scattering. In (I) we have the original paper of Laue, Friedrich and Knipping; the early work of the Braggs; Friedel on symmetry. (III) includes the first treatments of atomic scattering factors, and the theories of thermal motion by Debye, by Waller, and by Darwin. (V) covers rather later work on atomic scattering factors – the experimental studies of Bragg, James and Bosanquet, Hartree's self-consistent field principle (in very short extracts), the problem of imperfections and mosaic texture, and the theory and applications of anomalous scattering.

Altogether, there are 83 numbered passages taken from 73 papers by 31 different authors (if we arbitrarily count only the first name in a collaboration as that of the author). The longest passage (19 pages) is from Laue's 1931 paper on the dynamical theory; nearly the shortest (11 lines) is from W. H. Bragg's Bakerian Lecture in 1915, where he foresees the use of Fourier methods. Most of the long passages (as we should expect) are from the work of Laue, Ewald, W. H. Bragg and W. L. Bragg: others are by Darwin (two 1914 papers), Debye & Scherrer (1918), and Coster, Knol & Prins (1930). A histogram of the dates is interesting: 41 of the numbered references are for the years 1912-14, 5 for 1915-18, 7 for 1921-23, 19 for 1925-28, and 11 for 1930-34. All extracts are reprinted in their original language, of course, but page headings provided by the editors are in English throughout. These headings are a welcome help to the reader who may want to refer to a particular point without re-reading the whole of a long text to find where it comes.

The technical production of the book deserves praise. The printing is clear and attractive, with pleasant paragraph spacing, and the quotations which serve as introductions to chapters (or sections) are set out invitingly in italics. As a help for reference, chapter numbers and serial numbers of excerpts are printed at the top of every left-hand page. The whole appearance and design of the book, in fact, invite the reader's attention and create an expectation of enjoyment.

This is a book which ought to be in every library, and which many teachers, having once seen, will want on their own shelves. Its selection and arrangement reflect the editors' experience in the ways of thought that are being presented to the reader, and make the old work come alive in a new perspective. Besides its general interest, it will be of particular value to teachers preparing lecture courses and, on occasion, as formally recommended reading for their classes; and in any case, enterprising students wanting to know how discoveries looked to the discoverers and their contemporaries should be encouraged to browse in it.

My one substantial criticism is that the subject matter of this volume represents only half the story. Students as well as teachers will want to hear of the growth of ideas about what structures are actually *like* – for example, W. L. Bragg's original introduction of the idea of atomic radii in 1920 and Bernal & Fowler's tetrahedral picture of the water molecule in 1933. This field, even more than diffraction theory, is one where the origins of our present knowledge are obscure to younger physicists and chemists – and sometimes to crystallographers too – and incentives to new thinking are thereby weakened. A companion volume covering structural studies and Fourier methods is promised, if interest in the present volume warrants it. The proviso is a little dangerous: it is only too easy for the appreciative reader to forget to take active steps to record his interest; and in any case this is the sort of book whose value will be discovered by an increasing circle of readers over a period of years, rather than all at once. It is to be hoped, however, that as many as possible *will* write to the publishers asking for the second volume.

The International Union of Crystallography, who sponsored the book (on the recommendation of their Teaching Commission), are to be congratulated on the success of their undertaking, as are the three editors who have given it reality.

HELEN D. MEGAW

Department of Physics
Cavendish Laboratory
Free School Lane
Cambridge CB2 3RQ
England

N.M.R. basic principles and progress. Volume 1. N.M.R. studies of molecules oriented in the nematic phase of liquid crystals. By P. DIEHL and C. L. KHETRAPAL. **The use of symmetry in nuclear magnetic resonance.** BY R. G. JONES. Editors: P. DIEHL, E. FLUCK and R. KOSFELD. Pp. 174. New York: Springer Verlag, 1969. Price: cloth $ 10.80, DM. 39.

This is the first volume in a series devoted to authoritative reviews, plus progress reports and original work, in nuclear magnetic resonance spectroscopy. The main aim, as stated by the editors, is to publish articles which take the reader from the introductory stage to the latest development in the field. The descriptions 'introductory' and 'basic principles' are used in a restrictive sense in that a good knowledge of at least the fundamentals of n.m.r. is prerequisite. The concept, however, is a good one and should offer a useful and different approach from the Advances–Progress–Annual Review type of publication.

The first article, by Diehl & Khetrapal, describes the results of studies on molecules oriented by solution in nematic liquid crystal solvents, a method which is receiving increased attention as a means of obtaining information on molecular geometry, the anisotropy of chemical shifts, the absolute signs of indirect coupling constants, and the magnitudes of small quadrupole coupling constants. The basic principles and theory receive a brief concise treatment and the major part of the article is devoted to an extensive catalogue of results. Details of experimental methods are sparse. The authors have achieved the remarkable feat of including the literature data available to mid-1969 (and beyond with the inclusion of unpublished material from various sources). The molecules discussed are classified for this purpose on the basis of their spectral notation and tables of transition frequencies and intensities are given in a number of cases. A vast amount of information is presented in tables but no index is provided. The authors appear to have placed a limitation on the article in that it is essentially a survey of the available data, commendable for its comprehensive nature, but devoid of critical comment or comparison. For example, there is no discussion of the significance of the results on the anisotropy of chemical shifts, and, although this article places a major emphasis on structural information, the influence of molecular vibration and the comparison between molecular geometry determined by this and by other techniques receive only limited discussion. The important effects of vibrational anharmonicity are not discussed at all.

