and orbit determination by Doppler frequency-shift measurements are also included.

Vector and matrix notation are systematically used throughout. This enables the author to contain much more material within the confines of a relatively thin volume but leaves it highly theoretical and austere. Thus we have fairly complete expositions of the recent contributions of Brouwer, Garfinkel, Herrick, Izak, Jacchia, Kozai, Musen, Vinti, and others. But in other cases, the classical perturbation techniques for example, only brief summaries of the problem formulation and solution are given. This is actually a good feature, for the topics treated briefly here are well treated elsewhere and full references are given. As presented here, the Hamilton-Jacobi equation forms the foundation of perturbation theory. Recent publications, apparently issued after the book's manuscript was completed, have shown there are other approaches to perturbation theory. Nevertheless, we have here the classical approach.

Some topics had to be left out, in particular the motion of libration of the vehicle about its own center of mass and optimization of orbits. Other topics such as perturbations due to atmospheric drag, the earth's oblateness, and sundry minor perturbations have been included. The author's choice of material is commendable. This should be a good text for the teacher of graduate courses in orbital mechanics and an excellent reference for anyone concerned with the dynamics of space vehicles.

The Cherwell-Simon Memorial Lectures 1961 and 1962. By H. B. G. Casimir and J. H. Van Vleck. 79 pp. Oliver & Boyd, London, 1962. 8s 6d.
Reviewed by R. Bruce Lindsay, Brown University.

The Cherwell-Simon Memorial Lecture was founded in 1960 in joint memory of Lord Cherwell and Sir Francis Simon. Both of these well-known physicists had been professors of experimental physics at Oxford University—Cherwell (earlier F. A. Lindemann) from 1919 to the time of his death in 1957, and Simon from 1945 until his death in 1956. The first memorial lecture was given by Sir George Thomson in 1960. The present volume contains the second and third lectures given in 1961 and 1962 by H. B. G. Casimir of the Philips Laboratory, Eindhoven, and J. H. Van Vleck of Harvard University, respectively.

Both lectures merit a careful reading by the scientific community and perhaps an even more thorough one by nonscientists in positions of public and academic importance. Dr. Casimir chose as his topic "Technological Advance: A Stimulus to Basic Research". While the story he tells is by no means new, it deserves continued emphasis by outstanding scientists, so that the mutual relationship of science and technology will not be misunderstood. It is now a truism that modern technology depends directly on basic scientific research, but it should not be forgotten that advances in technology have been necessary for the sophisticated scientific research of the present. Both aspects are brought out by Casimir in effective and often witty fashion.

Professor Van Vleck's lecture addressed itself to "The So-called Age of Science". As the title suggests, the theme is the misunderstanding on the part of the general public of the fundamental nature of science. Though we are said to live in an age of science, people in general do not understand what science is about and confuse it with its technological applications. Hence, in spite of the long history of its contributions to our civilization, it still lacks acceptance as a major part of our cultural ideology. Van Vleck presents in incisive fashion his views as to the reasons for this situation, including the facts that science is difficult and that the general public distrusts scientists because of the terrific power they are placing in the hands of those who may abuse it. The author also pays his respects to those humanists, all too numerous, alas, who are unwilling to admit that science has any cultural value whatever. Perhaps scientists themselves should assume a greater obligation in the endeavor to persuade our humanistic colleagues to take a more rational and helpful view, but the melancholy fact remains that there are many who appear to prefer that the so-called gap between science and the humanities never be bridged. Such people ought certainly to read and ponder Van Vleck's reasoned approach to this fundamental problem.

In addition to the two lectures mentioned, the volume reprints a speech by Lord Cherwell in the House of Lords in 1951 on the general theme of the development of technological education. This was largely a plea for the establishment of technological (or scientific) universities. One of its fruits has been the considerable expansion of the Imperial College of Science and Technology in the University of London. The book concludes with two short pieces by Sir Francis Simon on the critical inadequacy of British science to meet the demands of an increasingly industrialized world economy. Only our British cousins can estimate whether his impassioned pleas for action (just before his death in 1956) have had any influence on the progress of science and technology in Britain today. We in the United States could even now well afford to weigh his words with care.

