Book Reviews

Works intended for notice in this column should be sent direct to the Editor (A. J. C. Wilson, Department of Physics, University College, Cathays Park, Cardiff, Great Britain). As far as practicable books will be reviewed in a country different from that of publication.

Growth of Crystals. Edited by A. V. SHUBNIKOV and N. N. SHEPTAL. Reports at the First Conference on Crystal Growth, 5–10 March, 1956, in English Translation. New York: Consultants Bureau, Inc. London: Chapman and Hall. 1959. Price 120*s*.

Published in Russian in 1957, by the U.S.S.R. Academy of Sciences Press, and in this English translation in 1958, this is the report of a conference held in Moscow in March, 1956 (about 10 months of the delay in reviewing it can fairly be blamed on the reviewer). The attendance at the conference was entirely Soviet, apart from two Czechoslovak guests. Seven years had elapsed since the Faraday Society's more international discussion on the same subject. It is interesting to observe what progress had been made in the interim. The weakest feature at the time of the former conference was undoubtedly the general approach to problems of diffusion and heat transfer arising in the growth of crystals: this was naive, timid, and ignorant. The 1956 conference (as would a Western conference held at the same date) shows notable advances in this respect. Even so, Ivantsov's paper on this subject gives the impression of a mathematician telling crystal growers the answers, and hardly expecting them to be interested in the methods: they will have to learn these (and those of hydrodynamics, too) if they are to understand some of their problems. As an example of the sort of problem unlikely to be solved while experimental observation and mathematical analysis are separated from each other is the periodic distribution of impurities in crystals grown from the melt reported by Petrov and Kolachev. One would like to be assured that the period is not generated by a rotation period, for example, in the withdrawal apparatus, but if genuine its explanation is almost certainly more subtile than that proposed: the reviewer does not believe that the diffusion process invoked will lead to oscillatory solutions.

The most substantial section of the report is that concerned with the practical growing of crystals. This shows a systematic attack on the development, up to technological production, of methods of growing, usually from the melt, various types of crystal required for practical use. The materials and methods employed are, in general, orthodox but as usual in crystal growing, a great deal of effort has had to be expended in countering the effects of minor impurities. Particular success and mastery of the subject is shown especially for the optically useful crystals such as fluorite and lithium fluoride.

Complete uniformity of orientation is not of extreme importance for optical applications of cubic crystals, and little interest is displayed here in methods of testing for crystal perfection. Work on the growing of semiconductor crystals is, of course, reported, but this was at a date when the electrical effects of dislocations were only beginning to be appreciated, and none of the workers reporting to this conference make assessments of the dislocation content of the crystals produced. The role of dislocations in crystal growth is one of the subjects covered by Sheetal in his general introductory paper: it is invoked only once again (by Gorodetzky and Saratovkin) to account for some experimental observations on what they call 'antiskeletal growth', and then without convincing proof that the explanation given is the uniquely necessary one. Lemmlein, one of the first experimenters to observe spiral growth hills, and still active in the subject, though thanked by several contributors for advice, is not a contributor to this report. Generally speaking, the papers classified as 'Experimental Research' show a disappointing lack of new departures. This earnest concentration on what is useful in preference to the merely inquisitive search for understanding no doubt shows a proper sense of proportion, and one almost feels ashamed for the injustice that those who go the other way about it from time to time learn something useful by accident.

An unusual feature in this report, well worthy of mention, is a short final paper describing the students' practical course on the growing of crystals given in the Department of Crystal Physics in the Physics Faculty of Moscow State University.

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Cours de Cristallographie. By R. GAY. Vol. 1 (Geometrical). Pp. 253 and 108 diagrams; Vol. 2 (Physico-chemical). Pp. 232 and 151 diagrams. Paris: Gauthier-Villars. 1959. Prices 2300 Fr.

It is difficult at this stage to judge this work as a whole because, although neither volume carries any explicit statement about any future additions, two footnotes (pages 158 and 182 of the second volume) refer to volume 4. But it is easy to get a clear view of the field of the present two volumes from the detailed contents pages at the end of each. Perhaps a reviewer may be permitted to welcome, in a French textbook, the alphabetical index that is also provided for each volume.

In the first volume the approach is historical and somewhat formal—Steno, Haüy, Sohnke, Schoenflies—and there are 111 pages of morphology and other geometrical argument before the modern concept of the lattice is reached; then 37 pages are devoted to lattices and space groups. After 8 pages on atomic and ionic binding, there are 60 pages on the geometry of the main types of crystal structures. There are 11 pages of appendixes, including a very brief description of the stereographic projection which, however, is never used in the diagrams of the two present volumes (Fig. 8 in volume 1 being entitled 'Principe de la projection stéréographique). Finally there are 9 pages of exercises, the answers being given for some of these.

