

silver, nickel, iron, tin, zinc, platinum, brass, bronze, etc. The chapter on the cost of electrolytic copper refining will appeal to many who are now conducting experiments on this and other metals for commercial purposes.

Thoroughness in detail and exactness in statement of procedure characterize the book. It will prove most helpful to all who use the current for the purposes it so exhaustively treats.

EDGAR F. SMITH.

HIGHER MATHEMATICS FOR STUDENTS OF CHEMISTRY AND PHYSICS, with special reference to practical work. BY J. W. MELLOR, D.Sc., of Owens College, Manchester, England. Longmans, Green & Co. 1902. xxi + 543 pp. Price, \$4.00.

To any one who has followed the latest development of theoretical chemistry, it is clear that the chemist of the future must be also a practical mathematician. The recent successive appearance of several volumes having as one object the application of mathematics to the scientific development of chemistry shows the general recognition of this condition.

Among all these books, none seems to the reviewer more complete or adequate than that at present under discussion. The importance of a concrete conception of mathematical expression is fully realized and continually exemplified, and the arrangement is progressive and logical. "The student of this work is supposed to possess a working knowledge of elementary algebra so far as to be able to solve a set of simple simultaneous equations, and to know the meaning of a few trigonometrical formulas."¹ This scanty foundation is gradually amplified and built upon until the student should find himself a master of practical calculus, and capable of integrating differential equations derived from his own experimentation. Analytical Geometry, Functions with Singular Properties, Hyperbolic Functions, Fourier's Theorem, Determinants, and the Theory of Errors all receive extended discussion. The last-mentioned subject is treated in a particularly lucid and just manner, with especial emphasis upon its limitations, which are too often ignored. At the end of the book are given a collection of useful formulas and tables of reference, including a table of natural logarithms. No space is given to vector analysis, but most chemists will not be troubled

¹ Prologue, p. xx.

by this omission. The emphasis throughout is laid upon that which is practically useful, and the usefulness is illustrated by actual problems taken chiefly from the modern literature of physical chemistry. In general, the book leaves little to be desired, and can be warmly recommended to the many who are in search of a guide more practical than the usual formal treatise upon pure advanced mathematics. THEODORE W. RICHARDS.

TEXT-BOOK OF ELECTROCHEMISTRY. BY SVANTE ARRHENIUS, Professor at the University of Stockholm. Translated by JOHN MCCRAE, PH.D. New York: Longmans, Green & Co. 1902. xi + 344 pp.

The first chapter deals very briefly with the many fundamental conceptions, definitions, etc., necessary to a study of the subject; but the arrangement of this matter could be improved. Polarization is here the first topic touched, and it would seem more logical to let this follow the definitions of atomic weight, of temperature, electrolysis, and other such matters, some of which in fact need not be defined in a book on electrochemistry.

The second chapter is a brief one on the early history of the subject, in which much more space is devoted to the Grotthus theory than to Faraday's facts.

The third chapter covers in a concise and clear manner the laws of gases and of their application in the case of solutions. It has, however, not been shown that van't Hoff's generalization of the gas laws to solutions applies to "all finely dispersed material." Suspensions, at least, may form an exception.

The subject of properties of solutions is then fully treated. Two pages devoted entirely to valency and entitled "Review of Results Obtained," do not seem of use.

The subject of chemical equilibrium is well treated in Chapter VI.

Following the unfortunate lead of Ostwald and of Nernst, Arrhenius considers that the identical light absorption of the various equally dilute permanganate salt solutions is proof of the dissociation theory, and leaves the reader to assume that the color of the ions is a splendid support of the theory. Any one who looks into this point carefully will find it very complicated. The depth of color of salt solutions of colored ions does not change, as does the electrolytic dissociation, with the dilution. In illustrating the