

son, Hecht and Nanger describe the method of magnetic attitude control used in the Tiros satellite, and McElvain presents a technique for using the geomagnetic field to remove the satellite's angular momentum. A paper by Williams considers the torque and attitude sensing problem for spin-stabilized synchronous satellites and how it was solved for the Syncom satellite. Two papers by Colombo and Naumann analyze the observed angular motions of the Explorer XI satellite.

As is true of many such collections of review articles, the ones contained in this volume do not go into sufficient detail to be anywhere near self-contained. The reader will have to turn to the references given. Some of these are company and contractual documents of limited circulation. However, on the whole the book does present an introduction to the scientific basis of attitude control, which is so important for many satellites, especially the orbiting astronomical observatory.

The Mechanics of Aerosols. By N. A. Fuchs. Translated from Russian by R. E. Daisley and Marina Fuchs. Translation edited by C. N. Davies. 408 pp. (Pergamon, Oxford), Macmillan, New York, 1964. \$17.50.

Reviewed by M. E. Straumanis, University of Missouri at Rolla.

Mechanics of Aerosols appeared first in Russian in 1955. When it was decided to translate the book into English, progress in aerosols was so rapid that parts of it became obsolete and the author was unable to correct the text. Instead he wrote, as it is said in the "Foreword to the English Edition," an addendum for this edition, covering the work published between 1954 and 1960 (in Russian the addendum appeared in 1961). However, the reviewer could not find the addendum in the book, although there are references for the period, including some of 1961.

The book is not a textbook. It is written for those who already have some knowledge about aerosols, their properties, and production, and who wish to broaden their knowledge with the intention of understanding the be-

havior of aerosol particles. The expression "Mechanics of Aerosols" as mentioned in the "Foreword", is used for the first time in this book and is only one, but an important, section of aerosol science. "Mechanics of Aerosols" is involved, e.g., in studies of the motion of droplets under various conditions (including electric fields), in the determination of the electronic charge, Avogadro's number, in condensation processes (Wilson's cloud chamber), Brownian motion, the absorption of sound waves, etc.

To give an example of how the author treats the material, Chapter 2 (of the eight chapters of the book) "Steady Rectilinear Motion of Aerosol Particles" (pp. 21-69) may be mentioned. In this chapter are the paragraphs: Resistance of a gas to the motion of very small particles; Stokes formula; Resistance of a gas to particles of a size comparable with the mean free path; Experimental verification and accuracy of Stokes formula; Resistance of a medium beyond the Stokes region; The general nature of the motion of nonspherical particles and rotation of particles in shear flow; Resistance of a medium to the motion of nonspherical particles; The settlement of clouds of particles; The motion of an aerosol in a confined space; Motion of particles in vertical and horizontal fields and practical applications (with the subtitles on the elementary electric charge, measurement of charge and mobility, determination of particle size, apparent density, and shape factors of particles); Radiometric forces in aerosols, thermophoresis, photophoresis, and diffusiophoresis. The next chapters are on "Non-Uniform Rectilinear Motion," "Curvilinear Motion," etc. Each chapter is treated fairly exhaustively with all the necessary equations, and frequently including the derivations. The aim of the author of the book was to collect and to examine critically all the experimental material concerning the mechanics of aerosols, although in many cases great mathematical difficulties had to be overcome. The criticisms are, of course, from the viewpoint of the author. There are also sections with less mathematics like "Deposition of aerosols in the respiratory system", "The spread of highly dispersed aero-

sols in the atmosphere", "The detachment and transport of particles by wind". There are 886 references at the end of the book, 162 of them referring to Russian authors. There is also a name and a subject index. However, the latter is not very extensive.

There seem to be no misprints in the book; it is well arranged, contains about 90 figures and makes a very good impression. It can be recommended not only to physicists who are interested in the behavior of small particles and droplets under various conditions in a gas, but also to colloid chemists and to engineers of the respective branches, such as aeronautical engineers, hydrologists, etc.

Crystals: Their Role in Nature and in Science. By Charles Bunn. 286 pp. Academic Press, New York, 1964. Cloth \$6.50; paper \$3.45.

Reviewed by H. D. Keith, Bell Telephone Laboratories.

