BOOK REVIEWS

Dislocations in Crystals. International Series in Pure and Applied Physics. By W. T. READ, JR., Bell Telephone Laboratories, Murray Hill, New Jersey. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, New York, 1953. xvii + 228 pp. 16.5 × 23.5 cm. Price, $5.00.

The science of solids has been blessed with two new books on dislocation theory during the past year. Both are by outstanding contributors to the field. One, being reviewed here, is by W. T. Read of the Bell Telephone Laboratories, most prominently known otherwise for his contribution to the Frank–Read mechanism of dislocation multiplication. The other is by A. H. Cottrell of the University of Birmingham, responsible among other things for the dislocation-locking theory of the upper yield point in steel. It is highly appropriate that either or both these men should decide to write a book at this time for the field has not been reviewed in such form for nearly a decade. The only substitutes are the reports summarizing the conferences held in Bristol in 1947 and Pittsburgh in 1949, and Nabarro's review article in "Advances in Physics" in 1951.

The book by Cottrell, which bears the title, "Dislocations and Plastic Flow in Crystals" (Oxford University Press), would be somewhat easier to review than the present volume, for it fits into a very well developed pattern. Cottrell's intent is to be as comprehensive as he can within the number of pages he has decided to cover. His book has enormous value because it serves to consolidate the relatively diverse subject, its hundreds of footnote references alone being of importance. Moreover, much attention is paid to historical perspective and to the probable future course of the rapidly developing subject.

Read's book is somewhat more specialized and is, as a result, apt to have slightly more limited interest. It is in a sense a detailed re-working, with extensions, of material close to his own contributions to dislocation theory. The contributions of others are included, in the main, when parallel to or basic to his own. This does not mean that the book will not be exceedingly valuable. Read and Shockley have made some of the most gallant attempts in the last decade to carry out quantitative calculations with arrays of dislocations. Any graduate student who is interested in engaging in this type of research will find the book very useful. For example, he will find analyzed in a simple and detailed way the forces which act upon a dislocation in a region of a solid which is under external stress. He will find a continuous development from such notions to those dealing with the behavior of arrays of dislocations, particularly the arrays associated with a grain boundary on which Read and Shockley have made a fundamental contribution.

One of the characteristic features of the volume, which indicates that the author's goal is the moulding of the young mind, is the inclusion of much of the basic materials in problems of a text-book variety which the reader is expected to work as he goes along. The solving of these problems will aid him in developing proficiency in the handling of the tools and techniques associated with computational aspects of the subject. This procedure, which has great value for the young student, will probably make the book less valuable for the mature research worker in another field who desires to obtain a general picture of the status of dislocation theory.

There is one point of philosophy on which I would like to cross swords with Read. In the introductory chapter, Read states, "What is definitely known about dislocations is distinguished from what is speculated; the latter is given little attention here (it is more than adequately covered in the literature)." Any author has the privilege of limiting his subject matter as he desires. Read has decided to limit his book to areas in which he has made explicit calculations and he has made an excellent contribution within this framework. On the other hand, I do not believe that dislocation theory has yet reached a stage where one can state that the available literature is over-rich in speculation. There is still an enormous number of very fundamental problems concerning dislocations which we understand only dimly, such as those related to the dynamics of motion, those related to the way in which dislocations generate other imperfections such as vacancies and interstitial atoms, and those related to the connection between dislocations and photolysis in the salts. It is possible that one will reach an understanding of these issues through routine calculation of an engineering variety; however, it is far more likely that they will be solved only as a result of ingenious experiments based upon highly speculative notions. It is hardly necessary to point out that our present understanding of dislocations has been derived primarily by this process. When T. A. Read and the writer attempted the first systematic survey of dislocation theory in the American literature in 1940 (*Journal of Applied Physics*), the subject was almost pure speculation. I do not believe it would have reached its present position without such speculation, nor do I believe it will progress further if fairly free speculation is regarded as superfluous from this point onward.

