aspects: theory, measurement, and application to practical problems. The absorption and scattering of solar radiation was the subject of an earlier book, which is not available in English, but the two topics are combined in chapter 7, which is concerned with the net radiative balance, principally at ground level—that is, with the prime topic from an agricultural point of view.

Radiative Heat Exchange in the Atmosphere was written in 1956, when it was a remarkable pioneering achievement. The present edition is in excellent English and contains additional references up to 1961 (why was it not published then, for the manuscript was essentially complete at that time?).

The book has many admirable features. The references are a gold mine, for not only do they record an extensive Soviet literature, but they appear to include most of the work of value carried out in the United States and in Europe. The physical fundamentals are treated with an awareness unusual in meteorological literature—for example, the careful discussion of the breakdown of local thermodynamic equilibrium. The book has a logical structure and development, and the subject is treated as a whole. Finally, theory and measurement of the surface radiative balance are treated with great detail and will be invaluable for agricultural research workers. Thus, chapter 6, which is concerned with long-wave radiation at the surface, occupies one-quarter of the entire book.

But the general meteorologist, or the reader whose interests lie in other planetary atmospheres, will find the theoretical argument rather uneven. Part of this uneven development can undoubtedly be attributed to the existence of Kondrat'yev's other works, but a student will surely find it difficult to understand the integral equations when the differential equation of transfer is not discussed. Moreover there are occasional claims that a derivation is "obvious," when important assumptions are implicit, but not expressed. Equation 4.1 is an example; the reader must seek elsewhere for an explicit statement of the awkward assumption that the absorption coefficient is *not* a function of state. The average reader would profit from elaboration in such sections at the expense of, say, the lengthy theoretical justification of semiempirical formulas in chapter 6.

It is also possible to take issue with the author on some factual and some theoretical points, but this does not rob the book of its essential merits based on its pioneering quality and its sound physical insights. It will be a standard work of reference for many years to come and can be read with profit by all students of meteorology.

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Radioactivity Measurements: Experimental Data

Die Physikalischen Grundlagen der Kernstrahlungsmessungen. E. Fenyves and O. Haiman. Akademiai Kiado, Budapest, Hungary, 1965. 727 pp. Illus. $17.50.

This encyclopaedic textbook of more than 700 pages is a most comprehensive *Handbuch* covering the whole field of radioactivity measurements and their physical foundations up to about the end of 1963. The preface is dated December 1963, but the book was published in 1965. Therefore most of the very full lists of references are dated prior to 1960. Of some 1700 references to other books and to original papers, only 5 percent were published subsequent to 1957, and the references for the years 1960 through 1964 number, respectively, 19, 10, 1, and 1 (the last cites a book "in press"). These references are actually a bit difficult to locate, some of the chapters being short and some quite long, and one has to thumb through the pages forward, say, until the figure or section numbers change, to indicate a change in chapter, and then turn back to find the references. Some indication of the chapter numbers on each page, in default even of an author index, would be a tremendous asset to this very valuable book.

The emphasis in this book, as one would infer from its title, is on the measurement of nuclear radiation, and the historical introduction is from the point of view of the "development" and "perspective" of the "methods" underlying such measurement. This introduction is followed by a description of the interaction of radiation with matter; the transmission of radiation through absorbers; the principles involved in various media of detection (for example, gas multiplication, scintillation, Cerenkov radiation, and photographic emulsion); the construction and operation of detectors for the detection of single particles; the use of such methods of detection to determine the physical properties of particles emitted from nuclei; the determination of gross energy and particle emission from radioactive samples (for example, microcalorimetry, dosimetry, and the measurement of the gross activity of radioactive samples by dosimetry or by comparison with radioactivity standards); the construction and operation of particle "track detectors" (for example, cloud and bubble chambers); and the determination of the physical properties of particles, largely cosmic, from their behavior in such "track detectors," with, for example, graphs and tables of range-energy relations in nuclear emulsions.

The book concludes with three appendices that deal with the use of radiation detectors in the discoveries of the elementary particles; the statistical evaluation of radiation measurements; and, finally, the principles of elementary circuitry used in the detection, amplification, discrimination, and multi-channel analysis of pulses due to nuclear particles. This last appendix is concerned entirely with vacuum-tube circuitry and although transistors are mentioned in its introduction there seems to be no further reference to them, even in the subject index. This, however, probably reflects the date of the preface, namely 1963.

There are a few curious omissions of reference. For example, the reference for the U.S. National Bureau of Standards "$4\pi\gamma$" ionization chamber is given (in the caption) as H. Muth in *Atompraxis* instead of to several publications from the National Bureau of Standards, which could give more data, and a $4\pi\beta$ counter that looks very much like the NBS version is captioned only as "after Muth," whereas the reference (the same article in *Atompraxis* by H. Muth) again credits the National Bureau of Standards and again gives appropriate references to NBS papers.

