British Space Research

Space Physics. Harrie Massey. Cambridge University Press, New York, 1946. viii + 237 pp. Illus. Paper, $2.95; cloth, $6.50.

The appearance of a book on space physics written by a single author is a welcome addition to the literature of symposium reports and collections of specialized articles, for it allows, perhaps paradoxically, a much broader treatment of the subject. And Sir Harrie Massey, who is well known for his work in atomic physics and upper-atmospheric studies, and who is presently chairman of the British National Committee for Space Research is well qualified to write such a book. In nine chapters, Sir Harrie covers a range of topics from the operation of p-n junction solar cells and the theory of orbits in a gravitational field, through the nature of the upper atmosphere, to the emissions of the sun, moon, and planets. These topics are not by any means treated in the same detail, however, and the author's experience and interest are very clearly indicated in the quality of the presentations. The chapter that deals with the orbits of satellites in a gravitational field, and the determination of the figure of the earth and atmospheric density from them, is excellent. (There is no corresponding discussion of the gravitational and other torques on the satellite.) But the best chapters are the three that discuss the upper atmosphere and ionosphere; these chapters proceed logically and historically from a discussion of what has been learned, and how, by earthbound techniques to the solution of some of the problems, and the posing of new ones, by rocket and satellite observations. The instrumentation of the British satellite Ariel is quite thoroughly discussed, and many results of its observations are presented. (The book is based on a set of lectures that Sir Harrie presented at the Cavendish Laboratory, Cambridge, in November 1962, so that many of the results are preliminary.) These sections can be recommended to nonspecialists as among the best available summaries.

Once above the ionosphere however, the discussion is less thorough, even perfunctory. There is a discussion of the theory of particle trapping and of observations of the radiation belts, which touches on most of the essential topics, but which also leaves a great deal unsaid about them. In the last chapter, on lunar and planetary research, the properties of these objects are presented as so many numbers to be collected, without much discussion of their significance for the history of the universe.

There are no references, which means that the book cannot be very useful as an introduction to additional and more specialized study, a very unfortunate lack.

PAUL J. KELLOGG
Institute of Technology,
School of Physics and Astronomy,
University of Minnesota, Minneapolis

Mathematics

Periodic Differential Equations. An introduction to Mathieu, Lamé, and allied functions. F. M. Arscott. Pergamon, London; Macmillan, New York, 1964. x + 281 pp. Illus. $9.50.

This book is concerned with the construction and analysis of a half-dozen special functions that are of importance in mathematical physics. These functions emerge, on the separation of the reduced wave equation (Helmholtz equation) into ordinary differential equations relative to various coordinate systems. Thus, they share the common heritage of being solutions of linear, ordinary, second-order differential equations with simply or doubly periodic coefficients. The treatment is rigorous and lively, and the author has successfully avoided the handbook flavor that is typical of many works on special functions. There is a substantial amount of interesting and serious analysis permeating the development of these functions, and both the student and the specialist should find the study of this book a stimulating experience.

Following an introductory chapter, which divulges the common source of the differential equations and the overriding importance of the special periodic solutions to be considered, there are five chapters (almost one-half of the book) that cover the familiar Mathieu equation. Though the general Floquet theory is presented, the analysis is concerned mainly with the construction and the study of the periodic solutions (Mathieu Functions). The treatment is fairly extensive and thorough, and includes the continued fraction expansions and the asymptotic expansions. The author has suggested that his treatment is intermediate between that of McLachlan's *Theory and Applications of Mathieu Functions*, written primarily for engineers, on the one hand, and Meixner and Schäfke's *Mathieusche Funktionen und Sphäroidfunktionen*, which rests on a fairly deep Banach space foundation, on the other.

There is a brief chapter on Hill's equation and the special Whittaker-Hill-Ince equation with three terms and a relatively long chapter on the spheroidal wave equation. Equations with doubly periodic coefficients are represented by Lamé's equation and the ellipsoidal wave equation. For the former, the Lamé polynomials as well as simply periodic solutions are constructed, while for the latter only the doubly periodic ellipsoidal wave functions are considered. No general techniques are available for constructing solutions of the ellipsoidal wave equation, and so the author has considered special cases and perturbational solutions.

R. A. STRUBLE
Department of Mathematics,
North Carolina State University,
Raleigh

Canberra Symposium

Water Resources, Use, and Management. Proceedings of a symposium held at Canberra in September 1963. Edwin S. Hill, Ed. Melbourne University Press, London; Cambridge University Press, New York, 1964. x + 529 pp. Illus. $35.

This book is a compilation of 40 papers and discussions presented at the National Symposium on Water Resources, Use, and Management, which was sponsored by the Australian Academy of Sciences in Canberra, 9 to 13 September 1963. The symposium brought together experts and specialists in various aspects of water development, measurement, use, and management to discuss the current status of hydrologic information, analysis techniques, and research needs. With three exceptions, all of the contributors were Australians. R. K. Linsley and W. B. Langbein of the United States and V. N. Kunin of the U.S.S.R. presented papers by invitation.

