A piece of this foil, which was swelled (11%) in distilled water, showed strong dilation in dilute acid or alkali and then contracted to its initial length in pure water. This change was isotropic and the linear dilation in 0.01 N HCl and 0.01 N NaOH was 35 and 45%, respectively.

A piece of metal, attached to the one end of a strip made from the foil, was carried up and down reversibly following the pH change of its surrounding medium (Fig. 1).

Its elongation, observed in water and 0.01 N HCl, was proportional to the weight of load (observed range of it was up to about 2,000 times the dry weight of the strip per 1 cm. long).

Further studies are required for a quantitative theoretical treatment of these phenomena and the comparison with muscular contraction, though it is clearly demonstrated that this synthetic amphoteric polypeptide network can contract at its isoelectric region and dilate on both the acidic and alkaline sides.

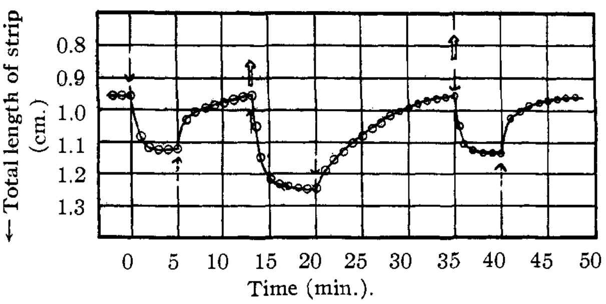

Fig. 1.—Reversible lifting and lowering of a load by a strip of amphoteric polypetide network: weight of dry strip (0.764 × 0.038 × *ca.* 0.003 cm.) 0.065 mg.; weight of load 5.07 mg.; medium 15 ml. 0.005N NaCl; ↓, acid (3 ml. 0.01N HCl) added; ↑, alkali (3 ml. 0.01N NaOH) added; ⇑, 6 ml. medium removed before addition of acid or alkali.

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BOOK REVIEWS

Rocks for Chemists—An Introduction to Petrology for Chemists and Students of Chemistry. By S. JAMES SHAND, Newberry Professor Emeritus of Geology in Columbia University, New York. Pitman Publishing Corporation, 2 West 45th Street, New York 36, N. Y. 1952. xii + 178 pp. 14.5 × 22 cm. Price $4.50.

Solution of the problems of the origin of rocks can come only as experimental work in physics and chemistry is combined with accurate geological field work. Interpretation of field data without the firm foundation of chemical principles properly understood and applied is valueless. One of the chief purposes of *Rocks for Chemists* is the creation of new interest on the part of chemists in the complex problems of the origin of rocks. Since the book is primarily for chemists, one might suppose that it would present important chemical aspects of the origin of all rocks. But this has not been done. More than three-quarters (105 pages) of the short book is devoted to eruptive rocks and their origin. Only 31 pages deal with metamorphic and sedimentary rocks.

A more appropriate title would have been *Eruptive Rocks for Physical Chemists*. Yet the book passes by much of the recent basic work on the physical chemistry of aqueous solutions of rock forming components. Hydrothermal solutions, derived from magmas, are considered in passing only, though these end products of differentiation effect profound changes on the parent and invaded rocks as well as giving rise to most concentrations of metallic ore minerals.

Elsewhere in the field of igneous rock petrology Dr. Shand has presented his own views to the exclusion of other widely held and strongly supported theories with which he does not agree. This is particularly true in his discussion of the origin of granite. Summary dismissal of the ideas of many geologists, who, on the basis of detailed field study, believe in the transformation of certain sedimentary rocks into granites by replacement through ionic diffusion, is hardly justified by the chemical data so far available. More study of ionic diffusion in silicate systems under conditions of high temperature and pressure is necessary.

