are not experts in the field, is quite welcome.

This little book is aimed at the "nonspecialist and intelligent layman." It emphasizes the qualitative crystallographic origins of the phenomena, with only an occasional, and always very simple (with the exception of the last appendix) mathematical discussion. The author is more concerned with making the reader *feel* why a given fact is so than with giving a rigorous proof or analytical description. Thus the text, which is generally clear and is written in a pleasant and sometimes even lively style, often resembles that of the more technical articles in *The Scientific American* with just a pinch of mathematics sprinkled in. In addition, the reader is given glimpses of a wide variety of solid-state phenomena and concepts, as these are gradually introduced to provide the necessary background.

The first two-thirds of the book is approximately evenly divided between four topics: crystals, basic diffusion concepts, diffusion in metals, and diffusion in ionic crystals. The remaining third is devoted to shorter discussions of diffusion in covalent crystals, grain boundaries, temperature gradients, effects of pressure and electron drift, and several brief mathematical appendices. For the most part I think the author has reached his goal of making diffusion phenomena seem real, ordered, and reasonable to the nonspecialist reader. One distressing defect of the book, however, is that the quality of the figures does not match that of the text. Several of the diagrams seem to have been carelessly produced; several more are confusing; and a few contain significant errors. It is to be hoped that this blemish in an otherwise attractive book will be corrected in a second printing.

It might be of value to compare this work with another thin and recent book on the same topic, Shewmon's *Diffusion in Solids* (McGraw-Hill, New York, 1963). Shewmon's text presumes a background knowledge of the physics of solids, is somewhat more technical, and specializes a bit more on metals. Thus, the two books are written for different readers and have different aims; therefore I am (fortunately) spared the task of making a difficult choice between two well-done volumes.

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## Elementary Particles

**Elementary Particle Physics**. Gunnar Källén. Addison-Wesley, Reading, Mass., 1964. xiv + 546 pp. Illus. $15.

Gunnar Källén tells us in the foreword that his book is based on a course given at Lund for students with a theoretical background. But the text leaps along at a lively pace with prodigal use of connective phrases such as "it is easily verified that . . ."; "we leave the working out of details to the reader . . ."; "it is a straight forward task to verify . . ."; "as is well known . . ."; "the integration can be performed by straight forward methods and . . ."; "we do not insist on the algebraic details here but leave them as an exercise for the reader . . ."; and similar expressions, without reference to sources where the missing material may be found. Therefore, if you want to use this book as one of the major texts in a graduate course on elementary particles, you will have to expend considerable effort to fill the gaps.

Actually, although few people will want to teach directly from this book, it is going to be a very useful one for the experimentalist working on the frontiers of elementary particle problems to keep at hand. For example, there is a lengthy treatment of dispersion relations and a (sketchy) comparison with experimental details, and there is a chapter on meson photoproduction with an excellent comparison of theory with experiment, containing a fair-minded statement on the uncertainty of identification of the quantum numbers of the higher resonances. Moreover, the chapter on pion production in pion-nucleon collision has an extremely valuable derivation of the cross section for one pion exchange and an extensive comparison with experiment. Multiple pion resonances, strange particle resonances, and associated phenomenological theoretical treatments (for example, Dalitz diagrams, methods of spin determinations, and expressions for phase space) are very usefully discussed. There is an entire chapter on nucleon form factors, concluding with a brief discussion of possible relation to multipionic resonances.

There is a nice treatment of space reflection and of charge conjugation, but unless you already know how, you will have to work out G parity for yourself. The subject of time reflection is similarly briefly treated. The optical theorem is mentioned only in a brief paragraph, and, in fact, diffraction theory is omitted. On the other hand, about one third of the book treats weak interactions with great detail—for example, beta decay selection rules, energy spectrum angular correlations, conserved vector current, decay probabilities, and the $\Delta T = \frac{1}{2}$ and $\Delta Q = \Delta S$ rules. Sufficient reference is given to the experimental literature so that the reader can nearly always go on into the subject.

Group theoretic treatment of elementary particles is not discussed in this book, nor is nucleon-nucleon and hyperon-nucleon scattering.

This is a book with limits and strengths that strongly reflect its author's personal tastes and disciplines. I am glad to have it on my shelf.

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## Mathematics

**Integral Equations**. And their applications to certain problems in mechanics, mathematical physics, and technology. S. G. Mikhlin. Translated from the Russian edition (Moscow, 1959) by A. H. Armstrong. Pergamon, London; Macmillan, New York, ed. 2, 1964. xiv + 341 pp. Illus. $12.50.

This is the second English edition of this work, which was originally published in Russian in 1944. Of course, revisions have been made, but the differences between the first translation (1957) and this volume seem to be relatively minor.

The book is divided into two parts. The first, and smaller, is devoted mostly to the Fredholm theory and states the most important theorems. The author furthermore outlines the various methods of proving existence and uniqueness, which methods are later used as practical means for getting approximate answers to physical problems.

The second part covers several different types of integral equations that serve as mathematical models of some physical problems. Most of the equations can be reduced to the Dirichlet type, however, and a goodly number are symmetric (self adjoint) equations.