X-Ray Diffraction in Crystals, Imperfect Crystals, and Amorphous Bodies. By A. Guinier. Transl. from French by Paul Lorrain and Dorothée Sainte-Marie Lorrain. 378 pp. W. H. Freeman, San Francisco, 1963, $11.00.
Reviewed by J. Gillis, Weizmann Institute of Science, Rehovoth, Israel.

It is useful to be reminded that x-ray crystallography does not end with crystal structure determination, any more than meteorology ends with weather forecasting. The decision to translate only the last part of Prof. Guinier's book was wise in that it has made it possible to concentrate on precisely those areas of the subject which are most inadequately dealt with in the existing literature. Moreover, these are the topics which offer some of the most interesting and challenging problems today.

After a short general introduction, the book discusses in turn diffraction by amorphous substances, crystalline powders, and imperfect crystals. The various types of imperfection are carefully studied along with their in-

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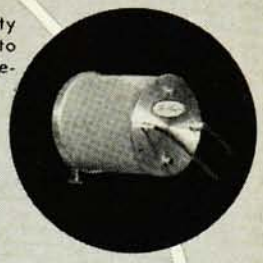

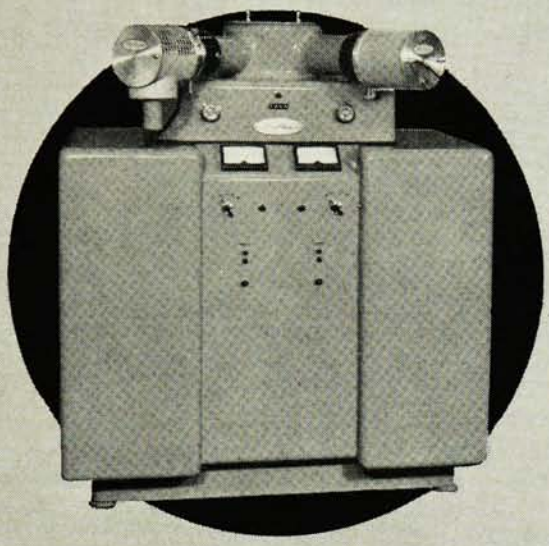

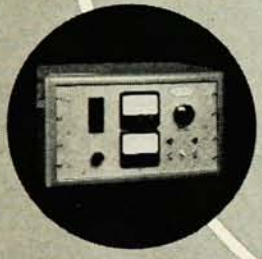

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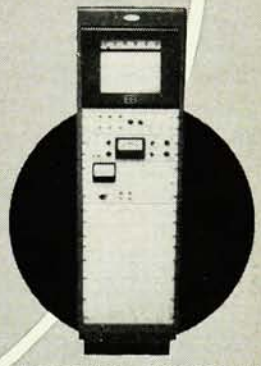

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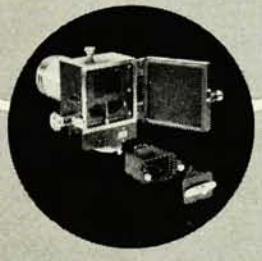

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fluences on the structure of the diffracted rays. The mathematical methods are simple but fundamental and suffice to examine all the basic problems without obscuring them. The chapter on small-angle scattering brings together the rather diffuse literature on the subject, much of it by the author himself.

Those who wish to study the mechanics of diffraction and what one can learn from it about crystal imperfections would do well to study this book carefully. Disorder and imperfection problems are of great actual interest and form the subject of extensive investigations. This lucid exposé of the various experimental methods, and of what one can learn from them, is likely to prove extremely helpful to workers in the field.

Fundamentals of Ultrasonics. By J. Blitz. 214 pp. Butterworths, London, 1963. $6.95. *Reviewed by Walter G. Mayer, Michigan State University.*

The small family of introductory texts on ultrasonics has been increased by one. Although this new book is relatively small, it is very informative and should be brought to the attention of the student of physical acoustics who is asking for a modern, uncomplicated, and not particularly specialized book on ultrasonics.

