

underlying unity and correspondence of all natural phenomena, inasmuch as they all depend on the transformation of a quantity, termed energy, which is in many cases measurable in its best-known form—*i.e.*, as energy of motion—and, where this is not possible, in the form of heat.

Helmholtz had already, in 1847, summarily reviewed the whole field, beginning with a restatement of the fundamental formulæ of dynamics in the light of the new principle, and ending with a reference to the transformation of energy in living vegetable and animal organisms. The key to his explanations is to be found in the introduction of a term to denote what becomes of energy if it ceases to exist as energy of motion or as a velocity, when it is changed to energy of mere position. To this end he introduces the idea of stress or tension. The conception is already contained in older books on mechanics as latent force (Carnot),¹ and the purely mathematical treatment of dynamics by Lagrange and Hamilton had prepared the ground by showing how all dynamical problems could be reduced to the knowledge of two quantities, the *vis viva* and the force function.

29.
Helm-
holtz on
"tension."

¹ L. N. M. Carnot (1753-1823), usually termed the great Carnot, father of Sadi Carnot, member of the Directory, War Minister, and one of the most celebrated generals of France, has a name in science through his 'Essai sur les Machines en général' (Dijon, 1784), his 'Principes fondamentaux de l'Équilibre et du Mouvement' (Paris, 1803), as well as through his 'Réflexions sur la Métaphysique du Calcul infinitésimal' (Paris, 1797) and his 'Théorie des Transversales' (Paris, 1806), by which he became, to-

gether with Monge, one of the founders of modern geometry, of which more in a subsequent chapter. He introduced the principle of the 'Corrélation des Figures de Géométrie' (Paris, 1801). His books were translated in Germany, where they had a great influence. On his connection with the history of the conception of energy, see Bohm in 'Phil. Mag.,' iv. 300, vol. xxix.; also Helm, 'Energetik,' p. 13; and the Éloge by Arago of the year 1837.