The second volume brings a new approach to crystallographic teaching and one that is very welcome. Its development is based on thermodynamical considerations applied to the crystalline state, and the field covered can be seen from the chapter headings—thermodynamical concepts, specific and latent heat, atomic diffusion, surface phenomena, polymorphism, isomorphism and

solid solution, ageing of solid solutions, crystallization, geometrical associations of crystals, corrosion. The exposition is always clear, but it does assume that the reader has studied quite a range of physical concepts and the mathematical methods of handling these.

Both volumes are produced by an offset process from typescript. This is very legible, but the nature of the process seems to require a thickness of line which does result in a heavy appearance in most of the diagrams. There is, of course, a loss of flexibility and elegance in the text and the mathematics as compared with good printing. What it would be useful to know is the difference in production costs between the two processes for a textbook of this nature. In any case the publication of any subsequent volumes will be awaited with interest, and then it will be possible to view the work as a whole.

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Crystals and Crystal Growing. By Allan Holden and Phyllis Singer. Pp. 320+137 Figs. and 49 plates (7 in colour). New York: Doubleday and Co., Inc. 1960. Price $1·45 ($1·65 in Canada).

This interesting and attractive little paper-backed book is one of the Science Study Series, the primary purpose of which, the publishers state, is to provide a survey of physics within the grasp of the young student, or the layman. Allan Holden is on the research staff of the Bell Telephone Laboratories, and has been concerned for many years with crystals for use in electronic equipment, and with methods of producing them artificially. The book is a result of the many requests which he has received from school teachers and students for suggestions on how to grow crystals. His co-author, Phyllis Singer, teaches art and mathematics, and has contributed the line illustrations. Many of these are based on simple pencil sketches, and this adds to the rather pleasantly informal treatment which is a feature of the book.

Careful general directions are given for growing large crystals of salts, either by the slow evaporation, or by the cooling, of saturated solutions, and using as apparatus nothing more elaborate than glass preserving jars and cotton thread or wire for supporting the seeds. In the form of detailed recipes these directions are applied to the cases of twelve salts, selected to afford examples of cleavage and glide, piezoelectricity, birefringence, pleochroism, optical activity, and the influence of crystal class on habit and the form of etch pits. To aid him in the study of this wide range of crystal phenomena, the reader is shown how to construct simple forms of a contact goniometer, a reflecting goniometer, an apparatus to demonstrate piezoelectricity, a polarimeter, and, as a side-line, a spectroscope in which a tetrahedral crystal of sodium bromate (one of the selected twelve salts) is used as the prism. Directions are also given for making cardboard models illustrating the symmetries associated with the thirty-two crystal classes. All of this is developed against a simple yet adequate background of theory. There are a number of problems (with answers) and suggestions for further reading, while for the real enthusiast some simple research problems are proposed.

The book forms an excellent introduction to crystallography for the enquiring sixth-former or the junior student, particularly if he is prepared to carry out at least some of the experiments described. The treatment is novel and the reverse of forbidding, in a subject which is often made to appear to the beginner very forbidding indeed, and the book should be given a warm welcome.

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Elektronenmikroskopische Untersuchungs- und Präparationsmethoden. By Ludwig Reimer. Pp. viii+300 with 135 diagrams and 20 plates. Berlin–Göttingen–Heidelberg: Springer Verlag. 1959. Price DM. 58.

For some years now electron microscopes have been available with sufficient resolving power to make possible direct observations on the crystal lattice. It is not surprising, therefore, that crystallographers and metallurgists are making increasing use of electron microscopy to supplement classical techniques. However, in order to obtain meaningful results from the electron microscope a sound working knowledge of the electron-optical imaging process is necessary; in addition, complete familiarity is required with the different methods of preparing specimens for electron microscopy.

Dr Reimer's book has been written to provide just this background knowledge, and it can be said at once that an excellent balance has been struck between theory and practice. The style is more that of the learned review than that of the practical manual but this should recommend it to a wider circle of readers, *e.g.*, those who wish to familiarize themselves with the subject in general, rather than master several intricate techniques in detail.

The first half of the book is concerned with the electron-optical aspects of the instrument; focusing properties and aberrations are considered quantitatively, not from the point of view of the designer but from that of the intelligent operator who wishes to gain an insight into the image-forming process so that he can interpret his micrographs, recognize artifacts and assess the resolution likely to be obtained with a given specimen.

The second half of the book deals with specimen preparation, starting with basic techniques such as the production of support films, replica methods and metal shadowing.

Special methods such as centrifuging, freeze drying, differential staining and fixing are systematically treated in subsequent chapters. Practically nothing of any importance has been omitted. The liberal use of simple diagrams has enabled the author to keep the book to 300 pages and to avoid the baffling descriptions often found in German textbooks.

The book is well produced, expensive, and contains an extensive bibliography. It can be confidently recommended to all who are concerned with investigations making use of the electron microscope.

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