

## BOOK REVIEWS

*THE INDUSTRIAL CHEMISTRY OF THE LANTHANONS, YTTRIUM, THORIUM, AND URANIUM*, by R. J. CALLOW, Pergamon Press 1967, 245 pages, 19 tables, 20 figures, \$9.50 U. S.

This book presents a general account of the industrial chemistry of the lanthanons and also uranium and thorium. The subject is logically introduced with an outline of the historical and general factors leading up to the present state of the technology and then the physical chemistry of the elements is reviewed sufficiently to provide a basis for the outlines of the extraction and purification processes. Considerable attention is given to the techniques for production of lanthanons and thorium from monazite and to the recovery of thorium by solvent extraction from the effluents of the Canadian uranium ore treatment plants and also to the principal processes for the production of uranium chemical concentrates. This is followed by summaries of purification techniques including the classical precipitation and the newer ion exchange and solvent extraction methods to eliminate impurities from primary products of the lanthanon, thorium and uranium processes.

In a text on this subject the section devoted to the separation of individual lanthanons on a commercial scale is of major interest but since uses for all the individual lanthanons have not been fully developed, only the separations of the lanthanons of commercial interest are discussed, with approaches to other problems indicated. Methods of producing the more important lanthanon industrial products and product specifications are described together with many of their ultimate applications. Analytical techniques are briefly touched upon and some attention is given to the legal implications of the processing of radioactive elements such as thorium and uranium.

The author of the book, Mr. R. J. Callow, has had many years of experience in the processing of lanthanons, thorium and uranium, and this is evident in his authoritative coverage of both the classical and newer technologies.

It is unfortunate that the book's publishing deadline apparently antedated some of the latest developments in solvent extraction separation techniques, reducing its value to the practising metallurgist. However, the book is a good reference to anyone seeking general knowledge in the field of lanthanon technology.

HAROLD W. SMITH, P. Eng.

*PAPERS AND PROCEEDINGS OF THE FIFTH GENERAL MEETING, INTERNATIONAL MINERALOGICAL ASSOCIATION*, The Mineralogical Society, London (1968), XV + 350 pages, Hard Cover, \$8.00 U. S.

This volume is devoted largely to the publication of the papers presented in the two symposia "Bonding Forces and Crystal Growth in Minerals" and "Amphiboles and Pyroxenes" given at Cambridge, England in 1966, under the auspices of the International Mineralogical Association. A summary of the general business meeting of the I.M.A., including reports from the various commissions given at that time, is also included.

The papers presented in Symposium I, "Bonding Forces and Crystal Growth in Minerals" cover a wide spectrum of topics. There is only one general paper on chemical bonding (A. S. Povarennykh), the editors having chosen not to include the two special lectures on chemical bonding given by D. W. J. Cruickshank and W. Cochran. Several of the other papers touch on this subject in a somewhat indirect way, K. L. Keester and W. B. White, using optical absorption spectra to evaluate the degree of covalency in manganese minerals, and G. M. Bancroft and R. G. Burns showing how the Mössbauer effect can provide information on bonding in iron silicates.

The topic receiving the most extensive coverage is that of crystal growth. Theoretical aspects of this subject are treated in papers by P. J. Shlichta and by M. Bienfait and R. Kern. Synthesis of diamond and boron nitride crystals is discussed by P. J. Gielisse. Crystal growth in nature is evaluated by studies on quartz (B. Poty), phlogopite (R. Kretz), galena (J. Banfield and A. F. Seager), and dendritic ore mineral assemblages (R. O. Radkevich). The significance of morphology in natural crystals of quartz and pyrite is considered by I. Sunagawa and Y. Endo, and in rutile-type crystals by P. Hartman. A sensitive refractometric method of detecting growth zoning in quartz is described by V. B. Tatarsky and V. F. Chernyshova. J. W. Harris offers an explanation for oriented crystalline inclusions in diamond, and H. Arming and A. Preisinger jointly describe a method for analyzing gaseous inclusions in minerals. Papers on the effect of chemically combined impurities on the cell parameters of quartz (V. A. Frank-Kamenetsky and I. E. Kementsev) and on the fluorescent properties of fluorite (K. Recker, A. Neuhaus and R. Leckebusch) complete the roster of papers on crystal growth. The remaining papers in this symposium are somewhat more remotely related to the general theme, and deal with the evaluation of electron-hole centres by electron paramagnetic resonance (L. V. Bershov and A. S.

Marfunin), and with the determination of OH orientation by infrared spectroscopy (J. Zeman).

