

**THE DEVELOPMENT OF THE  
PHILOSOPHY OF  
THE STEAM-ENGINE:  
AN HISTORICAL SKETCH**

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The Development of the Philosophy of the Steam-engine: An Historical Sketch by Robert H. Thurston

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**ROBERT H. THURSTON**

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An Historical Sketch

BY  
ROBERT H. THURSTON. 1839 - 19

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## INTRODUCTION.

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THE following sketch of the development of the philosophy of the modern steam-engine, and of the various heat-engines embodying the same principles, was originally prepared by the Author in the year 1833-4, and was presented to the British Association for Advancement of Science, when holding their session of 1834 on this side the Atlantic, at Montreal. The paper was given a very favorable place, and was later selected for incorporation, in full, in the transactions of that year. It has now been revised, and with slight modifications, and with the additional matter of the last page or two, is now reprinted for more general circulation. The present seems a very appropriate time for the publication of this sketch in a more permanent and more accessible form. It cannot be said that the theory of the steam-engine is yet in its final and complete, its most perfect and most

practically available, form. Its final shape must probably be given it by some such master of mathematical and physical science as was Rankine, or such as was Clausius; but the main principles and the essential facts of a complete theory are unquestionably now well determined and well recognized by the most advanced thinkers and most intelligent practitioners, and are in various ways presented by the recognized authorities among later writers. It is at least practicable, to-day, whenever a design is to be prepared, to compute from known and well-established data the probable wastes of the engine and its efficiency under prescribed conditions, and with such accuracy that no serious apprehension need be felt by the designing engineer in regard to the ultimate outcome of his venture financially and commercially. It is always the commercial aspect of the case that most concerns him. The method of Professor Marks may be adopted in computing the heat-transfer and consequent waste within the engine, for all cases of similar character to those for which the data were taken by him, and probably for a much wider range of conditions.\*

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\* *Relative Proportions of the Steam-engine*; Phil. 1838.



The method of computation of efficiency of engine and of fuel and steam consumption adopted by Mr. Buel is another illustration of a complete and practical system of treating familiar cases when, as in those taken by him, the data may be assumed fairly well established for such engine.\* The Author has elsewhere shown how the several efficiencies of the engine, including the commercial problems, may be treated to secure practically available results, and it is thus evident that the engineer has to-day all the elements previously lacking of a valuable and satisfactory system of engine designing. †

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\* American Machinist, 1888.

† The Several Efficiencies of the Steam-engine, Trans. Am. Soc. M. E., 1882; Jour. Frank. Inst., 1882.

DEVELOPMENT OF THE THEORY OF  
THE STEAM-ENGINE AND ITS AP-  
PLICATIONS.\*

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A COMPLETE history of the development of the Theory of the Steam-engine would include, first, the history of the Mechanical Theory of Heat; secondly, the history of the Science of Thermodynamics, which has been the outgrowth of that theory; third, the history of the application of the science of heat-transformation to the case of the Steam-engine; and, fourthly, an account of the completion of the Theory of the Steam and other Heat Engines by the introduction of the theory of losses by the more or less avoidable forms of waste, as distinguished from those necessary and unavoidable wastes indicated by the pure theory of

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\* Read, with slight modifications, at the Montreal Meeting (1884) of the British Association for Advancement of Science.

thermodynamics. The first and second of these divisions are treated of in works on thermodynamics, and in treatises on physics. The third division is briefly considered, and usually very incompletely, in treatises on the steam-engine; while the last is of too recent development to be the subject of complete treatment, as yet, in any existing works. The principal object of the present sketch is simply to collect into a condensed form, and in proper relations, these several branches of the subject, leaving for another time and place that more full and complete account which might, did opportunity offer, be prepared to-day.

The "Mechanical Theory of Heat," as is now well understood, existed, as a speculation, from the days of the earliest philosophies. The contest which raged with such intensity, and sometimes acrimony, among speculative men of science, during the last century, was merely a repetition of struggles of which we find evidences, at intervals, throughout the whole period of recorded history. The closing period of this, which proved to be an important revolution in science, marked the beginning of the nineteenth century. It was inaugurated by the introduction of experimental investigation directed