This is a book written for beginners; in the author's words, "for natural philosophers, whether laymen or science students . . . who may find it an agreeable preamble to formal studies." And, in a qualitative, descriptive style, it covers the subject remarkably fully for a book of its size.

The writing is leisurely but economical. For example, the book opens by explaining the distinction between what the layman thinks of as "crystal" and what the scientist means by the term; yet, fifty pages later we have already advanced beyond intermolecular forces and an atomistic description of nucleation and crystal growth (including the Frank mechanism), and are on our way to morphology, symmetry operations, crystal optics, and x-ray diffraction as a means of determining structures. These topics are all developed in simple language although basic concepts are not handled superficially. Causal relationships are highlighted, and the discussion of how different molecular shapes and different types of intermolecular interaction are reflected in the macroscopic characteristics of the crystals to which they give rise is particularly lucid. Illustrative material is frequently drawn from quite recent work, and the book is

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much enriched by historical notes, and by chapters on gemstones and on crystals formed by biologically active polymers.

It is difficult, however, to write satisfactorily for two classes of reader at one and the same time. As a personal opinion, I think the author would have done better to sacrifice the interests of the few interested laymen, for whom the text will be hard going, and to concentrate more on the requirements of science students. As it is, the book is one which no student could read without being much better and wiser for it. With the elimination of the more elementary material, and a slightly more formal approach where quantitative considerations become important, it would have made an excellent and appealing textbook at a level which has thus far been neglected.

Physical Acoustics. Principles and Methods. Warren P. Mason, ed. Vol. 1, Part A, 515 pp., \$18.00; Vol. 1, Part B, 376 pp., \$13.50. Academic, New York, 1964. Reviewed by Walter G. Mayer, Georgetown University.

This is the first part of a series of six volumes on physical acoustics which, when completed, should become a very important contribution to the literature in this field. The multivolume work is designed to serve as a reference book as well as a textbook on an advanced level.

All of the seven chapters in Part A of Volume I were written by highly qualified experts. Chapters 1 (by R. N. Thurston) and 3 (by Berlincourt, Curran, and Jaffe) could be regarded as a very thorough introduction to wave propagation in liquids and solids, and transducer materials. One can hardly think of any basic aspect related to these topics which is not considered in these two sections. Chapter 2 (T. R. Meeker, A. H. Meitzler) is devoted to guided waves in plates and cylinders. Specific geometries for ultrasonic delay lines are discussed in Chapter 6 (J. E. May), which treats various modes in strip and wire delay lines, and in Chapter 7 (W. P. Mason) which gives a short discussion of multiple reflection delay lines. Another somewhat longer chapter by W. P. Mason is devoted

to the use of piezoelectric crystals and mechanical elements in oscillators and filters. Chapter 4 (H. J. McSkimin) illustrates many experimental techniques for determining elastic properties of liquids and solids and presents a thorough discussion of the theory related to mechanical properties of substances.

Although Part B is a continuation of Part A, it is primarily concerned with semiconductor devices capable of producing kilomegacycle acoustic waves. An introductory chapter (W. P. Mason) gives the mathematical and physical background, concentrating on semiconductors, p - n junctions, and Esaki diodes. Some of the topics discussed in this section are taken up more specifically in a chapter (R. N. Thurston) on the theory of piezoresistance coefficients and the use of semiconductor transducers for strain gages. The chapter on the use of p - n junction transducers (M. E. Sikorski) not only gives useful information on the operation of semiconductor diodes and many experimental results but also discusses various applications of these devices. The section on resistive layer transducers (D. L. White), although not overly long, presents a good treatment of principles of operation of depletion layer, diffusion layer, and epitaxial transducers. Both theoretical and experimental aspects of these high-frequency devices are discussed.

There are three additional chapters which, as far as subject matter is concerned, are more closely related to the content of Part A than to what may be considered the main topic of Part B, i.e., semiconductor devices. One of these chapters is a very short discussion (E. Eisner) of design characteristics of resonant vibrators. Another chapter (B. Carlin) gives a descriptive résumé of ultrasonic processing techniques used in cleaning, welding, drilling, and many other technical applications. Finally, there is an extensive section (H. G. Flynn) on acoustic cavitation in fluids. Since the liquid state of matter is much less understood than the solid state, it is not surprising that some explanations of cavitation processes are open for discussion. Nevertheless, the author of this chapter se-

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