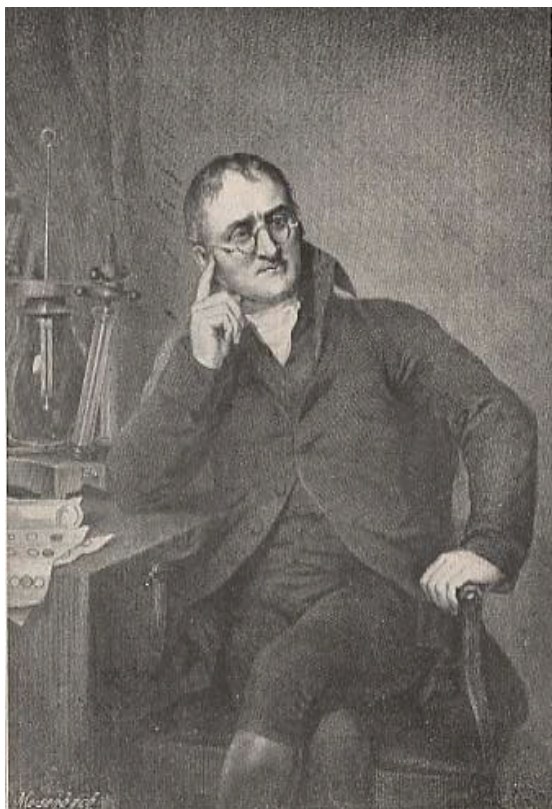


John Dalton (1766-1844): A New Atomic Theory

What is the difference between one element and another? John Dalton formulated a new atomic theory to explain chemical reactions, based on the concept that each element consists of its own unique brand of indivisible atom. Atoms of one element would all be alike but they would differ from atoms of other elements. In particular, he assigned atomic weights to the atoms of the twenty elements he knew of at the time. The Museum's collections include his surviving apparatus and personal items, which were previously preserved by the Manchester Literary & Philosophical Society and the University of Manchester.

Dalton was a Quaker weaver's son, born in Eaglesfield, Cumberland (now Cumbria). His schoolmaster was Elihu Robinson, who had observed the weather for many years and was a scientific instrument maker. Dalton became Principal at a Quaker school in Kendal, teaching there until 1793. He moved to Manchester to become tutor in natural philosophy and science at the Manchester Academy, a Presbyterian college. However, his teaching duties left him with too little time to pursue his own scientific interests and he became a private tutor, one of his pupils being James Prescott Joule. Dalton joined the Literary & Philosophical Society which was at the centre of the scientific and business community in Manchester. The Society gave him a room for teaching and research at its premises on George Street. He read over 100 papers to the Society and became its Secretary, Vice-President and, ultimately, President.



Inspired by Elihu Robinson, Dalton kept a daily record of the local weather, from his childhood until his death. Edward Schunk attended the Academy and remembered Dalton recording the temperature every day:

'... peering every morning out of his bedroom window...and looking at his thermometer outside, the bulb of which was shaded by a card....'

Dalton had an interest in the atmosphere and thus in mixtures of gases in general. He formulated the Law of Partial Pressures in 1801, according to which the pressure of a mixed gas is the sum of the pressures that each of its components would exert if occupying the same space. He also independently developed the law of the thermal expansion of gases. Henry Roscoe, a later Manchester chemist, suggested that Dalton was trying to explain why the constituents of a gaseous mixture remain homogeneously mixed instead of separating into layers according to their density.

At the end of a paper on the absorption of gases by liquids in 1803, Dalton rather casually set out the first table of atomic weights. Encouraged by the favourable reception this paper received, he developed his theory further, in lectures to the Royal Society in 1803-1804 and, later, in his *New System of Chemical Philosophy*:

"...every particle of water is like every other particle of water; every particle of hydrogen is like every other particle of hydrogen... Chemical analysis and synthesis go no farther than to the separation of particles one from another, and to their reunion. No new creation or destruction of matter is within the reach of chemical agency."

This concept, that atoms of different elements were distinguished by differences in their weights, brought a quantitative edge to studies of elements and opened up new fields of experiment. Each aspect of Dalton's theory has since been amended or refined, but its overall picture remains as the basis of modern chemistry and physics. Dalton also pioneered the use of ball-and-stick models to illustrate the three-dimensional structure of molecules.

In addition to his atomic theory, his law of partial pressures and his meteorological observations, Dalton also developed a theory to explain colour vision deficiency, from which he himself suffered. He suggested that the colour of the fluid in the eyes acted as a filter to certain colours in the spectrum. He left his eyes to be dissected after his death to test this theory; his theory was disproved. In the 1990s, the DNA in his eyes was tested and showed the cause of his colour vision deficiency to be genetic.

John Dalton was widely honoured in his lifetime. He was elected one of the eight foreign associates of the French Academie des Sciences, a Fellow of the Royal Society and their first Royal Medallist. Oxford and Cambridge Universities gave him honorary degrees. The City of Manchester commissioned his statue, which is in the Town Hall. At his death, 40,000 people filed past his coffin and there were 100 carriages in his funeral procession. Dalton is now regarded as a poor experimenter. However, but he had a powerful and vivid pictorial imagination that often gave him profound insights into the nature of atomic phenomena.

For further information:

- Read** Cardwell, Donald S. L. (ed.). *John Dalton and the Progress of Science*. Manchester, UK: Manchester University Press, 1968.
Smyth, A. L. *John Dalton, 1766-1844: a bibliography of works by and about him*. Manchester, UK: Manchester Literary & Philosophical Society, 1997.
- Consult** The John Dalton archive collection at John Rylands University Library, University of Manchester.
- Visit** The Museum's Manchester Science Gallery