To turn to the contents of the book, in contrast with its philosophy, the volume is divided into two main parts, one dealing with theory and the other with applications. The part on theory, which occupies two-thirds of the volume, starts with a discussion of the contrast between the perfect and the imperfect crystal, viewed from the standpoint of lattice geometry, describes the geometry of dislocations at rest and the change in geometry induced by motion. Next, the effect of applied forces on the motion of dislocations is treated and questions concerning ease of motion of various dislocations are discussed. Following this, the problem of dislocation generation, on which Read has been one of the principal contributors, is reviewed and this is followed by chapters on partial dislocations, the stress field around dislocations and forces between dislocations. In all of this, Read sticks very close to the aspects of the topic which he has worked on personally, or in coöperation with Shockley. For this reason, some of the chapters are much briefer than need be the case. For example, there is no discussion in the sections dealing with forces between dislocations of some of the elegant theorems concerning lines of dislocations lying in the slip plane which were developed by Cottrell, Eshelby, Frank and Nabarro.

The section on applications focuses attention on two major problems, namely, that of crystal growth, where Frank's theory is developed and the cases in which it has been confirmed are discussed, and that dealing with the accumulation of dislocations at grain boundaries, the latter being a problem on which Read and Shockley have made an outstanding definitive contribution.

The book is profusely illustrated with schematic line drawings, which illustrate many of the conceptions presented.

In conclusion, it may be stated that this is a specialized book written to expound the relatively pragmatic view of a single investigator, who has placed emphasis on an important group of problems. Unquestionably it belongs on the shelves of anyone who is interested in undertaking detailed calculations with dislocation models. It probably has somewhat limited use for the individual interested in broad applications of dislocation theory or for those who desire something approaching a general review of the subject. Such readers would find Cottrell's book more nearly appropriate.

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Electrochemical Constants. Proceedings of the NBS Semicentennial Symposium on Electrochemical Constants Held at the NBS on September 19–21, 1951. By National Bureau of Standards. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 1953. iv + 310 pp. 16 × 23.5 cm. Price, $2.00.

Of the 30 papers presented at the symposium and published in this volume, 27 are given in full, including the ensuing discussions, and 3 are in abstract form. They contain results of original work as well as review material by eminent experts in theoretical and experimental electro-

chemistry. The collection is certainly an interesting, informative and inexpensive addition to a bookshelf on physical chemistry, but it would be impractical to undertake individual critical reviews of so many disconnected topics. However, an adequate idea of the contents can be gained from a listing of the articles and their authors with a few comments:

The problem of inclusions in the silver of the silver coulometer is reviewed and inconclusive attempts to estimate inclusions by means of radioactive tracers are described by A. F. Scott. Recent accurate experimental work on the determination of the faraday constant by the electrolytic oxidation of oxalate ions, resulting in a value of 96492 ± 3 absolute coulombs on the chemical scale of atomic weights, is presented by D. N. Craig and J. I. Hoffman. Under the title of the faraday and the omegatron, H. Somer and J. A. Hipple report a determination of the faraday by a physical method using a new instrument, that they call the omegatron, designed to make use of the cyclotron resonance condition to measure the charge to mass ratio of a substance of known isotopic weight. Their measurements gave a value of 9652.2 ± 3 e.m.u./g. (physical scale) or 96496 ± 3 absolute coulombs on the chemical scale. E. G. Baker and C. A. Kraus discuss the extended Onsager equation as applied to dilute aqueous electrolyte solutions with applications to actual conductance measurements. Experimental measurements of the high field conductance of some paraffin chain electrolytes are described by S. Grusman and R. H. Cole with a discussion of its bearing on the nature and stability of micelles. A study of iodide–iodine solutions with the electromotive-force centrifuge is reported by D. A. MacInnes and Margaret O. Dayhoff. They have improved the accuracy of the method, obtained transference numbers of sodium iodide, and found evidence for the presence of the ionic complex I_3^-. Moving boundary measurements in methanol and water solution with indicator concentrations below the critical Kohlrausch value are described by A. R. Gordon and R. L. Kay. An experimental investigation of the moving boundary separation of salt mixtures is presented by L. G. Longsworth. H. S. Harned gives a theoretical treatment of diffusion coefficients of electrolytes in dilute aqueous solution and its comparison with experimental results. M. Eppley and G. D. Vincent discuss the effects of various septa in standard cells. Aging of standard cells by F. X Lamb is a brief review of their improvements over the past 50 years and a summary of data on their stability and reliability. Standard cells and the unit of electromotive force, by W. J. Hamer, Langhorne H. Brickwedde and Phyllis R. Robb, is a review of the work of the National Bureau of Standards in maintaining the standard of electromotive force. Under the title of thermal-diffusion phenomena in electrolytes and the constants involved, H. J. V. Tyrrell gives a theoretical treatment of the heat transfer processes that occur in non-isothermal electrolytic systems. H. B. Callen, on thermoe-lectric and thermomagnetic effects, derives a set of basic equations. T. Shedlovsky, on electromotive force from proton transfer reactions, shows that it is possible for electrical work to arise directly from proton transfer in a manner analogous to the electron transfer mechanism of the galvanic cell.

