A Brief History of the Atom : Notes - 10

Democritus (470-370 B.C) proposed that all matter was composed of very small, indivisible particles which he called atoms.

Aristotle (384-322 B.C.) supported the theory that all matter was composed of four elements; earth, air, fire and water.

John Dalton (1766-1844) revives the atom concept. The main points of Dalton's atomic theory are given below.

1) Matter is composed of small, indivisible particles called atoms.
2) Atoms of the same element have the same mass and different elements have atoms with different masses.
3) Atoms can combine to form compounds in simple numerical ratios.
4) Atoms cannot be created or destroyed.

Michael Faraday (1791-1867) discovered that some substances when dissolved in water will conduct electricity. He suggested that some atoms were electrically charged. He invented the term "ion".

Svante Arrhenius (1859-1927) suggested that ions were atoms carrying a positive or negative charge.

Sir William Crookes (in 1875) studied cathode rays using his "Crookes tube". This was a vacuum tube with two electrodes inside which were attached to a high voltage source. The rays were emitted by the cathode. They traveled in straight lines and could be blocked easily. They were also deflected by a magnetic field. He assumed that they were negatively charged particles. The Crookes tube was later called a cathode ray tube or CRT.

Joseph John Thomson (or Lord Kelvin, 1856-1940) using a CRT, showed that cathode rays were composed of small negatively charged particles that he assumed were a basic component of all matter. This particle was called the electron. Thomson later found that in a cathode ray tube with hydrogen gas at a low pressure, positive particles (H^+ ions) moved toward the cathode. He found the e/m ratio or the charge to mass ratio for both the electron and the hydrogen ion. Thomson assumed that the atom was like a "raisin muffin". That is, small

negatively charged electrons were embedded in a positively charged sphere.

Robert Milliken (in 1909) showed using his oil drop experiment, that electrons had a charge of 1.6×10^{-19} coulombs. The mass of the electron was found to be 9.11×10^{-28} grams using the e/m ratio that was found by Thomson. The hydrogen ion was found to be about 1837 times heavier than the electron. We now know that the hydrogen ion is the proton.

Henri Becquerel (in 1896) discovered radioactivity. Radioactivity occurs when an unstable atom ejects alpha particles (He nuclei), beta particles (fast electrons), or gamma rays (highly penetrating electromagnetic waves). Both alpha and beta particles can be deflected by a magnetic field. Gamma rays are not affected by a magnetic field.

Ernest Rutherford (1871-1937) used (positively charged) alpha particles to bombard gold foil. He showed that some alpha particles were deflected backwards. Most went straight through the foil. This showed that gold atoms were mostly empty space with most of the mass of the gold atom concentrated in a heavy positively charged nucleus. The light electrons were assumed to form an electron cloud outside of the nucleus.

Niels Bohr (1885-1962) modified Rutherford's theory after studying the spectra (emitted light) of hydrogen. He concluded that electrons move around the nucleus in specific orbits just as the planets orbit the sun.

James Chadwick (in 1932) proved the existence of the neutron. His work was based on the work of Irene Joliot-Curie who bombarded beryllium with alpha particles. The beam produced was shown to be made of neutral particles (neutrons) with the same mass as protons. Rutherford and others had predicted its existence earlier. (proton mass = neutron mass = 1.67×10^{-27} kg = 1.0 A.M.U.)