tive one involving confusing discussions about simultaneity and clock synchronization, or he is given an apology and told that only after development of more sophisticated mathematical machinery will he be ready for relativity; later on, he is apt to be overwhelmed by the complexity of mathematical language which tends to hide the simplicity and consistency of its axioms. A lot of students never will have an occasion to develop the mathematics needed and therefore should not be denied the chance to understand and appreciate the far-reaching effects relativity has had on our basic concepts of space and time.

The use of this book does not demand tensor or vector analysis; it does not demand a knowledge of differential geometry, but it does require a respectable use of the student's available background in calculus and elementary physics. It is important to note that in this respect it does not have the usual relativity-made-easy-for-the-layman approach that is typical of so many introductory books. *Electromagnetism and Relativity* is written for second- or third-year science students, and it is for them this book is recommended.

The introduction to relativity via electromagnetic theory is rather natural, and the need for relativistic invariance is shown in sections starting with a discussion of coordinate systems and wave motion through Maxwell's equations to the Michelson-Morley experiment. In the second chapter on special relativity, the conventional relations involving energy, momentum, and mass are derived without the usual confusion as to which coordinate system is which. Chapter 3 treats general relativity, and Chapter 4 deals with calculations of the general relativistic effects. The fifth and last chapter consists of sixty-three elucidative problems.

An important feature is the continual indication of the magnitude of the relativistic effects and the accuracy of confirmation of the different predictions of the theory. Especially interesting is the discussion of the various solutions to the twin paradox and the experimental tests of the general theory. With due respect for the capabilities of the reader, the author uses a few of the implications of general theory to derive Einstein's cosmology.

Introduction to Microwave Theory. By H. A. Atwater. 244 pp. McGraw-Hill Book Co., Inc., New York, 1962. $8.75.

The Wave-Guide Mode Theory of Wave Propagation. By K. G. Budden. 325 pp. (Logos Press, London) Prentice-Hall, Inc., Englewood Cliffs, N. J., 1961. $16.00. *Reviewed by H. J. Hagger, Albiswerk AG, Zürich, Switzerland.*

THE growing interest in the use of electromagnetic waves guided by boundaries or metallic walls has created a demand for specialists familiar with the problems involved; at the same time, the discovery of unusual wave-propagation methods has led scientists to ask for new and unified propagation theories. Atwater's *Introduction to Microwave Theory* is the product of a one-semester course in the field. It covers transmission-line theory, Smith-Chart application, wave propagation in rectangular, circular, and coaxial waveguides, and it contains a very well-written chapter on multiport junctions, a topic not often considered essential in an introductory book. The author also deals briefly with microwave generation and amplification by klystrons, magnetrons, and traveling-wave tubes, and with the behavior of ferrite materials in the microwave field and its application to rotators, isolators, and magnetic-parametric amplifiers. An introduction to problems of millimeter waves is included. Atwater's book may well serve as a guide to an introductory course in microwave theory, and both teacher and student may find the problems appended to each chapter to be valuable exercises. However, since the topics covered in this book are not by themselves sufficient for a full understanding of microwave problems, this volume should be supplemented either by the study of other books or by attending a course in microwave theory. The book gives a good, if brief review, of the problems involved, but fails to be a complete guide to the most necessary measuring techniques and to component design in the microwave field.

Budden's *Wave-Guide Mode Theory of Wave Propagation* serves a completely different purpose. It is written for the wave-propagation specialist and it demonstrates extremely stimulating and valuable parallels between the guidance of electromagnetic waves between the earth and higher atmospheric layers and the propagation of underwater sound waves between the surface and the bottom. Even though the main emphasis of the book is put on the electromagnetic wave, Budden draws parallels to other, more complicated wave motions. Starting with propagation in metallic waveguides, the author deals with effects in stratified and lossy media, as well as the influence of the curvature of the earth and of imperfect boundary conditions on wave propagation. The phenomena of abnormal range of very-high frequencies and surface waves are also treated. In spite of its purely mathematical basis, Budden's book is easy reading and extremely useful for the understanding of long-range radio and underwater sound propagation. The specialist will—after a careful look—not only enjoy the value of the unified propagation theory and the way it is developed, but will want to have the book handy on his desk, for it shows him new aspects, new parallels, new links in wave physics in a very unusual, but well-presented way. The reader will also find lists of symbols and subjects and very helpful references.

Gravitation: An Introduction to Current Research. Louis Witten, ed. 481 pp. John Wiley & Sons, Inc., New York, 1962. $15.00. *Reviewed by Jacques E. Romain, General Dynamics/*Fort Worth.

ALTHOUGH general relativity is nearly half a century old, the difficulties associated with the physical interpretations of its beautiful mathematical formalism are far from clarified. The extensive work that has been under way recently has led more to the dis-

covery and understanding of such difficulties than to their solution. The vastness of the problem is apparent in the wide choice of approaches currently considered by various investigators. This state of affairs makes review volumes on the subject most useful, even if two such books are separated by a comparatively short interval of time. Indeed, no single volume can deal extensively with all the aspects of current gravitational research.

The book under review meets the high standards to which readers in the field have been accustomed for the last few years, with respect to both competence of the contributors and careful presentation. The larger part of the book is made up of review papers on the following topics: the experimental situation of the theory of gravitation, solutions of the field equations of general relativity (exact solutions, equations of motion, the Cauchy problem), conservation laws in general relativity, gravitational radiation, and relativistic cosmology. In addition, four papers are devoted to analyses of particular theories: an interesting confrontation is offered of two rival approaches to the quantization of the gravitational field (the canonical approach and the "geometrical approach", in which the stress is on general covariance), and two expositions are presented on attempts at a unified geometrical theory of the gravitational and the electromagnetic fields (a detailed presentation of the Einstein-Maxwell-Rainich system of field equations, and a qualitative sketch of "geometrodynamics"). Useful mathematical summaries of the geometrical background of general relativity are found in the chapter on exact solutions and as appendices to the chapter on cosmology.

In view of the purpose of the book, one may regret that it is practically two years old at the time of its release, and that several authors have been obliged to update their papers with "notes added in proof".

Instead of the usual subject index, the book is provided with a very detailed table of contents. Such a table is undoubtedly useful, but it may be disputed whether it really is as handy as a conventional index.

The Classical Theory of Fields (2nd ed.). Vol. 2 in Course of Theoretical Physics. By L. D. Landau and E. M. Lifshitz. Transl. from Russian by Morton Hamermesh. 404 pp. Pergamon Press, London, 1962. Distr. in US by Addison-Wesley Publishing Co., Inc., Reading, Mass. $12.50. *Reviewed by C. H. Holbrow, Haverford College.*

ASIDE from a five-dollar increase in price, the principal changes in this second edition are additions to and revisions of the interesting chapters in general relativity and gravitational field theory. The remainder of the book continues to serve as an excellent exposition of classical electromagnetic field theory and special relativity.

The authors begin by formulating the theory of relativity in terms of the principle of least action. This rather abstract approach to their subject matter is