

and waste (degradation) of energy, have hardly resulted in those practical achievements and improvements<sup>1</sup> which in other departments of applied science, notably in chemistry and electricity, have followed upon new discoveries, the influence of these new conceptions on scientific thought and method themselves has been enormous. Next to the conceptions introduced by Darwin into the descriptive sciences, no scientific ideas have reacted so powerfully on general thought as the ideas of energy. A new vocabulary had to be created; the older text-books, even where they dealt with known subjects in perfectly correct ways, had to be rewritten; well-known and approved theories had to be revised and restated in correcter terms, and problems which had lain dormant for ages to be attacked by newly invented methods. I propose in the rest of this chapter

greatly shaken. . . . There thus arose a rather angry controversy which has been summed up in the question, 'Is it water or iron?' I do not know that this controversy has been as yet completely decided." See also Peabody, 'Thermodynamics of the Steam-Engine,' 4th ed., New York, 1900, p. 301 *sqq.*

<sup>1</sup> This explains how it comes about that theoretical thermodynamics is still regarded with suspicion, not to say aversion, by many engineers of the old school, whose knowledge is principally based upon experience derived from the steam-engine. The first theoretical treatment of the steam-engine by Rankine in England, and Zeuner in Germany, exhibited such enormous discrepancies between theory and practice; the simplifying assumptions which were introduced in order to make

the behaviour of steam in the cylinder at all calculable were so far wide of the mark,—that a general consensus seems to prevail among theoretical engineers that progress depends less upon an immediate application of thermodynamic principles, than upon a careful analysis—guided by theory—of elaborate tests upon the various types of engines now in use. Such experiments are accordingly—following the example of Hirn—being carried out in many scientific establishments in this country, on the Continent of Europe, and notably in the United States of America, and are elaborately recorded in many modern publications. See Peabody, 'Thermodynamics of the Steam-Engine,' 4th ed., preface, and chaps. xiii. and xiv.; Ewing, 'The Steam-Engine,' 1894, p. 31.