Symmetry plays a fundamental role in the analysis and

understanding of high resolution n.m.r. spectra and the application of symmetry methods is the subject of the second article in this volume. An elementary description of symmetry elements and operations is given, followed by discussions of the symmetry of non-rigid systems, permutation groups, factorization of the Hamiltonian matrix, the X approximation, and a brief section on sub-spectral analysis. Appendices include a discussion of matrices and vectors, a 'worked example' for the $A_2A_2'XX'X''X''$ system, and character tables. Unfortunately this chapter does not meet the stated aims of the editors. The subject matter is not developed with particular clarity, and is further confused by an inconsistent and clumsy numbering of sections, subsections, and equations, *etc.* (especially pages 118, 119 and 122). The definitions of magnetic equivalence and inequivalence are confusing and incompletely referenced. Although standard textbooks on n.m.r. and on symmetry are listed in the bibliography it is surprising to find no reference to the book by Corio. Group character tables are available in many texts, their reproduction here would be worthwhile had they been specifically adapted to n.m.r. There are errors in the C_{5h} and C_{6h} tables. Speaking of errors, a hypothetically oriented methane molecule is expected to have a five line spectrum (page 120).

If greater attention is paid to the editorial philosophy this series should be a worthwhile and valuable one. The first volume is highly recommended to anyone working in these specific areas of n.m.r. but the unitiated might have a difficult time bridging the gap between introduction and latest development.

D. F. R. GILSON

Department of Chemistry
McGill University
Montreal
Quebec
Canada

Crystals. By PETR KRATOCHVIL. Pp. Ill. London: Iliffe, 1967. Price (paperback) 15 *s.*

'Physics paperbacks' are a series of monographs which claim to provide an 'inexpensive, succinct, rapidly absorbed yet comprehensive introduction to a number of advanced physics subjects for science and technological students.... Each monograph has been written by a distinguished Czech physicist, and edited, and where necessary updated, by an English specialist'. The author's introduction notes the vast progress made in electrical engineering during recent years and makes it clear that the book is aimed mainly at readers interested in this field and more particularly in the development properties and technical applications of metals and semi-conductors.

The book consists of four chapters:

(1) The structure of matter
(2) Crystal structure
(3) Origin of crystals
(4) Properties of crystals and their applications.

Chapter 3 is only slightly less in length than the other three put together and this tends to throw the book out of balance because of too great detail on specialist topics such as zone melting and methods of growing crystals, while other more interesting topics are declared to be beyond the scope of this book. Three instances of this irritating feature (particularly when no guidance is given for further reading – in fact there is no bibliography, as such, anywhere in the book) were noted: (*a*) interactions between defects (p. 31) (*b*) influence of grain boundaries on physical properties of materials (p. 44) (*c*) the dependence of the electron structure of metals on valency (p. 101). However, any book in this interdisciplinary field is welcome and it does avoid the Scylla of too much theoretical crystallography and, apart from the exceptions noted above, the Charybdis of too much practical detail.

If the book lacks anything it is on the geometrical side, using the word geometry in its most general sense. The usual geometrical topics, which are essential in any book on crystals, are discussed; *e.g.* space lattice, dislocations and close packing. On the other hand polymorphism is not mentioned, nor are liquid crystals nor the many aspects of morphology, which, though particularly applicable to crystalline polymers, are also of interest in a much wider field, *e.g.* spherulites, lamellae, fibres and microfibrils. Reference is however, made to dendrites and whiskers. This is understandable in a book mainly concerned with metals and semi-conductors. The title *Crystals* perhaps raises too many hopes.

The production is good and the index is quite adequate. There are printing errors but on the whole these are not troublesome. A few mistakes were detected; there may be others. Some of these arise from translation and can be readily corrected by the reader, *e.g.* 'tetrahedron' is obviously meant where 'quadrilateral' is used (on p. 20) referring to the four bonds of the carbon atom. On p. 29, in Fig. 10, the labelling of the axes does not correspond with the text. A mistake due to inadequate updating was noted on p. 16 where noble gases are 'totally inert in chemical reactions'. What about the recently discovered chemistry of xenon? An example of a more substantial mistake occurs on p. 9 where 'every element then has its own particular atomic number and this determines its physical properties'. Here was a chance to mention the allotropy of the elements (one aspect of polymorphism) and avoid this error. For example the two forms of tin have the same atomic number but widely differing densities.

This book can certainly be recommended for students but is too light weight for those who would wish to delve more deeply.

J. R. S. WARING

I. C. I. Ltd.
Dyestuffs Division
P.O. Box No. 42
Hexagon House
Blackley
Manchester M9 3DA
England

X-ray diffraction methods in polymer science. By LEROY E. ALEXANDER. Pp. 582 + xv. New York: Wiley – Interscience, 1969.

This monograph is a most valuable compilation of material which, up to now, has been scattered through a wide range of journals such as *J. Polymer Sci., Kolloid-Z., Phil. Mag., Helv. Chim. Acta, Makromol. Chem., Nuovo Cimento, Acta Cryst., Nippon Kagaku Zasshi, etc., etc.* Among other purely factual items are almost five hundred references to specific papers in the text and a further five hundred refer-