

## THE RIDDLE OF THE UNIVERSE

in constant reciprocal action. It is well known that the optical and electrical phenomena of ether are closely connected with mechanical and chemical changes in ponderable elements; the radiant heat of ether may be directly converted into the mechanical heat of the mass; gravitation is impossible unless the ether effects the mutual attraction of the separated atoms, because we cannot admit the idea of an *actio in distans*. In like manner, the conversion of one form of energy into another, as indicated in the law of the persistence of force, illustrates the constant reciprocity of the two chief types of substance, ether and mass.

The great law of nature, which, under the title of the "law of substance," we put at the head of all physical considerations, was conceived as the law of "the persistence of force" by Robert Meyer, who first formulated it, and Helmholtz, who continued the work. Another German scientist, Friedrich Mohr, of Bonn, had clearly outlined it in its main features ten years earlier (1837). The old idea of *force* was, after a time, differentiated by modern physics from that of *energy*, which was at first synonymous with it. Hence the law is now usually called the "law of the persistence of energy." However, this finer distinction need not enter into the general consideration, to which I must confine myself here, and into the question of the great principle of the "persistence of substance." The interested reader will find a very clear treatment of the question in Tyndall's excellent paper on "The Fundamental Law of Nature," in his *Fragments of Science*. It fully explains the broad significance of this profound cosmic law, and points out its application to the main problems of very different branches of science. We shall confine our attention to the important fact that the "principle of