more derivations of equations rather than depending so very heavily on the presentation of final equations. Another example of overemphasis on the rule-of-thumb approach is the rather light treatment given to the x-ray effect in ionization gauges and that given to the significance of the development of the Bayard-Alpert gauge.

The author should be complimented on the overall accuracy of his statements and examples. Some statements do not reflect the latest literature, but these are primarily in the field of ultra-high vacuum. In general, the text is a valuable one not only for the beginner but also for the more experienced worker. I enjoyed reading it and think that this book would be a valuable addition to the library of anyone who devotes much of his time to using or designing vacuum equipment.

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Rutherford of Nelson

The Collected Papers of Lord Rutherford of Nelson. vol. 2, *Manchester.* Published under the direction of Sir James Chadwick. Interscience (Wiley), New York, 1963. 590 pp. Illus. $17.25.

The first volume of Rutherford's *Collected Papers* was reviewed in this journal [*Science* **137**, 1044 (1962)] on 28 September 1962. We now have the second volume, which covers the Manchester period from 1907 to 1919, the most fruitful and the happiest epoch of Rutherford's life. In 1931 he said, "I owe a great debt to Manchester for the opportunities it gave me for carrying out my studies. I do not know whether the University is really aware that during the few years from 1911 onwards, the whole foundation of the modern physical movement came from the physical department of Manchester University." The statement is not modest, but it is truthful and reflects, I believe, Rutherford's personality. What were these foundations of modern physics? The discoveries of "the nature of the α-particle" (p. 134); "the scattering of α- and β-rays and the structure of the atom" (p. 212); "collision of α-particles with light atoms" (p. 547)—in plainer words, the discovery of the nucleus, of the structure of the planetary atom, and of the artificial disintegration of the nucleus.

When these momentous discoveries are followed in the *Collected Papers* they appear in a very different light from the textbook presentation with which every physicist is acquainted. In school we learn one hypothesis and all the facts that buttress the hypothesis and make it into an accepted theory, but to the discoverer there are always innumerable choices and the path to the final result is far from straight and clear.

Every physicist will gain something from the perusal of these papers, not factual information but an education on the qualities needed to be a great investigator. Humble, tedious, and apparently pedestrian investigations are the daily routine, even of a Rutherford, but once in a while this struggle, which tests the endurance and patience of the experimentalist, leads to supreme achievements. Perhaps it will also be a comfort to common mortals to realize that even Rutherford occasionally made mistakes or followed false leads. On the whole, Rutherford's already legendary figure is made much more human by these papers, but his personality does not lose anything in the process. In developing our personal acquaintance with the author we are helped very much by essays written by N. Feather, H. Geiger, E. N. da C. Andrade, and A. B. Wood, for the authors communicate effectively their own experiences in the exhilarating surroundings of the Manchester Laboratory. These essays give an intimate view of Rutherford, of the unique assembly of young talents surrounding him at Manchester, and of their personal relations.

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Solid-State Physics

Quantum Theory of Solids. C. Kittel. Wiley, New York, 1963. xii + 435 pp. Illus. $13.50.

During the last decade very few domains of physics advanced as successfully as solid-state physics. This may be verified by studying Kittel's *Quantum Theory of Solids* and then comparing it with a book which has the same title but was written a generation ago by R. Peierls. The older book is essentially a study in applied quantum mechanics. The new book could perhaps also be called that, but under that guise it presents a very large number of new experimental and theoretical ideas. The most impressive aspect of Kittel's book is the number of advanced theoretical techniques that he presents. Many of these techniques were originally designed to solve problems in other fields, a context in which they sometimes met with indifferent success. Kittel's book demonstrates to those who are inclined to doubt that these methods do extremely well in solid-state physics.

Since the book deals with the most advanced topics in an active field, it is a difficult book to read. But it can be recommended to advanced graduate students and research workers, or to average graduate students who have expert guidance available. It must have been a difficult book to write. Only an author with a truly encyclopedic knowledge could think of doing it. Kittel shows that he has such knowledge.

In addition he shows that he has a strong physical intuition which helps elucidate many difficult passages. However, the task is so hard that uniform success cannot be expected. Every once in a while we find that a close argument on a physical point has been terminated by a reference because a complete account would be too long. And of course, the recapitulation of involved mathematics means a number of misprints. It might be useful to publish a table of such errors at some future date. For this book may very well become a standard reference work for research workers in solid-state physics.

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Crystallography

The Art and Science of Growing Crystals. J. J. Gilman, Ed. Wiley, New York, 1963. x + 493 pp. Illus. $20.