This book is, however, most comprehensive, with a wealth of experimental data in the form of curves and tables; it should be an excellent refer-

ence book for both teachers and students. More than 700 pages of good solid German may, however, preclude its use as a textbook in this country.

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Electrical Engineering

Fundamentals of Semiconductor Devices. Joseph Lindmayer and Charles Y. Wrigley. Van Nostrand, Princeton, N.J., 1965. x + 486 pp. Illus. $11.95.

As the title indicates, this book treats the fundamental physical phenomena of semiconductor devices with emphasis on understanding rather than on a bare presentation of facts. The gradual buildup of material allows an individual with limited background to undertake the study of "fundamentals," but owing to sufficiently detailed presentations, advanced solid-state scientists may well benefit from certain sections of this text.

The first eight chapters are devoted to an orderly development of these fundamentals as related to conventional semiconductor materials, diodes, and transistors. In addition to elementary considerations, appropriate attention is given to second-order effects, small-signal equivalent circuits, and large signal transients.

In the last four chapters consideration is given to more sophisticated effects in semiconductors and recent device developments, such as space-charge-limited currents, field effect devices, and hot-electron amplifiers. In common with other books that attempt to cover a wide variety of topics, the descriptions of recently developed devices are quite brief and merely serve as an introduction to the subject. This problem is compounded by the fact that the references for supplementary reading are few in number and quite inadequate for the purpose at hand.

The pedagogically sound scheme of organization, the clarity of exposition, the more than 400 excellent figures, and the gradual increase in depth of material as the treatment progresses should make this book particularly useful to technicians in industrial laboratories, who need an increased understanding of the semiconductor phenomena in which they are involved. It might also be viewed as a likely prospect when considering textbooks for use in an undergraduate course in the theory and technology of semiconductors. My own preference, however, would be one of the recently published texts which treats the same subject but relies more heavily on the experimental approach.

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Lectures in Mathematics

Systems of Linear Equations. B. E. Margulis. Translated from the Russian edition (Moscow, 1960) by Jerome Kristian and Daniel A. Levine. Pergamon, New York, 1964. x + 88 pp. Illus. $2.75.

The author has attempted a systematic development of the major elementary topics in the study of systems of linear equations. The material is presented in a straightforward manner, and most of it should be intelligible to a good high school student.

The introductory chapter, apparently designed to stimulate the reader and make him eager to pursue the rest of the book, is likely to have the opposite effect unless the reader has some basic knowledge of electricity and mechanics. This chapter is devoted to analyzing selected problems from physics and mathematics; it shows how these problems can be reduced to problems involving systems of linear equations. The author ranks it as fourth in difficulty among the seven chapters.

The topics of major interest are found in the mid-section of the book. The standard method of solution by reduction to triangular form is developed in chapter 3, and Gauss tables (essentially, programs for the reductions) for systems of 5th order and below are included. Determinants are introduced and Cramer's rule is derived in chapter 4. An iterative procedure that enables one to obtain a sequence of approximate solutions which converge to the actual solution is developed in chapter 5. Chapter 6 is devoted to obtaining approximate solutions of inconsistent systems, using both the method of the mean and the method of least squares.

I find chapter 7, on graphical methods of solution, of little interest. In this chapter, techniques are developed for reducing systems to triangular form and for solving the reduced systems by means of lines drawn in the Cartesian plane.

The book is well written, emphasizing techniques and results rather than mathematical rigor (a boon to the nonmathematician). In a typical "proof," the proposition is established for 2nd- and 3rd-order systems and the result is extended to higher order systems by analogy.

In my opinion, this book would be an excellent addition to the library of anyone who teaches algebra to high school students or college freshmen. It should also be useful to the nonmathematician who uses some of the methods described in the book without thoroughly understanding them.

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Visible and Ultraviolet Spectra

Volume 5 of **Absorption Spectra in the Ultraviolet and Visible Region** (Akademiai Kiado, Budapest; Academic Press, New York, 1965. 416 pp. + index. Illus. $23), edited by L. Lang, presents the spectra and numerical data for 192 additional compounds, almost all of which are organic in nature, although they generally contain hetero atoms. With one exception—a minor change in the manner of pagination that is designed to make it easier to avoid introducing spectra from one volume into another—the format of volume 5 is the same as that of the previously published volumes [vols. 1 and 2 reviewed in *Science* **136**, 519 (1962); vol. 3 in *Science* **142**, 223 (1963); and vol. 4 in *Science* **144**, 1564 (1964)]. Those who use this compilation frequently will welcome the inclusion of a cumulative index that covers all 898 spectra thus far published. This index is printed on punched sheets that may be placed in the ring binder with volume 5. The editors note that cumulative indices will be issued periodically and that future volumes will see an increase in the number of "medicinal compounds" included.

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