It was about this time—after experimental research had been carried on for many years by Julius Thomsen and Berthelot, after Horstmann had made a beginning of

second law of thermo-dynamics can be expressed ('Allg. Chemie,' vol. ii. part 2, p. 150). In every case it is simply a question how most conveniently to express and apply the general principle that heat cannot of itself pass from a colder to a hotter body, the principle on which Fourier built his "Théorie de la Chaleur," and which revealed itself as the rationale of the expositions of Carnot when in the middle of the century their hidden truth emerged from the criticisms of William Thomson (Lord Kelvin) and Clausius. Thus already in the different treatment of the same subject there showed itself the twofold tendency which reasoning on physical matters so frequently exhibits—viz., towards physical directness and mathematical elegance; the former leading to practical application, the latter to analytical refinement. Maxwell, in a review of Tait's 'Thermodynamics,' written in 1877 ('Scientific Papers,' vol. ii. p. 666), contrasts the methods of Clausius and Thomson, and Prof. Mach ('Wärmelehre,' 1896, p. 300) has made similar remarks. Of Thomson the former says, "that he does not even consecrate a symbol to denote the entropy, but he was the first to clearly define the intrinsic energy of a body, and to him alone are due the ideas and the definitions of the available energy and the dissipation of energy. . . . He avoids the introduction of quantities which are not capable of experimental measurement." Since these criticisms a great deal has been written to make the second law of thermo-dynamics and the conception of entropy more intelligible. The object here again has been twofold: first, to make the conceptions useful for the practical purpose of perfecting the heat engines (Rankine, Zeuner and his school) and of investigating the conditions of chemical equilibrium (Gibbs, Helmholtz, Duhem); next, to place the second law, which deals with the transformation of energy, on an equally firm foundation with the first law, which deals with the conservation of energy. There is no doubt that the principle of the conservation of energy owes a very large part of its intelligibility to the fact that for purely mechanical systems it follows from such well-known dynamical axioms as the laws of motion. When heat was conceived to have a mechanical equivalent in mechanical work, the more general principle of the conservation of energy seemed intelligible by mechanical conceptions. The second law, however, introduced a property of natural processes which is not so easily understood mechanically—viz., that they are not reversible—and this property was shown to be connected with a special physical quantity, for which we have a special sense—viz., temperature. The problem of making the second law mechanically intelligible thus coincides with the problem of giving a mechanical definition of temperature. It is not sufficient to call heat a mode (or, more correctly, the energy) of motion; we must express temperature, on the difference of which the usefulness of heat depends, in some way by motion, we must arrive at a