REVIEWS OF BOOKS

Physico-Chemical Methods. BY J. REILLY and W. N. RAE. (Methuen & Co. Ltd., London.) Fifth edition, 1954. Vol. I, pp. 760; vol. II, pp. 800. Price £7 10s. (2 vols.).

" Reilly and Rae " has now grown to the record size of 2257 pages (including the supplementary volume III, published in 1948). This monumental compilation is a unique source of information on the experimental techniques of physical chemistry, and should be available for reference in all research establishments. The authors have rendered a valuable service in condensing such an enormous mass of material into one work.

On the other hand, it must be admitted that the treatment of the material leaves much to be desired; a more *useful* work could surely be produced for this high price. The weakest feature is the want of balance. Often important methods are ignored while one or two particular researches are described in detail, and in some chapters the selection of material is so unrepresentative of current practice as to be positively misleading (e.g. the chapter on vapour pressure). Some of the apparatus described is completely obsolete (e.g. the capillary electrometer, to which a page of text and 3 figures are devoted) and far too many portions of the first edition have still escaped the waste-paper basket (e.g. a quaint 3-page section entitled Efficiency of ultra-violet light). The only really authoritative chapters are those contributed by outside specialists—notably, a chapter on radioactivity by Dr. B. Cook and Dr. J. F. Duncan, which is an admirable example of an up-to-date and well-balanced résumé.

Looking to the future, it is frankly a relief to read in the preface " In subsequent editions it is intended to have more specialized assistance in particular chapters or sections ". The authors evidently recognize the sheer impossibility of keeping abreast of all the rapidly developing modern techniques and they could now with advantage adopt the role of editors. The collaboration of *many* active specialists is essential if this book is to gain balance and authority.

<div align="right">J. A. K.</div>

Theory of Electric Polarisation. By C. J. F. BOTTCHER. (Elsevier Publ. Co., Amsterdam, 1952.) Pp. xiii + 492. Price 70s.

It is the opinion of the author that there is a need for an adequate survey of the classical theory of dielectrics and he does achieve his objective in this book. Among the topics covered are electrostatic theory in a dielectric medium, the theory of the dielectric constant of polar dielectrics based on Onsager's concept of the reaction field, Kirkwood's theory of non-polar dielectrics, the thermodynamics of polarization, the classical theory of polarization at optical frequencies, the phenomenological theory of polarization at high frequencies, the determination of dipole moments and the polarization of solids. There is also a mathematical appendix. The author himself has been responsible for a number of the recent theoretical results which are described in this book. Among the particular merits that have impressed the reviewer are a full account of the reaction field, the significance of which was first recognized by Onsager, a survey of the various formulae which are used to determine dipole moments of molecules and a discussion of their accuracy, a matter of some importance to the experimentalist. Throughout the book the author warns against the use of inaccurate formulae by the experimental chemist or physicist who may not fully appreciate their range of validity.

Minor blemishes inevitably find their way into every book of science. One noticed by the reviewer is an unsound mathematical argument on p. 66. The

author is discussing the solution of Laplace's equation inside a spherical cavity of radius a immersed in a medium of the dielectric dipole of constant ϵ, the centre of the cavity being occupied by a rigid electric dipole moment μ. The potential inside the cavity is expressed in the usual general form in polar co-ordinates,

$$\phi_2 = \sum_{l=0}^{\infty} \left(C_l r^l + \frac{D_l}{r^{l+1}} \right) P_l (\cos \theta).$$

The statement is then made that as $a \to \infty$, $\phi_2 \to \mu \cos \theta / r^2$ (which, incidentally, is strictly not a boundary condition, although it is described as such) and hence $D_l = 0$, $l \neq 1$ and $D_1 = \mu$. This implies that D_l is assumed to be independent of a, but in general one assumes the coefficients C_l and D_l to be functions of the relevant parameters which enter into the problem, in this case a and ϵ. A better argument is that ϕ_2 has a singularity of the form $\mu \cos \theta / r^2$ at $r = 0$ and this condition uniquely determines the coefficients D_l. A similar situation arises on p. 94-96 where the electric dipole has been replaced by an arbitrary charge distribution. Here the corresponding coefficients have been assumed to be independent of ϵ and then determined by letting $\epsilon \to 1$. (The required result could also have been obtained by having $a \to \infty$.) Actually the coefficients are obtained by replacing the charge distribution by the equivalent infinite set of (multi-) poles at the origin and so fixing the nature of the singularities.

