open question. The important case of tourmaline is also an interesting one, in light of more recently published papers on the structure by Donnay & Buerger (1950), and Ito (1951). Both workers have used the classic method of refinement, by reading atomic coordinates from a Fourier map. Each has arrived independently at what is undoubtedly the correct structure, but refinement cannot proceed beyond $\pm 0{\cdot}05$ Å by such a method based on a projection 7·2 Å deep. Recourse should be made to three-dimensional methods (with appropriate series-termination corrections) or differential methods; perhaps a least-squares analysis would be the most direct method.

Finally, at the end of the book is a detailed discussion of a procedure for indexing a triclinic powder pattern. The procedure consists of indexing the pattern on an arbitrary unit cell, based on three lines of low angle (representing three non-coplanar reciprocal lattice vectors), followed by a series of ingeniously symbolized systematic transformations after Delaunay, to find the proper unit cell for a triclinic, monoclinic or orthorhombic (or higher symmetry) lattice. The method is illustrated by application to two known crystals, and appears to be complete and straightforward, though its success admittedly requires very accurately determined spacings. The practicability of such techniques as this can only be proved, however, by its successful application to several unknown examples.

References

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Geometrische Kristallographie und Kristalloptik.

By F. Raaz and H. Tertsch. Pp. x + 215, with 260 figs. Vienna: Springer. 2nd ed. 1951. Price 32*s*. 6*d*.

The science of crystallography has nowadays so many diverse applications that a sound knowledge of the subject is rapidly becoming indispensable to an ever increasing number of scientific workers both academic and industrial. Although the emphasis has passed from the purely morphological to the structural aspect, it is unsatisfactory for the student to go straight into the study of the principles of structure analysis without the initial discipline of a course in morphological and optical crystallography. For this purpose an introductory textbook, such as this, provides an admirable approach.

The second edition is practically a reprint of the first, which appeared in 1939. It is divided into two parts: the first, by Prof. Raaz, deals mainly with morphological crystallography, and occupies 123 pages; the second, by Prof. Tertsch, consists of only 85 pages, and deals with the optical properties of crystals. The general arrangement of each part follows orthodox lines. After the discussion of axes, indices, zones, stereographic and gnomonic projections, crystal symmetry and the systems with their classes, the first part ends with a short description of twinning and a very concise historical summary of ideas on crystal structure. In the descriptive section of the crystal classes, iodosuccinimide (p. 68) is used to illustrate class C_4^v–*4mm*. This is correct according to the outward symmetry shown in Fig. 74, but the substance has now been placed in class C_4–4 on structural grounds.

The second part of the book is exceedingly concise, most aspects of theoretical crystal optics being dealt with, together with outlines of the optical methods; these including not only microscopical ones, but those also in which polished plates and prisms are used. Brief sections are devoted to the effects of temperature and pressure on optical properties.

It is a pity that in this edition the optical part could not have been expanded somewhat to give more practical guidance in the technique of determining optical properties. A little over one page is all that is devoted to immersion methods; about two pages are given to a description of the polarizing microscope; and—not so serious in an introductory text—two and a half pages to a description of the construction and use of the 4-axis Federov Universal Stage. These are minor points however. The book is otherwise excellent; it is clear, concise, has a good range, is very legibly printed and (although some of the diagrams are rather small) is well illustrated, especially in the morphological section.

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Der Ultraschall und seine Anwendung in Wissenschaft und Technik.

By L. Bergmann. Pp. xi+748, with 460 figs. and 83 tables. Zürich: S. Hirzel Verlag. 5th ed. 1949. Price 50 Swiss francs.

This well known book, now in its fifth edition, stands completely apart in its field; it is so much better and so much more complete than other books on the same subject that one is tempted to call it *the* book of ultrasonics.

As in the preceding edition, the book is divided into two parts: the first deals with the production and the measurement of ultrasonics; the second is devoted to applications. It is impossible, in this short review, to give an idea of the wealth of material, scientific or bibliographic, contained in these 750 pages. Let us simply list a few of the applications covered thoroughly: velocity and absorption of ultrasonics in liquids, gases and solids; ultrasonic stroboscopy; material testing; application to communications techniques; coagulation and dispersion produced by ultrasonics; cavitation; chemical, thermal, biological and medical action of ultrasonics.

This new edition has been brought fairly up to date; for instance, its description of the use of the pulse method is adequate. It contains a very remarkable series of photographs (between crossed nicols) of vibrating glass rods. The reviewer found it worth while to devote some time to the contemplation of their beauty, their symmetries and the elaborate nature of their patterns. The sort of delight one gets thus is too rare in modern physics to pass unnoted.

One sometimes may wish that Bergmann had been more critical instead of retaining an aloof and purely de-

scriptive attitude. A word or two on the value that a connoisseur like Bergmann would attribute to the work being described would have helped in many cases (see especially the application to biology). On the whole, though, this book cannot be too highly recommended. Every one having to deal with ultrasonics will need to refer to it sometime or other.

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Theory of Groups and Its Application to Physical Problems.

By S. BHAGAVANTAM and T. VENKATARAYUDU. Pp. x+274. Waltair: Andhra University. 2nd. ed. 1951. Price Rs. 20.