The other contributions comprise absolute half-cell potentials, by R. E. Wood; standard potentials in aqueous hydrochloric acid solutions containing organic compounds, by H. D. Crockford; use of potential diagrams in the interpretation of inorganic chemistry, by W. M. Latimer; determination of activity coefficients, by R. A. Robinson; electrolytic solutions under pressure, by B. B. Owen; standardization of the *p*H scale, by D. I. Hitchcock; significance of constants involved in electrochemical double layers, by J. Th. G. Overbeek; some stepping stones on the path to the true explanation of the mechanism of overvoltage, by A. L. Ferguson; parameters of electrode kinetics, by J. O'M. Bockris; electrokinetic researches in capillary systems and in colloidal solutions, by A. J. Rutgers and M. De Smet; development of constants in polarography: a correction factor for the Ilkovic equation, by O. H. Müller.

The volume closes with abstracts of the following 3 papers. Some electrode properties of mild steel in sea water, by T. P. May and F. L. LaQue; electrolyte–solvent interaction, by R. C. Miller and R. M. Fuoss; significance of ionization constants, by W. F. K. Wynne-Jones.

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Substances Naturelles de Synthèse. Volume VII. By A. ALLAIS, Ingénieur-Docteur, J. MATHIEU, Ingénieur-Docteur, A. PETIT, Ingénieur I.C.P., P. POIRIER, Ingénieur I.C.P., and L. VELLUZ, Docteur ès Sciences. Masson et Cie, Editeurs, 120, Boulevard Saint-Germain, Paris VI, France. 1953. 157 pp. 16 × 22 cm. Price, Broche 1800 Fr.; Cartonne toile 2200 Fr.

This little book is volume 7 in a series on synthesis of natural products. This reviewer has not seen any of the previous volumes, and it is difficult to appraise this volume by itself. The series appears to be somewhat more than the title would indicate, for in addition to the preparation directions in section I, there are notes on general procedures, and then in section II there are discussions, more general in nature, of processes which are important in the investigation of natural products. Section III of this volume is called a "Practical Note" and here is given a long table of indicators. The three sections are not too closely related, which gives the reader the impression of more or less randomly assembled notes on laboratory techniques and preparations.

There is an index of compounds considered, and a frontispiece showing eight good photographs of the crystals of the 4-phenylsemicarbazone of iso-α-irone, DL-proline hydrochloride, cortisone acetate, cortisone, the 2,4-dinitrophenylhydrazone of cortisone acetate, adrenosterone, lyxoflavine and the condensation product of 3,4-xylidine and L-lyxose.

A useful, but by no means indispensable, book, at least for American chemists; the contents of the various sections are as follows:

Section I (76 pages). Preparations. A. Cortisone from desoxycholic acid, method of Kendall, *et al.*, with notes on other natural products of possible importance as starting materials; on the activity of the oxygen functions in position 11; on elimination of the elements of hydrobromic acid from positions 4,5; and on oxidations by action of selenium dioxide. As a supplement to this preparation, there are given preparative directions for 3α,12α,21-triacetoxypregnane-20-one, and for adrenosterone. B. *dl*-Hydroxyproline from epichlorhydrin, method of Leuchs, *et al.*, with notes on the modification of Traube and Lehmann, and on the stereochemistry of hydroxyproline. C. *dl*-α-Irone by the method of Naves, with notes on other synthetic approaches; on the cyclization of alkadienes; and on the partial hydrogenation of acetylenic linkages. D. Lyxoflavine by the method of Folkers, *et al.*, with notes on the synthesis of flavines. E. L(+)Lyxose from α-D-galactose, with notes on the preparation of aldopentoses. F. *dl*-Proline from acrylonitrile and ethyl malonate, with notes on other synthetic approaches and on chlorination by action of sulfuryl chloride.

Section II (52 pages). Methods. In this section there is a short discussion of the methods for synthesis of pyrroles and indoles, together with a discussion of the methods for progressive degradation of aliphatic acids.

There follows, in Section III (17 pages), a long table of indicators, giving *p*H range, color changes, preparation.

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