of forces are passed in quick review: 1. An ordinary magnetic force due to the presence of permanent magnetism. 2. Ordinary electrostatic force due to the presence of electrostatic charges. 3. Electromagnetic force consisting of four distinct components. One component is the electromagnetic action of the field upon conduction currents. The second component is the electromagnetic action of the field upon the displacement currents. The third component corresponds to the electromagnetic action of the field upon the currents observed by Rowland and Roentgen. The fourth type of force is that between a variable current and the electrical reactions set up in the field by its variation. All these forces except the last have been observed experimentally. The last one is too feeble to be detected by any of the known experimental methods.

The work is, unfortunately, marred by quite a number of typographical errors. Some of them occur in the midst of important and rather difficult mathematical operations and will undoubtedly be a source of considerable perplexity to the younger students for whom, especially, this work is intended.

The reviewer is of the opinion that he will reëcho the sentiment of every lover of the Faraday-Maxwell electromagnetic theory when he states that this, the latest, contribution of the brilliant French mathematician will be a welcome guide to everyone who wishes to keep in close contact with the latest advances of the electromagnetic theory.

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The Steam Engine and Other Heat Engines. By J. A. Ewing, Professor of Mechanism and Applied Mechanics in the University of Cambridge. Cambridge University Press; New York, Macmillan & Co. 1894. 8vo., pp. xiv + 400. Price, $3.75.

Professor Ewing, in his article on the steam engine in the *Encyclopædia Britannica*, gave good measure to his ability and knowledge of the subject by the production of a treatise in which, for the first time, a systematic and fairly complete discussion was attempted of the theory of the real steam engine, as distinguished from the purely Thermodynamic Theory of the Ideal Heat Engine, which only had previously been presented by writers on that wonderful machine. Clark and Hirn and Iserwood had cleverly shown the wide discrepancy between the ideal and the real engine, and Cotterill had discussed with elegance and clearness the extra thermodynamic losses of the machine; but Ewing brought together, for the first time, and in such form as to make his discussion useful, to theorist and 'practical man' and professional engineer alike, in the study of existing engines and in the attempt to improve upon them by scientifically accurate designing and construction. His article was a condensed, but complete, exposition to its date, of scientific and practical knowledge of the methods of economical production of heat in the boiler, and of the economical thermodynamic utilization of the energy thus made available at the engine, with exact accounts of the various methods of waste of thermal and of dynamic energy. Had its author written nothing else, this article would have sufficed to give him a full share of fame.

His new treatise on the steam engine, now issued in book form, is based upon his earlier discussion, but is entirely rewritten to give it a shape better adapted to its present purpose, and to permit the introduction of new matter. "The endeavor has been, throughout, to make evident the bearing of theory on practical issues." Some space is devoted to experimental work and the discussion of facts and data revealed by it. In so condensed a work it would have been impossible to introduce as complete a study of pure thermodynamics as may be found in

Wood or Peabody, as full treatment of the extra-thermodynamic wastes as in Cotterill, or of experimental methods as in Carpenter; but the book exhibits much of that rarest of talents, ability to condense, and, for an abridged work, maintains an extraordinarily high standard of scientific quality. The discussion of the 'entropy-temperature' diagram of Professor J. Willard Gibbs, which is only now, after many years, finding its place in the treatment of the heat motors, is the fullest and most satisfactory yet produced, not even excepting the work of its first trans-Atlantic advocate, Mr. J. Macfarlane Gray. This method of graphical treatment is gradually finding its place, and a very useful one, in the discussion of thermodynamic machines. Following Wood and Peabody, and later writers, this author has adopted, in all his own computations, the value, 778, for the thermodynamic equivalent obtained by Rowland. It may probably be safely asserted that this value is now universally accepted.

The unavoidable brevity with which all topics are treated in so small a space gives the reader occasion, frequently, to wish that the volume had been doubled in size, and fuller discussion and more of result thus secured; but the book takes its place, among the many other treatises on the steam engine, as meeting a need that is being continually felt more and more by engineers, and which is not as well supplied by any other of the existing abridged discussions of the theory of the machine. It is well up to date in its practical aspects, as well as in the van on its purely scientific side.

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An Introduction to Chemical Analysis for Beginners.—From the Sixth German Edition of DR. FR. RUDORFF.—Translated by CHAS. B. GIBSON and F. MENZEL.—Chicago, The W. J. Keener Co. 8 vo., 96 pp. Price $1.00

This book is divided into two parts: Part I, Reactions; and Part II, Systematic Course of Qualitative Analysis. Metallic copper is the first substance examined, and then follow copper, zinc, zinc chloride, manganous sulphate, iron, lead, etc., in the order named. A careful examination of this part fails to detect any great novelty either of matter or arrangement. In Part II the metals are grouped under the familiar group reagents except that lead, mercury and silver are placed along with those precipitated by hydrogen sulfid and not, as is usual, separated under hydrochloric acid as group reagent. The scheme of analysis is well conceived, but offers little of novelty. The explanations and notes have been carefully adjusted to meet the needs of the student and are a valuable feature. The translation is, however, a very slovenly piece of work, and the nomenclature is especially bad. For example, on page 72, we find 'ammonic' sulfid written Am_2S, and lower down we have NH_4OH. Why the authors deny to bismuth cobalt and nickel the ic terminations which they give to nearly all the other metallic salts is not apparent. Several very awkward sentences occur. For example, in the introduction, "We have made a few additions calculated to assist the medical and dental student who suffers mainly the disadvantage of being unable to devote but a small part of his time to chemical studies."

The mechanical execution of the book is pretty good. There is no index.

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NOTES AND NEWS.

PALEOBOTANY.

A LARGE collection of fossil plants made by Professor W. P. Jenny in the Cretaceous rim of the Black Hills during the past field season has just been opened at the National Museum and proves to be of the highest interest to paleontology. It was made under