The appearance so soon of a new edition of this book, originally published in 1948, seems to indicate an increasing interest in the applicability of group-theoretical ideas in the fields of molecular and crystal physics.

This new edition, while following closely the material and organization of the first edition, has been improved in several directions. Two new chapters have been added and some of the old material has been regrouped to make for better continuity. In the re-set chapters the closer coupling of text and tables, and the reorganization of the latter, help considerably. Throughout much of the text important points have been added and many arguments have been tightened. A number of earlier mistakes have been corrected.

The discussion of the theoretical material in the first chapters has been expanded to give a much improved introduction to the basic language and methods of group theory. More examples have been introduced, and, while spatial symmetry is still discussed primarily geometrically, more algebraic arguments have been included.

In a new chapter, the analysis of the active Raman and infra-red modes in molecules has been extended to include a larger number of the simpler molecules and ionic structures. In connection with the discussion of normal modes some comment on the orthogonality of normal coordinates has been added. This explanation does not remove the discrepancies encountered when examples are worked out in detail later, since it ignores the fact that earlier, in agreement with common usage, normal coordinates had been defined with respect to kinetic energy.

The discussion of crystalline Raman spectra has been revised slightly to include a comment on the importance of selection rules, but the general treatment of crystal vibrations, criticized at length in the review of the first edition of this book (*Acta Cryst.* (1950), **3**, 79), remains unsatisfactory. The impression remains that a crystal has only $24p-3$ normal modes, if there are p atoms per Bravais cell.

A new chapter deals with the symmetry of various macroscopic matter tensors in the different crystal classes. Finally, a small addition discusses in very condensed form the application of group theory in relativistic elementary particle theories.

The Mauguin–Hermann notation has been introduced in one general table but the Schönflies notation is used otherwise. More names are mentioned in the text than before, but there are very few detailed references.

In its revised form, the book has become more balanced both as an introduction to the theory and in the extensive discussion of the many applications. This has greatly increased its interest and its usefulness.

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Structure Reports for 1947-1948.

Edited by A. J. C. WILSON, C. S. BARRETT (metals), J. M. BIJVOET (inorganic compounds) and J. MONTEATH ROBERTSON (organic compounds). Published for the International Union of Crystallography. Pp. 779 with many figs. Utrecht: N. V. A. Oosthoek's Uitgevers Mij. 1951. Price 55 guilders.

In sieben Ergänzungsbänden hat die *Zeitschrift für Kristallographie* der Akademischen Verlagsgesellschaft in Leipzig bis 1939 *Strukturberichte* herausgegeben, in denen möglichst vollständig die Kristallstrukturbestimmungen zusammengefasst wurden. Durch den zweiten Weltkrieg und das Eingehen der Zeitschrift entstand eine grosse Lücke. Nach dem Krieg wurde die Union of Crystallography gegründet, die bereits 1948 eine Kommission für Strukturberichte einsetzte und als neue Zeitschrift die *Acta Crystallographica* herausgab. Mit grosser Spannung hat man den ersten Band der neuen *Structure Reports* erwartet, der als Band 11 die Strukturbestimmungen der Jahre 1947–1948 umfasst. Es ist verständlich, dass die Materialsammlung für die Jahre 1940–1946 zunächst zurückgestellt wurde, obschon es gerade für diesen Zeitraum grosse Schwierigkeiten bereitet, die Literatur zu finden. Hoffentlich wird die Lücke recht bald ausgefüllt. In der neuen Kommission hat von der früheren Herausgebern der *Zeitschrift für Kristallographie* P. P. Ewald mitgewirkt, der zum Strukturbericht 1947–1948 auch das Vorwort schrieb.

Der sorgfältig redigierte neue Strukturbericht stellt ein *unentbehrliches Nachschlagewerk* dar, und es gebührt allen Mitarbeitern hierfür grössten Dank. Die Einzelberichte werden im allgemeinen nach folgendem Schema gegeben: Name, chemische Formel, Literaturangabe, Elementarzelle, Raumgruppe, Atomlagen und Parameter der Atomschwerpunkte, Abstandsverhältnisse, variable Einzelangaben. Die Dreiteilung ist: Metalle mit streng alphabetischer Anordnung, übrige anorganische Verbindungen und organische Verbindungen, die beiden letzteren in einer wenig übersichtlichen Anordnung (ungefähr nach zunehmender Komplexität). Ein Sachverzeichnis und Formelverzeichnis ermöglichen für eine gegebene Substanz das Referat aufzufinden. Ein Autorregister beschliesst den Band.

Es ist selbstverständlich, dass man versucht, den neuen Strukturbericht mit den Strukturberichten der *Zeitschrift für Kristallographie* zu vergleichen und danach zu bewerten, ob er übersichtlicher und für alle Forscher, für welche der Kristall Untersuchungsobjekt ist, zweckmässiger oder doch gleich wertvoll ist. Der Referent muss gestehen, dass vom Standpunkt der Kristallographen und Kristallchemiker dieser Vergleich nicht zu Gunsten der neuen Form der Berichte ausfällt, die fast ausschliesslich für den Kristallphysiker gedacht sind, der sich um vergleichende Strukturlehre und Kristallchemie wenig kümmert. Durch P. P. Ewald und C. Hermann ist in den früheren Strukturberichten versucht worden, das reich-