

Science and Metaphysics.

Matter.

- I. General concept of the nature of matter up to latter part of 19th century.
 - A. Atomic structure: a distinct and indivisible atom for each element.
 - B. Matter and energy distinct from each other.
 - C. Matter possessed mass but energy did not.
 1. Mass or inertia the prime characteristic of matter.
 - D. Conservation of Matter and of Energy.
- II. Discovery of radio-activity.
 - A. Here it was demonstrated that the atom of one element could break down and become atoms of other elements.
 1. This phenomenon was spontaneous, and man was unable to increase or retard rate.
- III. Discovery of the electron. 1897
 - A. The cathode rays of Crooks. Suggested a fourth state of matter
 - B. J.J. Thompsons proof that these rays could be deflected in an electric field; showing that something which looked like light had mass.
 1. Weighing of the electron. $1/1800$ th part of hydrogen atom.
 2. Observing of electron.
 - C. Discovery of the nucleus. Rutherford.
 1. ~~Heavy bombardment by alpha particles knocked H. out of N.~~
 - D. Development of first model of atom.
 1. Nucleus consisting of protons and electrons surrounded by rotating electrons.
 2. Particles at first conceived to be hard pellets.
 3. Model in solar system form.
- IV. Electricity found to be atomic.
 - A. Charges of electricity found to possess mass.
 1. This gave to an energy the distinctive characteristic of matter.
- V. Electrons and protons identified with negative and positive units of electricity.
and protons.
- VI. Electrons shown to give interference phenomenon which is characteristic of a wave system such as light.
 - A. This tied light and matter together.
 - B. Makes the hard-pellet concept of electrons and protons impossible.
- VII. Wave mechanics and principle of indeterminacy.
 - A. Only possible picture a mathematical one.
 - B. Ponderable matter becomes an illusion for the physicist.
- VIII. Composition of nucleus.
 - A. Protons.
 - B. Alpha particles.
 - C. Neutrons. Neutral charge of combined proton and electron.
 - D. Deuterium and tritium; combinations of two and three protons in nucleus of hydrogen.

(Neutron so heavy that lady's
weigh 1,000,000 tons:

With them would
thimble packed

- E. The Positron (positive electron) Discovered by Anderson in Millikan laboratories.
 1. Positive but has only weight of electron.
 2. Its existence predicted from mathematical considerations by Dirac two years previously.
 3. A positron meeting an electron both destroyed as gross matter and become light or photon.
- F. Millikan's theory of composition of nucleus. Built up of neutrons, positrons, and electrons. The proton being a neutron plus electron.
- G. Production of transmutation of matter without using natural radio-activity.
- H. Ordinary chemical substances rendered radio-active through bombardment.
- I. Theoretic physicists make use of other components not yet discovered such as neutrino (neutral electron) in their theoretical constructions.

The most significant fact is that the mathematical theory has so often predicted a component before it was discovered.
