectors