and the slip plane normal. In a compression test the rotation is not merely the reverse of that in a tensile test, because the constraint, which is that the planes parallel to the compression plate keep their initial orientation, is different. This constraint leads to the equation [3]

$$\frac{l_2}{l_1} = \frac{\sin \phi_2}{\sin \phi_1} \tag{2}$$

where l_2 and l_1 are the lengths before and after compression, respectively. Until the nature of the interaction between the individual stack of lamellae and the material which surrounds it is understood, it is impossible to specify the amount of rotation which must accompany the extension or contraction of the stack of lamellae by interlamellar slip. In [1] and [2] it is assumed that the constraints are such that equation 1 holds. The effect of slip under this constraint upon the diffraction pattern from our model is shown in fig. 2f. Of the diffraction patterns published in [2], only one appears, by rough measurement, to show a change of this type.

Interlamellar slip is an attractive mechanism for the deformation of crystalline polymers, and it is reasonable to postulate its occurrence. However, when the diffraction patterns observed in [1] and [2] are interpreted in terms of a model of discrete stacks of lamellae, they give little support to the postulate that the stacks deform by interlamellar slip. An alternative interpretation of the diffraction patterns might well give better support for interlamellar slip in polyethylene under the conditions described in [1] and [2]. The present uncertainty emphasises the need for further knowledge of the structure of the material, so that the diffraction patterns can be interpreted unambiguously and the relationship between interlamellar slip and lamellar rotation can be predicted.

Acknowledgement

Thanks are due to A. Keller for a useful correspondence and to N. G. McCrum for helpful comments.

References

1. I. L. HAY and A. KELLER, *J. Materials Sci.* **2** (1967) 538.
2. A. COWKING, J. G. RIDER, I. L. HAY, and A. KELLER, *ibid* 3 (1968) 646.
3. E. SCHMID and W. BOAS, "Plasticity of Crystals" (Chapman and Hall, London, 1968).

21 April 1969

G. W. GROVES
P. B. HIRSCH
Department of Metallurgy
University of Oxford, UK

Book Reviews

Advances in Materials Research, Volume 3

H. Herman (editor)

Pp 417 (John Wiley, 1969) 182*s*

With this third volume, the character of the series "Advances in Materials Research" appears to have changed considerably. Hitherto, the accent has been on experimental methods. Volume I (1967) was specifically entitled "Experimental Methods of Materials Research", and dealt with diffraction and microscopy, Mössbauer effect, mechanical methods, calorimetry and diffusion. Volume 2 (1968) was again largely experimental, and the central theme was microplasticity. The new volume is predominantly theoretical, and has no longer any pretension to homogeneity.

If we are to judge by its first article, it would appear that this book is aimed at a readership completely different from the one for which the first two volumes were written. The article is "The Continuum Theory of Dislocations" by T. Mura of Northwestern University, and is an account of the work of the author and others in developing rigorous mathematical methods for solving plastic strain problems. Many of us who feel at home with Cottrell or Lothe and Hirth must, I feel sure, throw in the sponge at this point. Excellent though the article may be, one feels that in this series it is sadly misplaced; it fails to fulfil the editor's purpose as he presents it in his Introduction.

The second article, "Fatigue Hardening in Face-Centred Cubic Metals", by R. L. Segall of the University of Warwick is, in complete contrast, ideally suited to the series, and is a readable survey of how direct observation of dislocations has aided our understanding of fatigue behaviour. C. M. Wayman of the University of Illinois contributes a review of the "Crystallography of Martensite Transformations in Alloys of Iron". Much of the ground covered is similar to that contained in Wayman's book on the same subject, published by Macmillan in 1964, although new material has been added. The inclusion of results of electron-metallographic studies and the exclusion of most of the matrix algebra makes this article much more readable for the non-specialist than was the original work. Nevertheless one wonders whether the different treatment was sufficient justification for republication in this series in a form a mere 30 pages (out of 180) shorter than the textbook itself.

The flourishing field of composite materials is represented here by a paper on "Properties Calculations for Heterogeneous Systems" by S. P. Mitoff of the G.E. Company, Schenectady. The author does not refer specifically to fibre composites, but restricts himself to the general problem of computing physical and mechanical properties for heterogeneous, two-phase systems, taking into account size, shape and distribution of the phases. A little more attention might have been paid to comparisons between calculated properties and experimental results. The final article, "Lattice Dynamics and the Stability of Crystals", by D. C. Wallace of the Sandia Laboratory, Albuquerque, is a detailed study, in terms of harmonic lattice dynamics, of the mechanical equilibrium and stability conditions, and the corresponding thermodynamic equilibrium and stability conditions, that must be satisfied by a system of interacting atoms.

B. HARRIS

Ionic Crystals, Lattice Defects and Non-Stoichiometry

N. N. Greenwood

Pp 194 (Butterworths, 1969) 32*s*

This small book contains a large number of topics in solid state physics and chemistry. The first three chapters deal with lattice energies of ionic compounds and with the crystal structures of some simple compounds (61 pages). The next two chapters contain information on lattice defects, their experimental investigation and their occurrence in some materials (49 pages). Chapter 6 (32 pages) describes non-stoichiometric compounds, and the last chapter summarises experimental methods, including X-ray diffraction, neutron diffraction, electron diffraction, spectra and semiconductivity (34 pages).

Since the book contains so many theories and applications, it is not difficult for a reviewer to select some areas of his own interest and to criticise them in detail. For example, the description of Madelung constants does not make clear which convention is followed with respect to the inclusion or exclusion of charges for the materials in table 2.3. On p. 62, dislocations are said to be of a non-equilibrium nature, but it is not explained whether this non-equilibrium nature is different from that of frozen-in defects. On the next page Schottky and Frenkel defects are mentioned, although actually two defect *situations* are given as examples. With respect to Chapter 4, the reader is left with the impression rather of a historical treatment, than of one based on a logical distinction between defect situations.

Obviously the book is written as a broad introduction to the chemistry of non-ideal crystals, and thus it is perhaps unfair to criticise it on points of detail. As an introductory text it is very attractive; the style is lively using many examples, and the approach of the author is personal. The attention paid to the Berthollet-Proust controversy (p. 111) and to the lack of a precise definition of the structure of grossly non-stoichiometric crystals (p. 130) are examples of such a personal approach: many other introductory texts do not mention these principal aspects.

Finally, it should be mentioned that the positive approach of the book might give students the idea that all problems have been solved; there are so many examples of solved problems that one section outlining the *remaining* major problems could have made clear why so many chemists are still involved with solid state chemistry.

W. VAN GOOL