Dr. Shand claims that sedimentary rocks do not offer as interesting problems as the eruptive rocks. This is the point of view of the igneous rock petrologist. A great number of geologists will disagree. In the pages on sedimentary rocks there is a superficial and even erroneous statement of the chemical aspect of sedimentary rock origin Such statements as "Most limestone begins as a simple accumulation of shells and shell fragments" and "Since no shells are so rich in magnesia as $[CaMg(CO_3)_2]$, dolomite must be formed by exchange of bases between calcium carbonate and the magnesian salts held in solution by sea water" show a disregard for the complexities of carbonate rock origin, which is a field of research for intimate coöperation between chemists, biologists and geologists. With regard to the second statement quoted, some dolomites show clear evidence of having undergone base exchange in the presence of circulating ground water and, more locally, hydrothermal solutions. The use of the term *rock flour* with reference to shales is incorrect.

Chemists would be interested in the extremely complex problems in physical chemistry presented by the metamorphic rocks. In view of the carefully analytical studies recently published about these rocks and their origin, the 20 pages devoted to this topic are neither ample nor searching. Moreover, Dr. Shand, after showing that schists are complex equilibrium assemblages, and pointing out the unique place held by garnet because of the interchangeability of various bivalent and trivalent ions in the crystal lattice, says, in the last paragraph of the book, that "in the metamorphism of any rock which contains the components of garnet, that mineral will be formed in preference to others." In his concluding statement he suggests that, rather than indicating grades of intensities of metamorphism, assemblages of metamorphic minerals simply indicate an excess of certain components over the amount which may be incorporated in garnet. This speculation is not justified in view of much recent, careful field observation which clearly shows that metamorphic zones may be traced with great accuracy across lithologic boundaries.

Rocks for Chemists presents a partial statement of the status of petrology of igneous rocks in the light of selected chemical data. The book fails to present the equally important problems of sedimentary and metamorphic rocks. The narrowness of the views presented does injustice to the complicated variety of problems still unsolved and to many chemically minded geologists who, with the same facts and many others not presented, reach opposing conclusions.

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The Elements of Nuclear Reactor Theory. By SAMUEL GLASSTONE, Consultant, United States Atomic Energy Commission, and MILTON C. EDLUND, Physicist, Oak Ridge National Laboratory. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y. 1952. vii + 416 pp. 16.5 × 23.5 cm. Price, $4.80.

The authors have written a text for physicists and engineers who, for the first time, are taking up the study of nuclear reactor theory. The book is an expansion of the material presented by Dr. Edlund in his course at the Oak Ridge School of Reactor Technology, and presents a more or less complete exposition of the subject which has previously been restricted by secrecy regulations.

The first four chapters give a clear elementary introduction to the broad aspects of nuclear structure and the fission process. The following chapters deal with the complicated aspects of neutron flux and neutron economy under the complex conditions of diffusion, slow down, reflection and capture. The treatment bristles with vector operators, Bessel functions and differential equations. The mathematics, however, are not beyond the capacity of a good engineering student. Much of the theoretical treatment is due to the work of Fermi, Wigner and their associates in the war time Metallurgical Laboratory at Chicago. The authors have had the advice and criticism of Dr. Weinberg, Director of the Oak Ridge Laboratory.

The Atomic Energy Commission is to be commended for making public the general principles of reactor technology. This volume should facilitate the training of "nuclear engineers." It should stimulate the thinking of men, who are outside the governmental programs, with regard to the development of the commercial applications of nuclear energy.

The experts in the field may find minor items in the treatment which are open to criticism, but students will welcome the text for its complete and coherent presentation.

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Gmelins Handbuch der Anorganischen Chemie. Eighth Edition. By E. H. ERICH PIETSCH (editor). Verlag Chemie, G.m.b.H., Weinheim/Bergstrasse, Germany.

System-Nummer 41. Titan. 1951. xxii + 481 pp. 17.5 × 25.5 cm. Price, $27.20.

System-Nummer 3. Sauerstoff. Part 2. 1952. Pages 83–300. 17.5 × 25.5 cm. Price, $15.48.

System-Nummer 17. Arsen. 1952. xv + 475 pp. 17.5 × 25.5 cm. Price, $33.33.

