# Book Reviews

*Works intended for notice in this column should be sent direct to the Book-Review Editor (J. H. Robertson, School of Chemistry, University of Leeds, Leeds LS2 9JT, England). As far as practicable books will be reviewed in a country different from that of publication.*

**The development of X-ray analysis.** By Sir LAWRENCE BRAGG. Pp.viii+270, Figs. 151. London: Bell, 1975. Price £ 6·50.

The scope and aim of this beautiful book is best expressed by quoting the first paragraph of the Introduction which W. L. Bragg wrote shortly before his death on July 1st, 1971:

'This book does not claim to be a complete and up-to-date account of all the progress now being made in X-ray analysis in laboratories over the world. It is of a more historical and reminiscent nature. In describing each new advance I have chosen my examples and illustrations from the first work which broke new ground, rather than from the latest achievements. I have tried to see these advances in perspective, and recall the excitement and enthusiasm at the time as each new insight into the structure of matter was achieved, over the sixty years since X-ray analysis started.'

It is sad to think that W. L. B. did not live to enjoy the acclaim that this work of love and pride will undoubtedly receive by those familiar with the subject as well as by students who approach it for the first time.

Like his father W. H. Bragg (Sir William), W. L. B. is a master of simplified presentation of subjects which could easily be blurred by a mass of scientific detail or an attempt at being encyclopedic. His style is concise, yet clear. He stresses the essential steps in the development of crystal structure analysis from the first deciphering of the ZnS and NaCl structures, *via* the silicates and metals to the full analysis of protein structures like hemoglobin. In each of these steps W. L. B. has been a tenacious pioneer against great odds, clearing the way for a host of workers following in his path. The various chapters show up the principal ideas that brought about the sudden advances in the decoding of the information hidden in the X-ray diagrams. All the freshness of discovery is recalled in the examples of actual structure determinations which the author uses in his discussion. Introductory chapters on X-rays, on the principles of optical interference, and on symmetry prepare the reader for a course covering all the standard (non-algebraic) methods of crystal structure analysis. Mathematical derivations and formulae are replaced by a qualitative inspection into the physical causes leading up to the results. Any teacher offering a course on X-ray diffraction would do well to read this book carefully and to extract its physical argumentation. This is all the more advisable at a time when so often thinking is prone to be dominated by the computer.

The manuscript was practically finished only two weeks before Bragg's death, according to the foreword by his son. W. L. B.'s co-workers and friends, Henry Lipson and David Phillips, carried out the final editing. The book is a worthy legacy from a great scientist whose life's work opened up new continents.

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**Diffraction physics.** By JOHN M. COWLEY. Pp.xiii+410. Amsterdam: North Holland, 1975. Price Dfl 135·00, US. $ 56·25.

The publication of this book is an important event in the world of optics and microscopy. The author has made many fundamental contributions to the theory and practice of electron microscopy and electron diffraction, and when such a person decides to put his thoughts together in a systematic way in a textbook, one looks forward to a work that should be outstanding.

With this book one is not disappointed. The author has surveyed his field in masterly fashion; he discusses diffraction and image formation with light, X-rays, neutrons and electrons, but, having laid down the general principles of these subjects, he has wisely decided to concentrate mainly on the last. He deals with kinematic and dynamic theories, diffraction by imperfect structures, diffuse scattering, the study of defects, and order–disorder phenomena, but subjects such as crystal-structure determination – on which many textbooks already exist – he dismisses very briefly indeed.

I am pleased to see that the author has adopted the approach that I have advocated over many years – introducing diffraction through the concept of the Fourier transform; this may sound complicated to those who have been brought up on Laue's equations and Bragg's law, but it does ultimately make the subject of diffraction more logical and self-consistent.

One subject of topical importance, to which the author has made considerable contributions, is given some prominence in the book – 'imaging of thin crystals' or what is often incorrectly called 'lattice imaging'. If a crystal of thickness about 100 Å is viewed in a good electron microscope, an image closely resembling the structure found by X-ray diffraction can be seen. Since the aim of electron microscopists has always been to exploit the ultimate resolution of their instrument by producing images of individual atoms, it looks as though their ambition is now about to be fulfilled.

I have, however, some doubts. Electrons interact with crystals; they are not just scattered by them. It would not therefore be expected that they should give the same image as X-rays. Electron microscopes suffer from extreme spherical aberration, which means that the relative phases of the diffracted beams are affected – again producing a different image. Finally, the best image is produced with an 'underfocusing' of about 900 Å, which I find rather puzzling. The unit cell *must* be correct since it is based merely on the relative positions of the orders of diffraction; but how does one know that the fine detail really represents atoms? I shall be convinced only when the instrument produces *new* information.

