

It measured chemical reactions by what is termed their heat-toning, *i.e.*, by the amount of heat developed, and culminated in the celebrated third law of thermochemistry—*viz.*, that such reactions take place as are accompanied by the greatest amount of energy liberated in the form of heat. Now, although this contains an adequate description of a very large number of reactions that take place at the temperatures at which we operate in our laboratories, the rule is by no means universal, and it required a great amount of ingenuity to explain away the many exceptions which presented themselves. The rule needed to be modified or amplified. The measurement of the energy of a chemical process by the heat-toning was not the only instance in which the thermal side of a phenomenon had been considered a sufficient means of measuring. In an allied department, that of electrolysis, Helmholtz had suggested, as early as 1847, that the electro-motive force of a galvanic cell may be measured by the heat-toning of the chemical processes which produce the current, and for a long time this was considered to be a correct expression of facts. In consequence, however, of some discrepancies which had presented themselves, Helmholtz himself was induced, about 1881, to examine the subject more thoroughly. He arrived at the conclusion that the heat-toning is not always a correct measure; and at the same time he introduced a more adequate and generally applicable method of measurement. In fact, he arrived at the conception of available or useful energy for processes which take place at constant temperature. To this quantity, which decides in which direction a reaction takes place (tempera-