

portion as experimental science has taken the place of that purely mathematical treatment which obtained at the beginning of the century, notably in the Continental schools, and which thought it could exhaust the infinite variety of natural phenomena by a few easily defined properties measured by constants. The narrowness of this view has been gradually overcome by the influence of the great experimental philosophers in this country, and the independent development of chemical research abroad. Beside Faraday must be especially named Thomas Graham<sup>1</sup> and Thomas Andrews, whose original experiments did so much to extend and deepen our knowledge of the less obvious properties of matter. Graham carried on, between 1825 and 1850, extensive experiments on the diffusion of liquids and gases, on absorption, and on the phenomena of osmosis or gradual filtering of substances through porous partitions, showing how in liquids motion and pressure exist similar to that which is now

39.  
Graham and  
Andrews.

<sup>1</sup> Thomas Graham (1804 - 69), for many years professor at University College, London, then Master of the Mint, cultivated the unexplored regions of physics and chemistry in an original spirit and yet with very simple apparatus, some of which is still used under his name. His ingenious labours attracted the attention of Liebig, through whose influence was brought about the translation of 'The Elements of Chemistry' into German by Otto. This work in its subsequent enlarged editions has formed for sixty years, next to Gmelin's 'Handbook,' a cornerstone of chemical literature in Germany, where Graham's name is a household word. The discoveries of Graham on the move-

ment and "miscibility" of gases led to the well-known law, "that the diffusion rate of gases is inversely as the square root of their density." From gases he advanced to the more complicated study of liquids, divided bodies into two classes, "crystalloids" and "colloids," studied the "transpiration" of gases through fine tubes, and their "osmosis" or gradual filtering through porous (and many apparently non-porous) partitions. In many directions he anticipated later discoveries and collected invaluable materials for subsequent theories. *Inter alia*, he established the existence of "alcoholates," compounds analogous to "hydrates," and maintained the metallic nature of hydrogen.