they were analyzed and 43.7% of titanium dioxide and 68.3% of alcohol were found. There can be no question that these data indicate that the crystals consisted of a mixture of approximately 75% of $TiO(OC_2H_5)_2$ and 25% of $Ti_2O(OC_2H_5)_6$. The calculated percentages for $Ti_2O(OC_2H_5)_6$ are TiO_2 41.9%, alcohol 72.2%; for $TiO(OC_2H_5)_2$, TiO_2 51.9%, alcohol 59.7%; and for $TiOH(OC_2H_5)_3$, TiO_2 40.0%, alcohol 68.9%.

Tetra-ethyl titanate was obtained upon the distillation of the mother liquor from which the last crop of crystals was obtained. When Demarçay's method was applied to the preparation of butyl titanate even more unsatisfactory results were obtained than with ethyl titanate.

Summary

1. The tetramethyl, -ethyl, -*iso*propyl and *N*-butyl esters of titanic acid have been prepared in various ways and their properties described. All may be distilled and all are colorless liquids with the exception of the first, which is a white solid.

2. The substance described by Demarçay as tetra-ethyl titanate has been shown to be one of a series of oxy and hydroxy esters of titanic acid.

3. An example of a quantitative alcoholysis has been given in the conversion of ethyl titanate to methyl titanate.

MADISON, WISCONSIN

NEW BOOKS

The Chemistry Tangle Unravelled, being chemistry systematized on a new plan based on the works of Abegg, Kossel, and Langmuir. By FRANCIS W. GRAY, M.A., D.Sc., Senior Lecturer in Chemistry, Aberdeen University. Longmans, Green and Company, 55 Fifth Avenue, New York; 39 Paternoster Row, London, E. C. 4; Toronto; Bombay, Calcutta and Madras; 1923. x + 148 pp. 2 figs. 19 × 12.5 cm. Price $2.00 net.

This surprising book is much better than its unfortunate title, reminiscent of a medieval alchemical treatise, would indicate. It represents a bold attempt to apply the ideas of Abegg, Kossel, Lewis and Langmuir to the whole field of inorganic chemistry, and there is no question but what these new ideas, particularly because of the fresh and deeper significance which they give to the periodic table, promise a much closer and more illuminating correlation of the properties and behaviors of the various elements and their compounds.

Naturally, a book which attempts so sweeping an application of new and still controversial ideas, presents many opportunities for criticism. Thus, it is unfortunate at this stage of the development of the subject to mention and adopt only the Langmuir hypothesis as to the structure of the outer shells of atoms. What little pertinent evidence we have, and particularly that concerned with the positions of the rare elements in the periodic table, seems to support the hypothesis of Bury and of Bohr rather than that of Langmuir. It is also unfortunate that the author does not adhere consistently to the postulate of "negative" hydrogen,

and thus avoid his very evident difficulties with the hydrides of the more "positive" elements. Again his insistence on the significance of "equivalentials," that is, the lines connecting elements 8, 18, 18, and 32 numbers apart in the new form of the periodic table, is misleading, for it implies a similarity of structure of the inner shells which our best evidence today contradicts. Finally, the author is somewhat lenient in accepting chemical evidence as confirmatory of his doctrines. Thus, his statements that sulfur is liberated at the cathode in concentrated sulfuric acid by a primary discharge of sulfur ions, and that magnesium chloride exhibits no hydrolysis, are certainly questionable.

Everyone interested in the modern theories of the structure of matter, and particularly all teachers of inorganic chemistry, will find this a useful and suggestive book. The reader will perhaps feel that the author is carried away to some extent by his enthusiasm and is more certain of his explanations and generalizations than his facts warrant, but he will nevertheless be impressed with the power and fertility of the new ideas.

ARTHUR B. LAMB

Grundzüge der Angewandten Elektrochemie. Vol. I. Elektrochemie der Lösungen (Outline of Applied Electrochemistry. Electrochemistry of Solutions). By Dr. GEORG GRUBE, O. Professor und Vorstand des Laboratoriums für Physikalische Chemie an der Technischen Hochschule zu Stuttgart. Theodor Steinkopff, Dresden und Leipzig, 1922. xii + 268 pp. 67 figs. 23.5 × 16 cm.

This textbook of Electrochemistry is substantially a brief résumé of Foerster's Electrochemistry of Aqueous Solutions which, though unexcelled as a reference book, is much too long and detailed for many readers. The selection of topics and the method of presentation adopted in this briefer text appear to be excellent, and it should prove to be a useful and indeed valuable textbook, particularly for those who are beginning the study of electrochemistry.

It also will constitute a convenient volume in conjunction with the laboratory manual of Erich Müller, who like the author of this volume was trained in Foerster's laboratory.

ARTHUR B. LAMB

Wavelength Tables for Spectrum Analysis. Compiled by F. TWYMAN. Adam Hilger, Ltd., 75A Camden Road, London, N .W. 1, England, 1923. ix + 106 pp. 2 figs. 22 × 14.5 cm. Price 7s. 6d. 7s. 9d. post free.

