professional and private life, those brought into contact with him found themselves, at the close of their however forceful relations with him, imbued with a kindly and affectionate sentiment, and often became warm and strong friends.

He was a member of many scientific, technical and professional associations, at home and abroad, and his death leaves a vacancy in many ways very difficult to fill, particularly, in the position which he for a generation held as an educator of the youth of his profession.

R. H. THURSTON.

SCIENTIFIC BOOKS.

Thermodynamics of Heat-engines. By SIDNEY A. REEVE, Professor of Steam Engineering at the Worcester Polytechnic Institute. New York and London, The Macmillan Company. 1903. 12mo. Pp. 304; figs. 58; steam tables, etc.

This little book, by the author of 'The Entropy-Temperature Analysis of Steam-Engine Efficiencies,' the first formal attempt to introduce this method of analysis to the student of the heat-engines in this country by a native writer, is particularly useful as elaborating that subject still more completely and helpfully. It, however, includes very much more than this. It is an interesting, original and instructive elementary treatise on the thermodynamics of the heat-engines, written by an author who has given, evidently, much patient and illuminating thought to the subject, and who has made himself thoroughly familiar with his work.

Every chapter gives proof of independent thought, and while, unquestionably, many of the modes of expression of fundamental ideas and facts would be differently presented and probably sometimes criticized by one trained in the forms of the great school of Clausiusian writers, every competent critic will probably admit the soundness of the philosophy and the clarity of expression which distinguish the book.

The start is excellent—a page of tabulated notation—and the reader is permitted to begin his task by a comprehension of the language in which it is to be discussed. The symbols are all English. The general principles of energetics are elaborated and illustrated and viewed from various standpoints. The space taken is comparatively large; but the result is not only an understanding of, but familiarity with, the foundations of the science. The language of the 'laws' of energetics and of thermodynamics is sometimes paraphrased in multiple and with gain of understanding if not always in precision. The much-discussed 'Second Law of Thermodynamics' takes the form: 'The entropy of the world tends to a maximum and the temperature to a minimum.' It is, however, pointed out that the law may not hold with accuracy; 'since there is as yet no evidence accumulated which reveals any fixed proportion between the several sorts of energy in the universe,' and no such law can be stated, if it confines itself to a single form of energy, such as heat.

The cycles p–v and θ–ϕ, are described, compared, their uses illustrated and, particularly, their individual characteristics and special utilities exhibited. The illustrative comparison with hydraulic energy-movements is very helpful. Of the new 'Third and Fourth Laws' of energetics and of thermodynamics, it may at least be said that the author states his points correctly. The new laws may not be accepted as formally entered on the statute-book by the scientific jury which always ultimately decides such matters.

In the study of steam- and gas-engines, the two graphical forms of illustration are employed, side by side, and very admirably, in exemplification of the principles and of the operations constituting the thermodynamic case. The reader of the work can hardly fail, if intelligent and thoughtful and a conscientious student, to secure a good idea of the most abstruse points of the subject and ability to make useful applications of the knowledge thus acquired.

The book is a valuable contribution to the literature of applied thermodynamics. The appended steam table is a distinctly important

accession to our data as well as to our outfit of useful tools for work of this kind.

R. H. Thurston.

The Story of Alchemy and the Beginnings of Chemistry. By M. M. Pattison Muir. New York, D. Appleton & Co. 1903. 12mo. Pp. 182. Ill.

The author of this little book, Matthew Moncrieff Pattison Muir, fellow and prælector in chemistry of Gonville and Caius College, Cambridge, is known to the scientific world as joint editor with Dr. Foster Morley of the new edition of Watts' 'Dictionary of Chemistry,' as the translator of Ostwald's 'Solutions,' and as author of several treatises on practical chemistry published in part with the cooperation of others. Besides these valued works he is the author of 'The Story of the Chemical Elements' (London, 1896), as well as of 'The Alchemical Essence and the Chemical Element' (London, 1894). In the latter Professor Muir showed the weakness of the pseudo-science of alchemy in the attempts of its advocates to explain natural facts by wit and reason, before they had ascertained what the facts were that required explanation, and he contrasted with this useless undertaking the well-grounded, suggestive and rational methods of modern chemistry.

In 'The Story of Alchemy' the author expands and elaborates this view of alchemy and points out that it regarded nature by emotional methods, and that they resulted in baseless speculations; the alchemist 'began the study of nature with introspection, and spins his universe from his own ideas of order, symmetry and simplicity, as the spider spins her web from her own substance.' One of the characteristic features of alchemical doctrine was a commingling of ethical and physical ideas; the alchemists attributed to natural things moral virtues and even vices, and remains of this survive in many expressions still in use, such as 'noble and base metals,' 'imperfect gases,' and 'good and bad conductors of electricity.' These are Muir's examples, but the reviewer suggests that in some of these cases the adjectives 'good and bad' signify 'successful and unsatisfactory' (or terms analogous thereto) without any idea of imputing moral qualities.

The transmutation of metals was a natural adjunct of alchemical theory, and was based in part on observation of nature's methods, but erroneously interpreted; philosophers regarded metals as living things, and since nature strove to bring other living things to a more perfect state, so too the noble metals had been evolved from the ignoble and less valuable ones by Nature herself in the bowels of the earth. Were not gold found in copper mines and silver in lead mines, proofs of this?

Conceptions of an orderly, material universe were so intimately associated with ideas of morality and with religious beliefs, that to disprove the possibility of the great transmutation would have undermined the basis of material things as well as of ethics. Plants are improved by appropriate culture, by loosening and enriching the soil, and by choice of seed; animals are improved by judicious breeding; metals by analogous processes should be helped toward perfection. Metals, the alchemists argued, have bodies, souls and spirits; each has specific bodily form, a metalline soul characteristic of a class, and a spirit, or inner immaterial potency, the very essence of all metals. They asserted that there is present in all things One Thing, the Primal Element, and the final aim of alchemy was to obtain this primal element, the soul of all things, so purified from all admixture of 'elements' and 'principles' as to make it available for any transmutation. To secure this essence required patient, prolonged study in the laboratory, and the quest was fraught with peril.

After stating that the words 'element' and 'transmutation' did not mean to the alchemist what they signify at the present time, the author remarks that our present knowledge makes such a change as lead into silver unthinkable, yet facts *may* be discovered which will make possible the separation from lead of things unlike itself, from which silver may be produced by the combination of some of these constituents.

The alchemical quest of the primal matter still goes on, but modern chemistry conducts it in a more rational manner; considerations