Amphiboles get considerably more coverage than pyroxenes in the symposium "Amphiboles and Pyroxenes". Alkali amphiboles receive particularly favoured treatment, with V. I. Kovalenko undertaking a comprehensive review of the composition, properties and paragenesis of the riebeckite-arfvedsonite series, based on 134 chemical analyses, R. Phillips and G. Rowbotham reporting on synthetic richterite and eckermannite, H. Jans and P. de Bethune dealing with the alkali amphibole from the Lueshe carbonatite in the Congo and with the pleochroic peculiarities of the alkali amphiboles in general, and with A. Neuhaus reviewing the properties and nomenclature of cosmochlore. Hastingsitic amphiboles from the Yakutia region of the U.S.S.R. and from Southern Rhodesia are described by D. P. Serdyuchenko and C. M. B. Henderson, respectively. Stability relations of gedrite have been studied by Th. J. Hinrichsen, and of cummingtonite by K. Schürmann, while W. E. Addison and J. H. Sharp devote themselves to the redox behaviour of amosite. The behaviour of amphiboles during metamorphism is considered by B. J. Cahill and by J. Fabries. E. J. W. Whitaker presents a classification scheme for the amphiboles based on triangular diagrams depicting charge-balancing substitutions.

Crystal-field theory is applied by R. G. Burns to a study of the distribution of iron in pyroxenes and amphiboles. J. J. Babkine and co-workers report on the results of magnetic measurements made on pyroxenes and amphiboles.

Only a few papers are devoted entirely to pyroxenes. G. V. Gvakharia reports on the results of chemical and optical studies of monoclinic pyroxenes from effusive rocks of the Georgian S.S.R., V. A. Kirkinskii hypothesizes on possible phase transitions of enstatite in the Earth's mantle, and A. D. Edgar reports on the stability relations of spodumene under high water pressures. I. V. Ginzburg undertakes a comprehensive review of clinopyroxene compositions, in an attempt to rationalize their classification.

The papers in the two symposia represent valuable contributions to mineralogical literature. Unfortunately, the considerable amount of time that has elapsed between the original presentation of this material and its final publication has reduced its value considerably; indeed, some of the contributions have already been published elsewhere, in slightly modified form.

Almost all the papers are published in English, although a few are rendered in French or German. In the latter cases, the papers are provided with English abstracts. Abstracts are also given for some papers

presented at the symposia, but which have not been published in full. The volume is provided with topographical and alphabetical indexes.

E. H. NICKEL

*PROGRESS IN THE SCIENCE AND TECHNOLOGY OF THE RARE EARTHS, Volume 3*, Edited by LEROY EYRING, Published by Pergamon Press Limited.

This is the third in a continuing review series of the research and technology of the rare earths and rare earth compounds. The book consists of eleven reviews by leading workers in each of the several fields included, and covering about a five year period.

The book starts with a selective and comprehensive review concerning the electronic make-up of the component rare earths, and the magnetic characteristics of intermetallic compounds containing the rare earths. This is followed by a section dealing with optical transitions in crystals, and the role the lattice plays in observed intensities. Moeller gives a very complete review of recent work on bonding, structure and the thermodynamic stabilities of complex rare earth species, as well as certain specific complexes. In the fourth chapter, liquid-liquid extraction of the rare earths is described. The use of organo-phosphorous compounds or amines to extract from various aqueous systems is well documented, as well as a short dissertation on chromatography as applied to rare earth separations. Next are two papers dealing with binary and tertiary crystallization systems, incorporating sulphur, selenium, or tellurium with the rare earth, or adding, in addition, alkaline earths or transition metals to form the tertiary system. The preparation and properties of rare earth carbides and nitrides are described next, and deal with properties such as electrical and magnetic resistivity, thermal conductivity and specific heat. Two chapters separately treat the chemical thermodynamics of the oxides and rare earth metals. Some chemistry of reaction of pure rare earth oxides and hydroxides are given in a paper by Brauer. An interesting paper describes the possibilities of refining refractory metals with the rare earths and therefore to improve corrosion resistance, ductility, and other properties. Also the uses of refractory metals, such as tungsten, as materials for crucibles in the rare earth metallurgy are given.

Generally, this is an excellent review, and one which surely must be needed by those who are working in any of the aspects of rare earth technology. However, one possible disadvantage of the book to the unilingual reader is the use of two languages. Nevertheless, the book does provide a very good opportunity of obtaining a broad view of the field as a whole.

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