The problems are attacked by the techniques of successive approximations and of expanding solutions in series of eigenfunctions that span the space of solutions to the reduced equation, when known.

The last chapter of each part is concerned with a discussion of what the author classifies as singular integral equations—that is, those in which the kernel, K, can be represented as $K(s,t) = \frac{A(s,t)}{|s-t|}$, where A is analytic.

The bibliography seems to contain a fairly extensive sample of Russian work on the applications of integral equations.

The author does a great service by bringing together in one volume more applications than are available in any other work, but this does mean that the problems cannot be intensely examined. Anyone who plans to use this book should have a knowledge of complex variables, and if he does not have a grounding in integral equations he should have at hand something like Courant and Hilbert's book.

Some things are puzzling. The author introduces the concepts of inner product and norm, and also operator, then uses them very sparingly. Furthermore he fails even to mention the powerful generalizations that can be made when one uses the Stieltjes integral.

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## Crystal Dislocation

**The Direct Observations of Dislocations**. S. Amelinckx. Academic Press, New York, 1964. x + 487 pp. Illus. $17.

This book provides beautiful and ample evidence that all of the curious kinds of behavior devised by imaginative geometrical theorists before anyone ever "saw" a crystal dislocation do in fact exist. During the first 15 or 20 years after the dislocation theory was developed, a small group of theorists devoted themselves to exploring the geometrical configuration and the elastic stress fields of dislocations in various crystal structures. This first stage culminated in books that emphasized the theoretical developments [W. T. Read's *Dislocations in Crystals* (McGraw-Hill, 1953); A. H. Cottrell's *Dislocations and Plastic Flow in Crystals* (Oxford University Press, 1953); and J. Friedel's *Dislocations* (Gauthier-Villars, 1956, and Addison-Wesley, ed. 2, 1964)].

After the theory was developed experimental research workers began their attempts to find methods of observations that would give direct evidence concerning the behavior of dislocations. The extent of their success can be seen in this book in which a prominent scientist who has done much excellent work in the field describes many of the observations. The book is filled with many pictures that form a graphic record of the various ways in which dislocations reveal themselves. Amelinckx begins by describing crystal growth, the first phenomenon in which single dislocations or a few dislocations play a decisive role. Observations using low resolution are discussed first; they are made with an ordinary optical microscope. The author then describes evaporation methods using replicas which have recently become a high resolution method. He then discusses and considers the etch pit methods for ionic crystals, semiconductors, and metals and considers techniques for decorating the dislocations with impurities. Amelinckx himself has done excellent research in this area. The various x-ray methods are then described.

Most of the above discussion deals with low resolution research—that is, distances smaller than $5 \times 10^{-5}$ centimeters are not usually resolved. That discussion precedes a very complete coverage of the research involving transmission electron microscopy where the resolution can be 15Å. The theory is examined, and the kinematical and the dynamical theory are given. Applications in which all of the strange things that dislocations do in thin films of pure metals, alloys, and ionic crystals are described and illustrated in beautiful pictures. Finally, direct resolution of crystal lattices and the moire patterns of two thin crystals are described, and the influence of dislocations in such experiments is shown.

On the whole, the emphasis is geometrical and descriptive, although quantitative calculations are given where they provide useful information and can be made. This emphasis on the geometrical and the descriptive is a valid reflection of the state of the art. Thus far only about 20 percent of the observations are quantitative. In the future, with much hard work, more accurate numerical measurements will be made.

This excellent book has been published at the right time. It is well worth the attention of anyone interested in dislocations.

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## A World Stratigraphy

**Les Temps Fossilifères**. vol. 1, *Paléozoïque Inférieur*. Henri Termier and Geneviève Termier. Masson, Paris, 1964. vi + 689 pp. Illus. F. 270 ($54).

A well-known and widely used American text in a certain field of geology was condescendingly dismissed as a "masterful compilation," but one cannot thus slightingly refer to the genuinely masterful works we have come to expect from the Termiers. The present work, gorgeous in its scarlet and gold binding, weighing in at $8 per pound, and the two volumes yet to come will constitute the "Traité de Stratigraphie et de Paléogéographie" (the second volume, *Paléozoïque Supèrieur,* is in preparation), a work foreshadowed by the same authors' previously published books—*Evolution de la Lithosphère* (1956-1957), *Erosion et Sedimentation* (1960), *Paléontologie Stratigraphique* (1960–), and *Histoire Biologique de la Biosphère* (1952). The Termiers refer to the *Traité* as a more systematic and more detailed form of the last, a considerable understatement.

This volume can be compared to only one other work of this century—Haug's *Traité de Géologie* (II. *Les Périodes Géologiques*), published in 1911. For years the working geologist has kept Haug at his elbow so that he can turn to it first when searching for an entering wedge to the stratigraphy of practically any part of the world.

The plan of *Les Temps Fossilifères* is logical and easy to follow. After pointing out that this treatise is essentially for readers who are acquainted with the principles of stratigraphy, the Termiers content themselves with reviewing certain ideas about the relations of strata to each other and relevant questions: unconformity as indication of relative movements of land and sea; initiation of sedimentary cycles; paleontologic