The author divides the book into essentially two over-all groups of chapters: low amplitude and high energy waves. The first of the chapters on low amplitude waves deals with general principles of propagation, velocity, impedance, absorption, reflection, and diffraction. The section on propagation in gases describes classical concepts of velocity and absorption; it also includes a discussion of relaxation and velocity dispersion. The chapter on low amplitude waves in liquids treats current topics like propagation in liquid helium, shear and hypersonic waves in liquids, in addition to more fundamental topics. The section on solids gives enough classical background, so the reader can follow the more modern topics of absorption due to lattice imperfections, electron-phonon interactions, and photosensitive attenuation. These chapters also give condensed descriptions of experimental techniques and methods of measurement. The last chapter in this group describes briefly low power applications: flaw detection, delay lines, and other applications.

The chapter on high energy waves contains short discussions on cavitation, cleaning, and some other effects. The much longer section (Chapter 3) on generators and receivers gives an introduction to transducer theory, and applications of many types of transducers, including the depletion layer transducer.

One should not expect a complete and detailed treatment of all of these subjects, and in some instances the discussion is rather sketchy. This does not seem to be too serious, because the author frequently refers the reader to standard books (Kinsler and Frey, Cady, Mason, Bergmann's collection, etc.) whenever he feels that these books already cover a particular topic. However, in doing so the author has not sacrificed continuity and balance of his own text.

The book is up to date and deals with topics one does not usually find in elementary texts. I believe that students and teachers of ultrasonics will find this book helpful.

Operator Techniques in Atomic Spectroscopy. By Brian R. Judd. 242 pp. McGraw-Hill, New York, 1963. $9.95. *Reviewed by J. A. White, National Bureau of Standards.*

When applied to electronic configurations as complex as those commonly found in rare-earth and transition-metal ions and salts, the familiar, straightforward, and elementary techniques for compounding the angular momenta of equivalent particles often prove discouragingly cumbersome. Many potent methods have been developed to handle such complex configurations, however, and these are expounded with unusual clarity and scope, though not always in great detail, in Professor Judd's *Operator Techniques*. The methods necessarily lean heavily on abstract mathematical properties of finite and continuous groups. Professor Judd has attempted throughout, however, to keep the practical researcher in mind, and has included for this purpose a good and abundant collection of illustrations and exercises (some touching on controversies still current in the literature). He has taken pains with details and has used a consistent and familiar notation.

A list of some of the figures in the text will suggest the range of mathematical topics treated. There are coupling diagrams for 3,6,9, and 12-j symbols, root figures and arrays of weights for continuous groups, and Young tableaux for equivalent electrons. These and interesting asides—to note, for example, which of all simple groups obtained in Cartan's complete classification in 1894 have yet to find application in spectroscopy (answer: surprisingly few—compare p. 112)—lighten the mathematics. Even with the illustrations, the diverting asides, and concise paragraphing, however, the central portion of the book, dealing at length with abstract group properties, may seem unnecessarily demanding and extensive to many workers in the field. Fortunately, much of this material can be left to be savored at leisure as a rich dessert, for the preceding and following sections can be used independently for most practical calculations. Only the simpler group properties are used in the early chapters to dispose efficiently of simple configurations and general effects of external fields, while in the later chapters the reader is instructed in the use of Racah's tables of coefficients to calculate matrix elements in complex configurations.

The practicality of the techniques is nicely illustrated in the last chapter in a detailed discussion of the configuration f^6 such as is found in the Pu ion in PuI. There, the energy levels for the free ion, their decompositions and displacements in crystal fields, and the nature of the superposed hyperfine structure are treated and compared with experiment.

Although ambitious in scope, this is not a long book—only 242 pages. When used either as a text for a graduate course or as a research tool, therefore, it will need to be supplemented with other material to complete the discussion of many subjects. The carefully selected, representative bibliography should be helpful for this purpose, while serving also as an introduction to research problems. To sum up: in this reviewer's opinion, Pro-