numerical estimate as between mechanical energy on the one side, and the amount of one of the imponderables—*i.e.*, heat as measured by the thermometer—on the other. Although his methods were not free from objection,[1] while his arguments were mixed up with

Mayer, 1842. His determination is contained in his first paper, published, as was Mohr's, in Liebig's 'Annalen' (vol. xlii., May), with the title "Bemerkungen über die Kräfte der unbelebten Natur." The experiments performed by Rumford in 1798 were made the basis of a calculation of the heat equivalent, *i.e.*, of the weight which can be lifted one foot if the heat required to raise a pound of water 1° be converted into work against gravitation, and the figure turns out to be 1034 lb. as compared with 772 lb. given by Joule himself ('Phil. Trans.,' 1850; 'Joule's Papers,' vol. i. p. 299). The earlier computations of Séguin, based upon the work done by the expansion of steam, were referred to by Joule, Tyndall, and Tait in 1862 and 1864 ('Phil. Mag.,' 4th series, vols. xxiv. and xxviii.), and shown to lead to figures further off the mark than those of Mayer. In the course of this later controversy it became for the first time generally known that A. Colding, an engineer in Copenhagen, had a little later than Mayer (1843), and almost simultaneously with Joule, given a determination of the equivalent based upon friction of metals, which was lower than Mayer's. He accordingly now figures as second in Helm's list. One of Joule's earliest experiments with heat, "evolved by the passage of water through narrow tubes," gave the equivalent as 770, very near the figure, viz., 772, finally settled on as correct in 1850.

[1] The reasoning of Mayer is not completely contained in his first paper, which subsequently, on a suggestion of Joule's appeared in translation in the 'Phil. Mag.' (4th series, vol. xxiv. pp. 123, and 371 *sqq.*) The assumption (called by Thomson in 1851 "Mayer's hypothesis," see 'Math. and Phys. Papers,' vol. i. p. 213) that "the work spent in the compression of a gas . . . is exactly the mechanical equivalent of the . . . heat evolved," which Joule did not think it right to accept without satisfying himself by experiments (see 'Phil. Mag.,' 4th series, vol. xxiv. p. 122), was based by Mayer on an almost forgotten experiment of Gay Lussac's in the year 1807, as is evident from his subsequent paper, published in 1845 (reprint in 'Mechanik der Wärme,' ed. Weyrauch, 1893, p. 53), and still more from his correspondence with Baur previous to his first publication (ibid., p. 20, and 'Mayer's Briefe,' p. 130, September 1841). The subject was exhaustively investigated by Thomson and Joule in a joint-memoir on "the thermal effects of fluids in motion," 1852 (reprinted both in Joule's and Lord Kelvin's Scientific Papers), when it was shown that for air Mayer's hypothesis was approximately, but not absolutely, correct. So long, therefore, as the history of Mayer's reasoning was not completely known, it appeared as if he had by a kind of accident hit upon an approximately correct figure. See Tait, 'Recent Advances' (3rd ed., p. 53; but also Helm, 'Energetik,' p. 24, and Mach, 'Wärmelehre,' p. 249).