In the opening paper it is noted that Australia is the world's driest continent (it has the lowest runoff per unit area). However, water does not yet limit Australia's growth. In a section entitled The National Outlook, the present and future water needs for hydroelectric power, irrigation, and municipal and industrial uses are considered.

The second series of papers, entitled Basic Data, describe records and measurements of precipitation, evaporation, surface water, and underground water in Australia. This section also includes three papers on analysis and processing of hydrological data.

Eleven papers in the general category of "water balance" range from predicting flood flows to discussion of problems of irrigated areas. Socioeconomic problems of water resource use and management are discussed in four papers, and a final four deal with water investigations and research. These papers stress a need for increased efforts in data collection, research, and long-range planning—points that are mentioned many times in separate papers throughout the volume.

This compilation should be of value to those involved with water resource use, administration, research, or planning in Australia. Because it is directed specifically at Australian conditions and problems, which of course was its purpose, the total interested readership may be limited. Those seeking information on new technology will likely be disappointed.

MORTON W. BITTINGER
Civil Engineering Section, Colorado State University, Fort Collins

Techniques and Interpretations

Spectroscopic Properties of Rare Earths. Brian G. Wybourne. Interscience (Wiley), New York, 1965. x + 236 pp. Illus. $10.50.

Rare earths, in the spectroscopist's mind, are associated with large quantities of information and thick volumes containing numbers. It is, therefore, a pleasant surprise to see a new book entitled *Spectroscopic Properties of Rare Earths* which, despite its title, is quite small in size. The book contains, however, invaluable information. The second chapter is a very clear and useful presentation of Racah techniques, which are so easily displayed that they can be used immediately, even by spectroscopists who are not so familiar with the difficult chapters of the theory of complex spectra. In fact, the author, in chapters 3, 4, and 5, applies these techniques, very systematically, to three major problems in atomic spectroscopy: intensities, Zeeman-effect, and interaction with the nucleus.

In addition to a general treatment of each problem, which includes the evaluation of the matrix elements of all the involved operators in the L-S, J_1-j, and J_1-l coupling schemes, the author gives several particular examples that are of utmost importance and interest.

A distinguished feature of the book is the extensive list of references (487) which brings all the subjects discussed up to date. The author was scrupulous in giving credit to the various scientists. He has, however, incorporated quite a few of his own ideas into the text. One example is the application of J_1-j coupling calculations to the $f^N s$ type configuration, as in §5-5 for Pm II, thereby disproving the commonly stated argument that "since s-electrons are penetrating electrons, the contribution of the f^N core to the hyperfine structure may be ignored."

Considerable space is given to discussion of the spectra of the rare earths in crystals. One of the interesting effects in these spectra is the nephelauxetic effect, which could not be checked by the time the book was written. Since its publication, however, new data have been found in Pr^{3+} free ion, which include all the energy levels of the $4f^2$ configuration (except $^1S_0$). The analysis was done by Sugar, who also calculated the parameters of this configuration. He showed that, indeed, the free-ion parameters are larger than those obtained from crystal spectra.

The book is, unfortunately, not free from misprints. I would like to point out the misprint on page 102 where $g = 1.05116$ should read $g = 1.50116$.

On the whole, with its general treatment of the spectroscopic properties of the rare earths as well as the fine and revealing specific examples it contains, the book should be very useful for the experimental spectroscopists who are interested in the theoretical interpretation of their results.

NISSAN SPECTOR
Spectroscopy Section, National Bureau of Standards

Biological Research

Instrumental Methods of Experimental Biology. David W. Newman, Ed. Macmillan, New York, 1964. xiv + 560 pp. Illus. $15.

The editor states in the preface that this book is suitable for use as a single textbook for courses on methods, techniques, and instrumentation. The dust jacket indicates that it is "a presentation of the fundamental theory and techniques for biological instrumentation." Although the book presents some useful material, it is not sufficiently organized or balanced for use as a textbook. The 15 chapters, contributed by 17 authors, are varied in length, style, level, detail, and adequacy of references. The introduction identifies physical methods with instrumental methods and thereby includes chromatographic separation methods with instrumental methods. In previous publications these methods have generally been included under physical methods, and those methods in which physical principles are utilized to "refine the senses, measure and/or control" have been included in instrumental methods.

The first five chapters present paper, thin-layer, column, and gas chromatography and zone electrophoresis with a minimum of theory. Practical procedures are emphasized, some commercial equipment is described, and detailed procedures are outlined for specific separations. The instrumentation involved is neither explained nor evaluated; conspicuous omissions include column and gas chromatographic methods for amino acids, gel filtration, and immunodiffusion technques.

Freeze-drying techniques are described in practical terms, with some advice on the use of commercial equipment. I was pleased to note that "lyophilization" was described as an unnecessary word.

In the well-illustrated chapter on ultracentrifugation the fundamentals are presented in a lucid text which precedes a detailed mathematical presentation of theory (in fine print). Practical illustrations and extensive references make these 87 pages by Rodes Trautman particularly valuable. The short chapter on weighing sets forth some useful points on the tolerances of the standard classes of weights but provides no treatment of the submicrogram methods. The chapter on *p*H gives only the elementary buffer equa-