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Geochemical Society - Goldschmidt Medal Lecture
From particles to Pleiads

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On the occasion of the 200th anniversary of the formulation of atomic theory by John Dalton, I would like to pay homage to him and to the many others who played key roles in the history of isotopes and the development of isotope geochemistry. These men and women had breakthrough ideas, made revolutionary discoveries that were sometimes serendipitous, and displayed amazing fortitude and courage to challenge accepted scientific dogma of the times. The story also contains negative elements of national and personal pride, jealousy, disputes over priority of discovery, and the influence of wars and political upheavals on their science.

During the years 1803-1805, in lectures and publications, Dalton laid the foundations of modern chemistry with five postulates of which only one no longer has validity:

Atoms of the same element are similar to one another and equal in weight.

About ten years later, William Prout proposed that atoms of the different elements are aggregates of hydrogen atoms. According to this view, if all atoms of a given element have the same weight as suggested by Dalton, the atomic weights and combining ratios of all elements must be whole numbers. The results of subsequent careful experiments by a number of able chemists showed that it was impossible to express the atomic weights of all elements as whole numbers. In due course, Prout's hypothesis was abandoned. If only he had known about neutrons!

For almost 100 years, chemists could not distinguish between the two alternative explanations for the existence of fractional atomic weights:

(1) All elements are composed of atoms of identical weight, but the weights of certain elements are fractional.
(2) Elements with non-integer atomic weights are mixtures of atoms of different weights.

It is almost inconceivable to us today that the second view seems not to have been seriously considered by thoughtful chemists of the 19th century. But, without the requisite information about the true nature of atoms, such decisions were impossible to make. In fact there were more serious matters to resolve because the discipline of chemistry was in a sorry state during those years. Paul Schutzenberger and William Crookes are sometimes credited with early prescient acceptance of the existence of what we now call isotopes, but with the discovery of radioactivity in 1896 and the development of positive ray analysis shortly thereafter, this concept developed logically.

I shall review this history with anecdotes about the early scientists who paved the way for the development of radiation chemistry, isotope chemistry, and our own discipline of isotope geochemistry.