One of the most remarkable trends in contemporary physical science, a trend which is still gathering momentum, is the increased interest in single crystals. Long gone are the days when man's interest in crystals was largely esthetic, or when their chief economic use was as gems; gone, too, are the days when

crystallography, in its proper and wider sense, as the science of crystals, was the concern principally of mineralogists. It is true that chemists had a recognized and vital interest in crystallization processes for phase separation and purification, but it is only now that they strive for the large crystal as an end in itself in their search for matter in its most perfect, most characterizable, its most reproduceable form. It is equally true that for a little while physicists have used some optical properties of crystals such as the transparency to radiation of particular wavelengths. The interest in those physical properties that can be exhibited only by crystals, not by polycrystalline, amorphous, or fluid materials, is a more recent development that was stimulated by the spectacularly successful applications of piezoelectrical properties. Even that interest is already overshadowed by the study of relatively few highly specific defects in the otherwise regular atomic arrays of good crystals. Solid-state physics, the subject to which I refer, has opened the door for the semiconductor industry to solid lasers and to other energy-conversion crystal devices that are remolding the whole of our technology.

With all this and even more diverse interest in crystals, we might expect the techniques of growth to be highly developed and the physical mechanisms of crystal growth to be clearly understood. But that is not the case. Despite some notable exceptions, much of crystal-growth practice is haphazard, almost prescientific. To amend this state of affairs is one of the most urgent tasks facing contemporary science.

One immediate requirement is good textbooks, and so far there is certainly no glut of books in this field. It is likely that, for some time, *The Art and Science of Growing Crystals* will remain one of the few in the field. Fortunately it is a good book, and the 30 distinguished contributors and the editor, who have earned a permanent place for their book in the literature of crystal science, deserve our gratitude.

Yet, I feel obliged to warn about a few of this book's shortcomings. It is really a collection of 23 review articles on crystal growth, many of which are quite admirable, up-to-date accounts. Most branches of the subject are covered, often in several chapters without cross references. Polymer crystal growth, a topic that differs from most of the others, has justifiably been omitted; but there are other areas—for example, the production of thin single-crystal films, whisker growth, the use of high-temperature plasmas, and low-temperature solution growth—in which a more detailed and planned coverage might have been helpful to many readers.

The only real guide to any plan for the book must be gleaned from the table of contents. The four major divisions—Vapor Growth, Precipitation from Liquid, Solidification, and Recrystallization—are well chosen, but chapter 21, on alkali halides, has slipped into the wrong division of the text. The subdivision of each major division into "general principles" (one or two chapters) and "specific substances" is doomed to failure because inevitably some chapters are concerned with specific growth methods, not with specific substances.

The index is inadequate. Some important references are not given. For example, not a single paper by Haussuehl is quoted, an omission that will add, in German eyes, a little substance to the unfortunate and largely unjustified belief that Americans do not read papers published in foreign languages.

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Mathematics

Abstract Harmonic Analysis. vol. 1, *Structure of Topological Groups, Integration Theory, and Group Representations.* Edwin Hewitt and Kenneth A. Ross. Springer, Berlin; Academic Press, New York, 1963. viii + 519 pp. Illus. $19.

This book is the first of a projected two-volume treatise on modern harmonic analysis. It assumes on the part of the reader a knowledge of measure theory, point set topology, and algebra at the first-year graduate level. However, a whole chapter is devoted to a detailed development of integration theory on locally compact Hausdorff spaces, and additional background material on groups, topology, topological linear spaces, and normed algebras is available in a short initial chapter and three appendices.

The body of the book lies in four long chapters on locally compact groups. After working through the elementary theory not depending on local compactness, the authors establish the existence and basic properties of the Haar integral, mean values for bounded functions and the convolution algebra $M(G)$, and prove the Gelfand-Raikov theorem which asserts the existence of sufficiently many irreducible unitary representations. Beyond this fundamental material, the principal focus is on the structure theory of locally compact Abelian groups, including, of course, and ultimately depending on, the duality theorem, which is here given the Pontryagin-van Kampen structure-theoretic proof.

This synopis hardly accounts for the 500 densely packed pages that make up this volume. The special flavor of the work lies both in the meticulous, detailed development of its subject matter and in its almost encyclopedic air which results from the inclusion of rather special material not found in other books on the subject and from the discussion of large numbers of concrete examples. The dual aim of these two aspects of the treatment is accessibility to the beginner and usefulness to the expert. My chief regret is that this measured development has resulted in almost all the subject matter of harmonic analysis itself being put off to the second volume, which, in the nature of things, may not be available for some time.

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Note

Soviet Scientists

Soviet Men of Science (Van Nostrand, Princeton, N.J., 1963. 441 pp. $12), edited by John Turkevich, contains a collection of brief biographies of more than 400 academicians and corresponding members of the Academy of Sciences of the U.S.S.R. The material was obtained from sources scattered throughout Soviet literature; individual biographies were sent to the scientists for approval, and "many Soviet scientists have . . . corrected their biographies." The sketches vary in length: approximately six pages, including biographical citations, a bibliography, and his office address, are devoted to Viktor Amazaspovich Ambartsumian but only three lines to Mikhail Vladimirovich Khostenko—"In June 1963, M. V. Khostenko was elected Corresponding Member of the U.S.S.R. Academy of Sciences."