System-Nummer 27. Magnesium. Part A 4. 1952. Pages 483–818. 17.5 × 25.5 cm. Price, $23.81.

The publication of these four volumes of the Gmelin Handbuch constitutes noteworthy progress in the schedule of the Gmelin Institute for completing the Eighth Edition within the next decade. The high standards traditional with this excellent comprehensive and critical compendium of inorganic chemistry have been ably maintained in these additional volumes. The coverage in these volumes is complete up to 1950, making the treatment thoroughly up-to-date. They will be welcomed by all researchers and teachers and the editorial staff are to be congratulated for their admirable work.

System No. 41 gives, in one volume, a complete review of titanium and its compounds. Its appearance at this time of great activity and interest in research and development centering about this metal will be a boon to all workers in the field. The organization of the material is straightforward, the terminology and sentence structure is easily followed, and readers will find it easy to consult. The volume is dedicated to Dr. Roger Adams in acknowledgment of his great help in arranging for support of the rehabilitation of the Gmelin Institute following World War II.

The new volume on oxygen deals with the distribution, properties and behavior of the element, including a detailed treatment of the technology of its production and of the chemistry of ozone. Water and hydrogen peroxide are discussed comprehensively.

System No. 17 on arsenic completely covers this element and its compounds. Besides detailed review of the fundamental information about arsenic, technological applications receive considerable attention. The physiological effects of the element and its compounds are summarized.

The appearance of Part A 4 of the volume on magnesium completes the coverage of this important element. Covering the binary and ternary alloys from Mg–Zn to Mg–Re, as well as the surface treatment of magnesium and magnesium alloys, it summarizes the data in a fashion which makes it of great value as a reference work.

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Theory of Electric Polarisation. By C. J. F. BÖTTCHER, Professor of Physical Chemistry, University of Leyden. Elsevier Publishing Company, 402 Lovett Boulevard, Houston, Texas. 1952. xiii + 492 pp. 17 × 22 cm. Price, $10.00.

The title of this book suggests that its coverage of electric polarization is theoretical only, but such is not the case; the book is well supplied with experimental data in tables and graphs, critically considered in the light of the theories under exposition. There is also a comprehensive list of references to the literature for those who wish to examine the experimental aspects of the subject, which the book covers only most cursorily. The table of contents lists the following subjects: Electric dipoles; Some concepts and problems of electrostatics; The reaction field of a dipole; Multipoles; Polarization and energy; Polar dielectrics in a static or in a low frequency alternating field; Non-polar dielectrics in a static or in a low frequency alternating field; Polarization at optical frequencies; The determination of permanent dipole moments; Polarization at high frequencies; Polarization of solids. Four mathematical appendices and author, subject and chemical name indices are provided.

The book is comprehensive theoretically, although it does not consider quantum mechanical or statistical mechanical aspects of the subject in any detail. The entire electromagnetic spectrum of frequencies at which polarization might be expected is discussed. Related subjects such as microwave spectroscopy, piezo-, and ferro-electricity are briefly mentioned. As a result the book provides (as was the author's expressed intention) a survey of the theory of electric polarization and the fields of its application in a manner suited to theoreticians in other fields, experimental physicists and chemists, and advanced students.

The reviewer judges the book to be suitable for self instruction in the subject. However, in places the book seems to be needlessly mathematical, to the point that the author appears to be showing off his knowledge of vector analysis. The degree to which mathematical comprehensiveness is carried in teaching a subject is a matter of personal opinion, but the reviewer feels that in some ways the mathematics overpowers the polarization.

The book is well made; the binding and the paper are good. In the review copy, at least, there were a number of pages where the clarity of the printing was marred by annoying wisps of ink between or joining certain characters, as if worn linotype matrices had been used.

Böttcher's Theory of Electric Polarisation should be a useful addition to the bookshelf of students or experimental workers who wish to familiarize themselves with the subject.

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