agree to date the real birth, not the incubation, of any scientific idea from the moment when it was set forth in definite figures, and with mathematical precision permitting of a precise verification by actual test, the modern theory of gases was born in Manchester in the school of Dalton, when Joule in 1857 actually calculated the velocity with which a particle of hydrogen at ordinary atmospheric pressure and temperature must be moving, assuming that this atmospheric pressure is equilibrated by the rectilinear motion and impact of the supposed particles of the gas on each other and the walls of the containing vessel. This meant taking the atomic view of matter in real earnest, not merely symbolically, as chemists had done. Joule gave up the older and vague ideas of a rotatory or a vibratory motion of the particles of a gas which had been floating about since the time of Hooke[1] in various theories, and adopted the suggestion of Daniel Bernoulli, known to him through Herapath, that all particles of gaseous matter are in a natural state of rectilinear motion, which is changed only by the encounter with other particles or by the walls of the containing vessel on which they impinge, and from which they rebound.[2]

84. Joule's calculations.

Clausius, 'Die mechanische Wärmetheorie' (Braunschweig, 1889-91, p. 2, &c.) See also O. E. Mayer, 'Die kinetische Theorie der Gase' (2nd ed., Breslau, 1895, part i. p. 11).

[1] See Tait, 'Properties of Matter,' 2nd ed., p. 289, also J. P. Joule's Memoir on 'Heat and the Constitution of Elastic Fluids,' 1848, reprinted in 'Scientific Papers,' vol. i. p. 290, &c.

[2] The real proof that the kinetic, in contradistinction to what we may call the Newtonian, view of the motion of the molecules of a gas is the correct one, and that Newtonian (attracting and repelling) forces play only a subordinate, if any, part in the observable phenomena of gaseous bodies, is based upon Joule and Thomson's experiments made in 1853. It belongs to quite a different line of reasoning, neither chemical nor mechanical, but going upon the principle introduced into scientific thought about the middle of the century, that heat and work are convertible terms and equivalent quantities. Now, it was generally assumed, before Joule and Thomson