X-RAY DIFFRACTION FOR THE STUDENT

The Optical Principles of the Diffraction of X-Rays
By Prof. R. W. James. (The Crystalline State, Vol. 2.) Pp. xv+623. (London: G. Bell and Sons, Ltd., 1948.) 80s. net.

IT seems likely that Prof. R. W. James's book will remain for many years the standard text on the theory of X-ray diffraction. With an exception noted below, the mathematical development is full enough to offer no difficulties to the conscientious student, who will certainly welcome an alternative to the obscure brilliancy of Prof. Zachariasen's "Theory of X-Ray Diffraction in Crystals". The field covered is broad, with one chapter on the geometrical theory of diffraction by lattices, six on aspects of the theory of the intensity of diffraction, one on the use of Fourier series, one on scattering by fluids and non-crystalline solids, and one on diffraction by small or imperfect crystals.

Prof. James adopts a semi-historical approach, with obvious pedagogic advantages. The simpler and more easily understood results tend to come earlier in time, and familiarity with them is a great aid to the student when he has to grapple with the deeper theory that supersedes or includes them. Undeniably, however, it takes up more space than a single exposition on the highest level appropriate to the book. In the present volume, diffraction by a perfect crystal is treated first by Darwin's method, then Prins's, then Ewald's, and finally by Laue's extension of Ewald's method. The topic is important, and it is convenient to have all four versions to hand; but it may be felt that Prins's and Laue's treatments, with perhaps an indication of the points where they mark an advance over Darwin's and Ewald's, would have been quite sufficient. There are other less-important repetitions of doubtful value.

Space so saved could have been used to advantage in the chapters on scattering and anomalous dispersion. It is here that I feel Prof. James to be less successful than in the rest of his book. The mathematical development is compressed to the point where it cannot well be followed without the original papers; but it is more voluminous than is necessary for a critical exposition of assumptions and results. The assumptions and results are, however, clearly expressed, and the intervening material may easily be ignored, or used as a commentary when interest or necessity leads one to the original papers.

The chapter on the effects of thermal motions is clear and detailed, and it is interesting to learn from the preface that it had been written in practically its present form in 1936, before the burst of interest in diffuse scattering in the early years of the War. The only important alteration needed was the addition of a survey of the experiments that confirmed the theory so beautifully. Thermal scattering adds yet another example to the list of theories developed well in advance of techniques capable of confirming them —the theory of space groups and of dispersion are others in the field of X-ray crystallography. The Fourier-series method of representing periodic functions is fully explained, and is used as a basis both for Laue's dynamical theory of diffraction and for methods of crystal-structure determination. The latter are treated comparatively briefly, perhaps because they belong more properly to the projected Vol. 3 of Sir Lawrence Bragg's "The Crystalline State". Patterson projections and Harker sections are included; but the manuscript was completed too early for any mention of steepest descents or sign-determining inequalities. The chapter on diffraction by fluids and non-crystalline solids is good, and stress is laid on the reasons for the differences in behaviour at low angles, though there is no mention of Guinier's work on low-angle scattering. In the final chapter diffraction by small crystals is treated fully, and its formal identity with scattering by a gas is made clear. This chapter also includes the related problems of scattering by imperfect and distorted crystals and by partially oriented structures like organic fibres.

Vectors are used throughout, and the notation is generally clear, though the expression $(\mathbf{r}_n - \mathbf{r}_m \,.\, \mathbf{S})$, or its equivalent, occurs frequently in situations where it could be replaced by $(\mathbf{r}_n - \mathbf{r}_m).\mathbf{S}$ with greater clarity and no increase in the number of symbols. (Parentheses are not part of the notation for a scalar product.) A few misprints and slips have been noted, but none likely to cause more than a moment's hesitation. Perhaps the most important is on page 476, where it is stated that the distances between centres of close-packed spheres are given by $\sqrt{(h^2 + k^2 + l^2)}$ times the diameter of the spheres. There are bibliographies at the end of each chapter, with an average of about fifty entries, mostly earlier than 1940, and in the whole book there are only two or three later than 1943. A curious omission occurs in Chapter 10, where four pages of text are devoted to a paper not included in the bibliography. These are minor blemishes, however, and do not detract appreciably from the value of this important conspectus of the theory of X-ray diffraction.

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SOME SELECTED PROBLEMS IN RADIO AERIALS

Radio Aerials
By Prof. E. B. Moullin. (International Monographs on Radio.) Pp. xi+514. (Oxford: Clarendon Press; London: Oxford University Press, 1949.) 50s. net.

THIS volume is the second in the series of "International Monographs on Radio". It mainly describes the author's theoretical and experimental investigations during the Second World War of certain types of aerial systems. The presentation and treatment of the material have been markedly influenced by the author's outlook and his particular approach from the field equations, which will prove to be stimulating to some readers, but may be a defect in the eyes of others. It is, however, felt that the title should have indicated the restricted scope of the topics considered, which represent only a fraction of the subject of radio aerials.

The first two-thirds of the book is theoretical. Chapter I introduces the electromagnetic theory used in the later chapters, and mixed C.G.S. units are used throughout. The majority of the problems considered involve cylindrical co-ordinates, and the properties of Bessel functions are accordingly presented. Chapter 2 deals with curtain and in-line arrays, and contains the calculation of the power gains of typical arrays and of the radiation resistances of their elements using the induced-E.M.F. method. As an alternative method of calculating the power radiated by an aerial, the integration of the Poynting