The book is well produced, although, presumably for economy, the lines of print are not 'justified'. The illustrations are fewer than I would have thought necessary, and some of the diagrams are rather small. Since also the text is

somewhat mathematical in spite of the author's claim that he has 'avoided over-rigorous arguments and mathematical complexity', the book appears rather austere. This appearance, together with its extremely high price, might well discourage many readers. This is a pity because the book contains a great deal of good material that all students should make an effort to absorb.

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**Röngtenbeugung an Kristallen.** By K. H. JOST. Pp. xii + 404. Berlin: Akademie-Verlag, 1975. Price not known.

This book deals with the interpretation of X-ray diffraction patterns from crystals, within the framework of the usual kinematic scattering theory. It does not deal with crystal structure analysis, nor with diffraction phenomena that require the use of dynamical theory for their interpretation, and hence it may be regarded as somewhat limited in its scope. However, the topics that are discussed – basic X-ray physics, crystal symmetry, space-group determination, X-ray diagrams of ideal and non-ideal crystals, intensity measurements and corrections (including a short section on diffractometers), powder diagrams – receive a competent and thorough treatment.

There are any number of excellent introductory books on X-ray diffraction topics available in English, but not too many recent ones in German. Within its limitations, this book should therefore serve a useful purpose and it can be safely recommended to anyone who prefers reading German to English.

One chapter of the book is especially praiseworthy. It is the one dealing with crystal imperfections and their influence on diffraction diagrams and it contains an excellent, short, introductory account of order–disorder (OD) crystals that is not to be found in any other book at this level in any language. This can be highly recommended as preliminary reading for the study of the papers by Professor Boll-Dornberger and her colleagues on this subject, and it may even spur readers who normally prefer English to grasp for their German dictionaries.

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**Neutron diffraction - Monographs on the physics and chemistry of materials.** By G. E. BACON. 3rd ed. Pp.xiii + 636, Figs. 388, Tables 33. Oxford Univ. Press, 1975. Price £28.00

This is a much expanded version of a, by now classical, monograph. Previous editions in 1955 and 1962 contained 299 pages and 117 figures, 426 pages and 190 figures, respectively. The scope and outline of the first edition is retained: The first part is devoted mainly to the principles and techniques of neutron diffraction and the second part to its application. The first part has two new chapters, one on magnetic form factors and one with the title *Observation of magnetic scattering*. I find the latter title not very illustrative or precise since the chapter discusses how different types of magnetic order manifest themselves in the diffraction pattern. Most of the chapters have been revised so as to make place for new features in methods and applications. In this respect the major additions are found in two excellent sections on helimagnetism and polarization analysis, but also other sections on the profile refinement method, the gravity mirror refractometer and the Pendellösung fringes have been included. I was happy to see that the magnetic interaction vector **q**, which previous editions and most other books on the subject have had wrong, now is correctly defined such as to give the proper sign to the polarization-dependent term in the cross section.

One question to ask is whether a broad field such as neutron diffraction should be covered by one author and not by several contributors. On the whole a scholarly written monograph like the present one seems preferable. The result is a unified, clear exposition of an important research method. It is an almost impossible task for one single person, however, to keep abreast in a widely expanding research field. It is certainly forgivable that some new developments have been overlooked. One example is the magnetic structure of magnetite for which important developments after 1958 are not included. Less forgivable, perhaps, is the omission of references to important work on resolution by Brookhaven and Risø research workers and to the spectrometer intercomparison work by the Neutron Diffraction Commission. This writer may be biased, but he certainly believes that pyrolytic graphite deserves more place in a discussion on monochromators than does lead. For graphite, information on reflectivities and the great advantage of vertically bent monochromators would seem in order. It is probably wise that the author has retained the framework of the first edition, but in some cases it creates difficulties. Chapter 5 on fundamental measurements of scattering amplitudes is now largely one on experimental techniques in which important innovations, such as neutron guide tubes, are discussed in subsections not even indicated in the list of contents.

The layout and technical quality of this book are very good. The great number of figures are of a good quality and easy to understand (although not Fig. 186!). I have detected only one misprint which, however, occurs several times, $Co_{0.92}Fe_{0.8}$ instead of $Co_{0.92}Fe_{0.08}$. On the whole this book defends its position as a classical, high-quality monograph and deserves its place on the bookshelf of every diffraction scientist.

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**Low-dimensional cooperative phenomena.** Edited by H. J. KELLER. Pp.viii+350, Figs. 132, Tables 16. New York: Plenum Publishing Co., 1975. Price $30·10.

One element in the controversy about large international conferences and the publication of their proceedings is the relevance of those proceedings when the majority of the