The only criticism of any consequence that the reviewer would like to make is with regard to the omissions from this book. Since the most fruitful line of research in the field of electric polarization must lie in the application of statistical mechanics and quantum mechanics, a more detailed exposition of the application of these branches of theoretical physics would probably have been welcome to the theoretician or advanced student interested in theory. Indeed, the author does, of course, make use of statistical mechanics and clearly a satisfactory molecular theory of electric polarization cannot be developed without it. As an illustration, we may quote the failure of the Onsager theory for strong associating liquids. Nevertheless the book is well worth reading for it does give a detailed account of the extent to which classical theory can explain the electrical properties of matter.

S. L.

Les Modifications de Structure du Cristal Métallique et leur Influence sur la Cinétique du Durcissement Structural des Solutions Solides d'Aluminium. BY A. BERGHEZAN. (Publications Scientifiques et Techniques du Ministère de l'Air, no. 283, Paris, 1953.) Pp. vii + 95. Price 1200 Fr.

Until recently it was considered that the previous history of a sample of a super-saturated solid solution such as zinc dissolved in aluminium had only a small effect on the rate of age-hardening, but evidence is now accumulating that in this, as in other metallurgical fields, it would be profitable to focus attention on crystal faults—dislocations, slip-planes, polygonization contours, etc. Dr. Berghezan's book is virtually a thesis in support of this view. Specimens are subjected to various mechanical and thermal treatments so as to produce slip, polygonization, etc., and the influence of these treatments upon the rate of hardening and upon the location of sites of enrichment by the dissolved phase (e.g. whether dispersed throughout the volume of the grains or concentrated at the boundaries) is studied. Apart from establishing his main argument an interesting experimental result that emerges is that, contrary to previous belief, deformation of a specimen prior to ageing generally delays rather than accelerates the onset of hardening; acceleration only occurs in particular circumstances.

The book constitutes a contribution to the subject which is not available elsewhere and, although slightly expensive, the library of any laboratory working in this field would be incomplete without it.   It is also of interest from the point of view of solid-state reactions in general.   For example, in the light of this work any analogy between precipitation in solid and liquid systems must be regarded with circumspection since the latter cannot sustain the distortions which Dr. Berghezan has shown to be important in the former.   From a yet more general point of view it is an excellent example of the value of the phenomenological approach.   The author points out the difficulties of applying any metric to the systems studied and uses measurements only for purposes of comparison and identification.   The mainstay of the work is thorough observation.   At one point, however—the interpretation of the apparent anomaly that slip produced by quenching accelerates hardening, whereas that produced by mechanical deformation retards its onset—a rather more detailed discussion would have been an improvement, but otherwise the style is one of Gallic lucidity.

Only one typographical error was observed and the paper, print and photographs are excellent.   The temperature appears to be wrongly printed on graph 6, fig. 55, page 80, but the correct value is easily deduced from the text.

P. R. R.

The Statistical Approach to X-ray Structure Analysis.   By VLADIMIR VAND and RAY PEPINSKY.   (X-ray and Crystal Analysis Laboratory, Department of Physics, The Pennsylvania State University, State College, Pa., 1953.)   Pp. xvi + 98.

The volume under review consists essentially of a critical examination of recent work by Hauptman and Karle [1] in which the latter authors claimed to have found a general solution to the problem of phase determination in X-ray structure analysis. It is now well known that the wide claims of Hauptman and Karle were unfounded, and Vand and Pepinsky illustrate the point very nicely by means of a counter example, which is based upon the examination of a simple model for which the calculations were run off on Pepinsky's X-RAC.   The various syntheses which result from this work are illustrated by some photographs of the usual excellent quality which X-RAC produces.

Apart from its purely critical content, the book contains several essays which attempt to show modified and simplified versions of Hauptman and Karle's methods which may be useful in certain cases.   A criticism of the work is that it resembles more a set of papers on related topics than a piece of connected writing ; and this effect is heightened by the introduction, in which abstracts of the ensuing parts are given.

[1] Hauptman, H., and Karle, J., *Solution of the Phase Problem I. The Centrosymmetric Crystal* (Monograph, No. 3, American Crystallographic Association, 1953).

A. D. B.