are busy in clearing up obscure points and extending the field of inquiry.

Now, that this theory has been generally adopted by those whose work puts them in more immediate touch with it, a desire springs up in those whose interests are in more remote connection thereto to get some knowledge of its import and aspect. The author has responded in a most creditable manner to this demand. He gives in clear language the gist of the theory of solution, how it has arisen, and what it is to-day. The treatment and style is as non-mathematical as the nature of the subject permits, but it must be borne in mind that a criterion of the degree of advancement of a branch of science is the possibility of clothing its results in mathematical dress, and he who would keep up with the times must needs acquire at least the elements of higher analysis.

The chapter on analytical chemistry from the standpoint of electrolytic dissociation should be read and digested by every teacher and student of analytical chemistry as well as by every professional analyst; it is law and order introduced into empiricism.

Such a *résumé* is invaluable; it presents in compact and inviting form facts of great importance having a more or less direct bearing upon every branch of chemistry. Its perusal will show that the work of the physical chemists is not so abstruse and barren of practical results as it is too often supposed to be. The book cannot be too strongly recommended.

C. E. LINEBARGER.

THE PRINCIPLES OF MATHEMATICAL CHEMISTRY. THE ENERGETICS OF CHEMICAL PHENOMENA. BY DR. GEORG HELM. Authorized translation from the German by J. LIVINGSTON R. MORGAN, PH.D. Small 8vo. vi + 228 pp. New York: John Wiley & Sons. Price, $1.50.

The impression the reviewer got from reading the original German of this work was that, while the subject-matter was excellent, the treatment was faulty, and he now feels that it is a pity that the translator did not edit rather than merely translate the book. While the author's purpose was "to collect the results, according to the deductive method, of the investigations in the realm of general chemistry," the translator's "desire to spread the knowledge of physical chemistry" would have un-

doubtedly been better fulfilled if more power of editorship had been exercised. The translation, however, has been done very well. One seldom comes across passages where he must think in German while reading English. On the whole, the translation may be reckoned an improvement on the original, especially in mechanical execution.

The book is an application of energetics to the problems of chemistry. The division of energy into intensity and capacity factors is maintained, and generally Ostwald's ideas on energy have been accepted. The book is divided into four parts, treating of energy, entropy, chemical intensity, and degrees of freedom of chemical phenomena, respectively. Naturally, thermodynamics enters largely into the treatment of the first two parts. Of most interest to chemists, however, is the part treating of chemical intensity or affinity. In it we find an application of Gibbs' "Equation Twelve" to the phenomena of osmotic pressure, diffusion, and other topics upon which the modern theory of solution has thrown so much light. Also, Gibbs' "Phase Rule," that competent guide through the labyrinth of chemical equilibria, is well, although briefly, taken up by the author.

In certain points the translation is open to criticism. Thus, the numbers of reacting molecules in a system of reacting numbers (called by the translator "exchange numbers" probably as a close translation of *Umsatzzahlen*) which the author, following the initiative of Planck, denotes by the Greek letters $\nu_1, \nu_2, \nu_3, \ldots$, the translator writes $v_1, v_2, v_3, \ldots$, throughout; this is to be regretted as tending to cause confusion, inasmuch as v generally designates volume.

Also, the translation reads (p. 74) "third principle of thermodynamics" where *thermochemistry* is meant.

Furthermore, a word might be said in regard to the use of the words *speed* and *velocity*. While they both express the time-rate of change of position, velocity has the additional notion of direction; velocity is directed speed. A chemical reaction considered with reference to time is not a directed quantity or *vector*; consequently, we should speak of the speed and not the velocity of a chemical reaction.

While the book does not require very much mathematical

knowledge on the part of the reader, it presupposes that he has a not inconsiderable acquaintance with the facts and laws of physical chemistry. To those up in this particular the book will be of service from its unity of arrangement and broadness of treatment. C. E. LINEBARGER.

ELECTRIC SMELTING AND REFINING, BEING THE SECOND EDITION OF ELECTRO-METALLURGIE. By DR. W. BORCHERS, translated, with additions, by WALTER G. MCMILLAN. London: Charles Griffin & Co., Ltd.; Philadelphia: J. B. Lippincott Co. 1897. xx + 416 pp. Price $6.50.

This book treats of the extraction and refining of metals by the electric current and includes the electrolysis of aqueous solutions as well as electric smelting proper, but not electrolytic analysis, electroplating, or electrotyping. The introduction describes concisely the modern theory of migration of ions, with references to larger works, the translator adding some wise remarks upon the cost of electrometallurgical works. Additions by the translator supplement and broaden the work of the author throughout the book.

The following metals are treated: Magnesium, lithium, beryllium, sodium, potassium, calcium, strontium, barium, aluminum, cerium, lanthanum, didymium, copper, silver, gold, zinc, cadmium, mercury, tin, lead, bismuth, antimony, chromium, molybdenum, tungsten, uranium, manganese, iron, nickel, cobalt, and the platinum group. In considering each metal there is a good description of the properties of the metal, its natural occurrence, and, for comparison, a brief description of the ordinary methods of its extraction. Then follows a description of the attempts to use the current in the production and manipulation of the metal.

In general this history is remarkably full and complete, but with a few notable exceptions. Much purely experimental work is described, together with many impracticable propositions. The record of these, however, is valuable, particularly for shaping future investigations. The author quotes freely from original sources, with abundant references, and discusses the important propositions. He adds many valuable points from his own extensive and ingenious experience. He forgets, however, like a vast majority of people, that a patent is a crea-