

fects, including the evidence for their existence, and methods for establishing their density, but must also include discussion of such related categories as the means by which the defects are created, how they can be avoided, and their influence on basic properties of the crystal. To abstract the principal features from such an extensive discipline and to present the details in a coherent exposition, and within the confines of a volume that hopefully can be acquired by the average scientist, calls for considerable organizational ability on the part of the author. Rhodes has met this challenge quite admirably. By restricting the scope to phenomena of importance in germanium and silicon, he has achieved significant abridgment. This does not preclude references to other materials when a point is to be illustrated; indeed numerous results are quoted for alkali halides as well as various metals, but it does avoid consideration of various phenomena unique to certain compounds—for example, polar effects and faceting.

The organization of the book is such that the introductory chapter, which is devoted to definitions and qualitative explanations of various concepts, is followed by three chapters concerned with dislocations and their detection and with various aspects of plastic deformation. The next three chapters treat the growth of single crystals, the distribution and control of impurities, and the chemical and physical behavior of impurities, including diffusion and precipitation phenomena. The next chapter reviews, in fair detail, the salient findings from radiation damage studies on germanium and silicon, including annealing behavior. The final chapter deals with etching and the nature of various types of etch pits and includes a list of some of the principal etchants for germanium and for silicon.

Throughout the volume metallurgy and chemistry are emphasized—for example, in the discussion of the physics of transport processes we must accept the author's word when he makes the following statement in the preface: "It has been assumed that the reader will have some prior acquaintance with the subject of semiconductors. Electronic transport processes and solid-state device behaviour have already been comprehensively discussed in the literature and are adequately covered in the other monographs of this Series." In fact, in view of the

scope of the book, the discussion of electrical properties is, for the most part, adequate to bring out the influence of the chemical and physical defects. But, in several places, the rudimentary presentation might lead uninitiated readers astray. For example (p. 209), Rhodes gives an expression for resistivity which is valid when both holes and electrons participate in the conduction process, although he states that the equations are valid only in the *extrinsic* conduction range (that is, one type of carrier only). On the next page he gives an expression for the Hall coefficient which is valid strictly for a single-type carrier. This restriction might, however, be missed if the reader is unfamiliar with the equation. Recent findings concerning certain "hard" superconductors have apparently been responsible for the statement: "The possibility also exists that the dislocations act as high-conductivity channels, the electrons moving from one free bond to another along the dislocation line" (p. 263). But here we are dealing with semiconductors, and I assume the author does not mean to imply that inducing the right dislocation in the right semiconductor might yield a superconductor.

But these are isolated instances. The book is exceptionally well put together, with an unusual paucity of ambiguities and typographical errors. It is valuable as an up-to-date review article, containing some 550 references (of which 425 cover work during the last decade). Its lucid and detailed presentation will make the volume useful as a teaching aid for students, scientists, engineers, and technologists whose interests encompass semiconductors and related solid-state fields.

ALBERT C. BEER

*Battelle Memorial Institute,  
Columbus, Ohio*

## Mathematics

**Differential Equations with Applications.** Herman Betz, Paul B.urcham, and George M. Ewing. Harper and Row, New York, ed. 2, 1964. xiv + 354 pp. Illus. \$7.50.

In this country there seems to be a trend toward divorcing mathematics from its applications. This is an unfortunate trend which would present a subject like differential equations as a sterile and static logical exercise in

axiomatics instead of presenting it as a dynamic and fertile subject whose existence and development is inexorably intertwined with the physical sciences. Therefore, it is good to see the second edition of a book on differential equations, for this is a book in which a great variety of applications form an integral part of the presentation. In the first edition, the applications covered included motion of a particle, mechanical and electrical vibrations of one and two degrees of freedom, and the law of mass action, and biological genetics. In the second edition, rocket motion and planetary motion have been added.

In most respects the second edition is better than its predecessor. The authors have put somewhat more emphasis on "concepts" and less on "formal dexterity." This is to be commended. However, in my opinion, the authors could have gone even farther in this direction. Somewhat more emphasis could have been placed on the fundamental existence theory. There is no reason why theory and application cannot be treated in the same book.

In balance, the book is a good one and should continue to find considerable use in a first course in differential equations for scientists and engineers.

NICHOLAS J. ROSE

*Department of Mathematics,  
Stevens Institute of Technology,  
Hoboken, New Jersey*

## Physics

**Laser Abstracts.** vol. 1. A. K. Kamal. Plenum Press, New York, 1964. viii + 177 pp. \$12.50.

Several bibliographies of publications related to lasers have been published during the last few years. However, the number of papers listed is large, and the reader must rely on the information contained in the titles in deciding which papers he wishes to investigate. A collected set of abstracts seems desirable, as long as the number of volumes required does not become too large.

Kamal's *Laser Abstracts* appears to give quite complete coverage of the papers in the field up to mid-1963. The large majority of the 731 abstracts are well written and accurate. On the average, the abstract is about twice as long as the reference citation. The cross indexes provided by the publisher

are definitely desirable. The volume will undoubtedly be helpful to many people working in the laser field, and most scientific libraries and reading rooms will want to have it available.

