

may succeed in doing this consistently seems at present uncertain. It has been maintained that the very elements of all physical measurement, the independence of the three dimensions in space, necessitates us to supplement the energy-conception—which by itself includes no more reference to direction than the conception of mass—by an assumption of a purely mechanical nature such as the number of degrees of freedom, and that the much-discussed correlation of all forms of energy, as it is suggested by W. Gibbs's formulæ, cannot be usefully carried farther. This correlation¹ has been

and Clausius. The latter method grew out of the gradual application of thermo-dynamics to chemical phenomena, where the mechanical treatment had turned out to be powerless. This more ambitious scheme of remodelling the whole of physics, chemistry, and mechanics on the model of the classical thermo-dynamics dates from the year 1887, when Prof. Georg Helm published his first treatise ('Die Lehre von der Energie,' Leipzig) and revived the word "energetics" invented by Rankine. Subsequently he published his application to chemistry ('Grundzüge der mathematischen Chemie,' Leipzig, 1894), very much under the influence of Willard Gibbs's studies of chemical equilibria and Duhem's elaboration of Helmholtz's conception of free energy. His last work ('Die Energetik,' Leipzig, 1898) gives a history of the gradual purification of the energy conception from mechanical admixtures, into which all earlier writers on the subject except Lord Kelvin are shown to have lapsed, and attempts a reconstruction of mechanics on "energetic" principles, defending the author's position

against various criticisms which had meantime been made.

¹ The great generalisation of the science of energetics referred to in the text was first explicitly put forth by Helm in his treatise of 1887. He himself holds that he there finally brought together suggestions made in various ways by Zeuner (1866), Mach (1871), Gibbs (1875), Maxwell (1875), Von Oettingen (1885), and Popper (1884), and expressed them in the form of a general principle. The two factors into which all energy can be separated are called by various subsequent writers intensity, potential level on the one side; extensivity, capacity, weight, on the other. In spite of further expositions of Helm in 1890 the subject did not attract much attention till Prof. Ostwald introduced it in a slightly modified form in the second edition of his great work on physical chemistry (1893), making it the foundation of the doctrine of affinity. He had evidently, between the first and second editions, given up the mechanical for the "energetic" treatment of the subject (see, *inter alia*, note 2, p. 114, of the 2nd edition; vol. ii. p. 12). At the meeting of the German