This handbook is intended chiefly for the analyst or investigator wishing to make practical use of spectroscopic evidence with the least inconvenience.

In Part I are given definitions of wave length and wave number and methods of reduction to the primary standard adopted by the International Solar Union. Part II contains methods for producing the standard iron

arc and tables of wave lengths of standard iron and neon lines. Part III discusses the work of Hartley, Pollock and Leonard, and de Gramont on the detection of small proportions of various elements by means of the condensed spark, and gives tables of "distinctive" lines and "raies ultimes" as found by these observers. Part IV is devoted to tables of wave lengths for use in determining stellar radial velocities. A bibliography contains 55 references to work by de Gramont, besides 27 others.

In the tables in Part III one finds the usual discrepancies in wave length amounting to nearly one Ångström unit in some cases. This is in part due to different standards adopted. It would have been more convenient if the observations of all the different experimenters could have been reduced to the same scale and arranged in a single table. Nevertheless, the book is likely to be a serviceable laboratory tool.

G. P. BAXTER

Optical Methods in Control and Research Laboratories. By J. N. GOLDSMITH, Ph.D., S. JUDD LEWIS, D.Sc., and F. TWYMAN. Vol. I (Second edition, November, 1922). Spectrum Analysis; Absorption Spectra; Refractometry; Polarimetry. Adam Hilger, Ltd., 75A Camden Road, London, N. W. 1, England. iv + 56 pp. 8 figs. 24.5 × 15.5 cm. Price 1s. 9d.

"The optical methods dealt with in this book are those employing spectroscopes (or spectrographs), spectrophotometers, refractometers, and polarimeters. No detailed descriptions of these instruments or their techniques are included, but in each case references are given to sources of information on these points." (From preface.)

The four sections of the book deal with (I) Metallurgical and Analytical Applications of Spectroscopy, (II) Absorption Spectra and Spectrophotometry, (III) The Refractometer, (IV) The Polarimeter.

Although obviously a form of advertisement by an optical firm, this book should be really useful from a scientific standpoint in suggesting optical methods suitable in various types of laboratory problems. Abundant references are given.

G. P. BAXTER

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Vol. III. By J. W. MELLOR, D.Sc. Longmans, Green and Company, 55 Fifth Avenue, New York; 39 Paternoster Row, London, E. C. 4; Toronto; Bombay, Calcutta and Madras; 1923. x + 927 pp. 70 figs. 25 × 15.5 cm. Price $20.00 net.

Volume III of Mellor's Comprehensive Treatise contains four chapters, Chapter XXI on Copper and its compounds, Chapter XXII on Silver, Chapter XXIII on Gold and Chapter XXIV on the Alkaline Earths. Volumes I and II have previously been reviewed [THIS JOURNAL, **44**, 1836, 2261 (1922)] and an appreciation of Mellor's invaluable book has been recorded. Little can be added to the opinions there expressed. Volume III, like its predecessors, is a mine of information and makes

accessible to its possessor material which has nowhere else been so exhaustively collected; it would be a rash chemist who would proceed on the assumption that his bibliography was complete on any compound of the metals mentioned above, without first having consulted this volume. On the other hand, it would be hard to assign the volume a place in a five-foot shelf on theoretical chemistry, since the 18 pages given to The Flocculation and Deflocculation of Colloidal Solutions and to The Preparation of Colloidal Solutions comprise the only development of a theoretical topic found in the 927 pages of the volume. After all, however, this criticism is merely a reiteration of a disagreement with the title of the book as expressed in the review of the second volume, and does not affect in any way the sterling value of the contents. As a reference book on inorganic chemistry, Volume III will stand with the earlier two volumes—unequalled in their completeness and their clarity, and indispensable to those doing advanced work in that field.

ARTHUR E. HILL

Die Entwicklung der chemischen Technik bis zu den Anfängen der Grossindustrie: ein technologisch-historischer Versuch (The Development of Chemical Technology). By GUSTAV FESTER, Dr. Phil., A. O. Professor an der Universität Frankfurt A. M. Julius Springer, Berlin, 1923. vi + 225 pp. 26 × 17.5 cm. Price $1.50; bound $1.80.

This book gives the best published account of the early history of the chemical industries (including metallurgy and ceramics) from the earliest times to about the beginning of the nineteenth century. It gives a sufficient discussion of political and commercial history and of the development of alchemy to serve as a background for the discussion of the development of chemical technology. The author, so far as possible, has translated the astrological and mystical jargon of the alchemists into modern expressions and terminology, and traces in an interesting way the early discovery and first regular commercial manufacture of most of the important chemical commodities which have a history reaching back into the eighteenth century or before. An overemphasis on Teutonic achievements is not apparent. The book is well printed in Roman type on good paper. It clearly deserves a place in every chemical library. It is to be hoped that the author will write a sequel bringing his account down to date.

GRINNELL JONES