On the other hand, this first volume also points up some of the difficulties involved in choosing the articles to be covered. About 15 reports on work carried out for the Defense Department are included, and my personal feeling is that these abstracts could have been omitted without limiting the value of the book. Abstracts published in the *Bulletin* of the American Physical Society were abstracted, which is probably desirable. The few favorable comments made in the abstracts should have been omitted, since favorable comments were not made about the most important papers in the field. The problem of achieving uniform quality in the abstracts is obvious in several cases where the abstract is an almost exact paraphrase of the title. A somewhat more comprehensive foreword in which the author stated his criteria for inclusion of abstracts and the period covered by the volume would have been helpful.

P. L. BENDER

*Joint Institute for Laboratory  
Astrophysics, Boulder, Colorado*

## Economic Geography

**The Geography of Modern Africa.** William A. Hance. Columbia University Press, New York, 1964. xiv + 633 pp. Illus. \$12.

Although racial and social problems are still major factors in the pattern of Africa's rapid political change, the most important problems in the newly independent African countries are invariably economic. Are the smaller states economically viable, and what are the chief resource problems? How many of the states have adequate capital, labor, and technical equipment to develop their potential and raise standards of living?

William A. Hance is well qualified for the task of presenting Africa's economic situation, as professor of economic geography at Columbia University, as a frequent visitor to Africa, as a keen student of problems of economic development, and as the author of a notable study, *African Economic Development* (Harper, New York, 1958) and several major articles. *The Geog-*

*raphy of Modern Africa* is essentially an up-to-date survey of the main features of the economic geography of Africa, arranged according to seven major regions. In its enormous scope this book is remarkably accurate. Considerable care must have been taken to check the sources of information. The publishers deserve especial congratulation for the speed with which they produced this text, for the extremely attractive format, and for the high quality of print and of reproduction of maps and diagrams. Only five chapters are devoted to generalities. The whole emphasis is on regional aspects, and each region is treated differently. Thus, while in West Africa land use, including the agriculture, receives immediate treatment after the introduction, in South Africa, agriculture follows consideration of racial problems and of mining. Although the regional coverage of the continent is complete, particular attention is paid to tropical Africa (the largest single section is that given to West Africa), and there is a marked emphasis on current and future problems, leading, for example, to unexpectedly large subsections on industrialization. Problems of overpopulation and of population distribution receive considerable treatment, and attention is firmly focused on areal aspects. This is not a study of African economics but of economic geography. As such, it contains the best general appraisal of Africa's resources, and of her regional economic problems, yet produced.

Having acknowledged Hance's skill and authority in economic geography, one must, however, offer some criticism of his generalizations with regard to the biological and physical background. These are, in any case, very limited in scope, although of major importance in the consideration of Africa's economic future. For example, it is claimed that "latosolic soils provide the main reason for the dominance of shifting agriculture in tropical rainy and savanna areas . . ." (p. 16 and similarly on p. 202). Admittedly, latosolic soils can be fragile and pessimism has been expressed by numerous authorities. But some attention must be paid to the views of Vine ("Is the lack of fertility of tropical soils exaggerated?" in *Proceedings*, 2nd Inter-African Soils Conference, Leopoldville, 1954, 1, pp. 389-412), among others, and to the quite different views on shifting agriculture which regard it as limited not so much by soils, as by problems of capital, tradition, pasture, difficulties of

livestock integration, and availability of fertilizers. If rainforest plots are abandoned after 2 to 5 years of use, should we blame the soil or the almost continuous cultivation with long rainy seasons and without use of fertilizers? Longer periods of cultivation in some savanna areas may be related to the annual rest given the soil during the dry season. Minor blemishes include uncritical acceptance of such terminology as "savanna climate type" (p. 15), which misleads the student by begging the question of vegetation-climate relationships; claims that much of the more favorable land from the climatic standpoint "falls in the highland climatic regions" (p. 15), when the criteria for judging "favorability" are not provided and the greatest productivity in commercial agriculture is in the lower, hotter, and more humid areas; and the suggestion that formerly Africans were "of low average stamina" (p. 6), when, despite the possible correctness of the suggestion, the evidence is so controversial and when it is known that African porters performed remarkable feats of load carrying and endurance. Why, incidentally, is sea fishing included in the discussion of land use (p. 194)?

These criticisms are, however, small and are intended in no way to detract from this remarkably well-written and well-presented study which should be accepted as the standard reference work on the subject in English, and in which the attention to detail has set a remarkably high standard for all other similar studies to follow.

W. B. MORGAN

*Department of Geography,  
University of Birmingham,  
Birmingham, England*

## Tools and Techniques

**Physical Acoustics.** Principles and methods. vol. 1, part A. Warren P. Mason, Ed. Academic Press, New York, 1964. xvi + 515 pp. Illus. \$18.

Within the past few years the field of physical acoustics has become fashionable and exciting. The ability to generate, propagate, and detect elastic waves (phonons) in the microwave region, and their use in the study of thermal, electronic, magnetic, and mechanical properties of solids, are only the most striking of the new