thrust faults; strike-slip faults; structures in metamorphic rocks; and tectonic aspects of igneous rocks. For each topic, he summarizes much of the recent literature, uses pertinent well-reproduced illustrations, and points out his differences or concurrences with other authors. For some subjects, the reader should be familiar with the cited papers. Badgley's (and his students') active research in the Rocky Mountain region heavily colors the text. For example, geologists who work in the Gulf Coast area will find very little on salt tectonics, normal fault development, or growth faults. On the other hand, extensive use of recent analytical and experimental work and excellent illustrations give the reader a broad insight into thrust-fault and strike-slip (wrench-) fault tectonics.

The last two chapters ("Factual data bearing on world-wide orogeny," and "Tectonic patterns and tectonic classification") summarize many of the new data and developments that should contribute to a better understanding of the evolution of the crust of the earth. These are the subjects of endless discussions, reams of published speculations, and, in some cases, of hare-brained opium dreams. The data summarized in the text should cause many earlier concepts on mountain building to quietly disappear into oblivion. The new wealth of isotopic age determinations, paleomagnetic pole determinations, crustal layer delineation by geophysical techniques, and heat flow determinations (each of these topics is briefly discussed) have given new life to the concepts of polar wandering, continental drift, convection currents, and continental accretion. The final answer is still in the future, but my hat is off to Badgley for attempting a synthesis now. His book will be very useful to students of the earth—whether they are in the vales of academia or are pursuing an industrial career—if they wish to bring themselves up-to-date in structural and tectonic concepts.

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Encyclopedia of Physics

Inherent difficulties are associated with the production of a one-volume encyclopedia such as this one—**The Encyclopedia of Physics** (Reinhold, New York, 1966. 852 pp., $25), edited by Robert M. Besançon. Obvious problems are encountered in compressing into a book of 852 pages a satisfactory explanation of each topic of importance in so large a field as physics.

One might begin by contrasting the book with the many volumes of the *Handbuch der Physik* or with a small dictionary of scientific words. An encyclopedia such as this one cannot possibly give a large number of complete and definitive review papers, like those in the *Handbuch*. Neither can it provide a concise definition of most important scientific terms, such as one might find in a dictionary.

After summarizing what this volume cannot be, it seems sensible to evaluate its success in achieving its main purpose. A first impressive measure of this success can be seen in the list of authors. More than 300 distinguished physicists have contributed to the volume. There are articles by Jesse Beams (University of Virginia) on the centrifuge, Glenn Seaborg (chairman of the Atomic Energy Commission) on transuranium elements, R. Tousey (Naval Research Laboratory) on ultraviolet radiation, and many other experts. The articles uniformly are written by people who have done significant research in the fields about which they write.

One reviewer cannot speak definitively on the many subjects covered. However, he can glance at many topics, and study in detail those about which he has special knowledge. And he can ask friends in other fields to spot check items on subjects in which they have worked.

The impressions that I have as a result of such an effort are uniformly favorable. For example, the brief two-page review by J. Delvaille (Cornell) on cosmic rays is an excellent survey of what was known about and speculated in this subject as of approximately a year ago. (It is difficult to be more up-to-date in any hardbound volume.) Delvaille's article is accurate and informative. It assumes a good background in physics, but is not very detailed or particularly mathematical. It refers to a good selection of articles in other sections of the encyclopedia, and contains an excellent brief bibliography. These characteristics seem to be equally common in the other sections of the encyclopedia.

In summary, this appears to be an excellent book for brief review of a topic in physics. It contains good references for a later, more detailed follow-up. As a result, it surely belongs in every physics department library, and could serve a useful purpose on the desk of many individual scientists.

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Developments in Solid Earth Geophysics Series

The author, Tsuneji Rikitake, states that **Electromagnetism and the Earth's Interior** (Elsevier, New York, 1966. 320 pp., $22.50), which is based on a series of lectures that he gave at the University of Tokyo, is intended for graduate students. He has achieved his objective admirably for the book provides the student with a comprehensive summary of the current knowledge and theory of the geomagnetic field and its fluctuations and the attendant electromagnetic induction within the earth. Full use is made of mathematics, and the derivations are presented in detail; in some instances alternative solutions are suggested. The bibliography is comprehensive and up-to-date.

In the first seven chapters the geomagnetic field and its long period variations are described and the various theories for its origin are reviewed. The most widely accepted theory, that of a self-exciting dynamo in the earth's core, is presented in great detail. Rikitake analyzes very lucidly the different models of the assumed dynamo and quite candidly explains the fallacies inherent in the simplifications required in each analysis. At the present time, the self-exciting dynamo is the most likely explanation of the origin of the main geomagnetic field, but its secular variation and its westward drift are not well explained and the complex effects at the core-mantle boundary are not yet tractable to study.

The next seven chapters are concerned with the electromagnetic induction produced in the earth by the day-long and shorter period variations in the geomagnetic field. The theories of electromagnetic induction are developed in a homogeneous earth with a plane surface, in a thin plane sheet, in a thin hemispherical sheet, in a cylinder, and in a layered earth. With

these and observations of sudden magnetic storm commencements, geomagnetic bays, and solar flare effects, it should be possible to study the distribution of conductivity within the earth and thereby "to say something about the temperature distribution and the phase transition supposed at a depth of a few hundred kilometers." However, Rikitake "is of the opinion that in view of the resolving power of existing analyses of transient geomagnetic variations, we can only say that the increase in the conductivity at a depth of several hundred kilometers is very steep."

The last three chapters deal with the effect of the ocean on geomagnetic variations, the advantages and limitations of the "magneto-telluric" method, and local anomalies of geomagnetic variation that indicate lateral inhomogeneities of electrical conductivity within the earth's crust and mantle.

The book can be highly recommended as a clearly presented, comprehensively documented, and well-illustrated summary of the results of the current research in geomagnetism and electromagnetism relating to the interior of the earth.

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Studies in Mathematics Series

Volume 1 in the Mathematical Association of America's "Studies in Mathematics" series, *Studies in Modern Analysis*, was published in 1962. Volume 3, **Studies in Real and Complex Analysis** (Prentice-Hall, Englewood Cliffs, N.J., 1965. 221 pp., $4), edited by I. I. Hirschman, Jr., might be considered a continuation of volume 1, for it makes contact with the subject matter of that book at several points. The second volume, *Studies in Modern Algebra*, was concerned with quite different mathematical material.

In the introduction to volume 1, it was stated that the purpose of the series is "to bring to the general mathematical community expository articles at the collegiate and graduate level on recent developments in mathematics and the teaching of mathematics" in order to help overcome "the communication barrier which has arisen as a natural consequence of the tremendous acceleration in mathematical development that has taken place especially in the last twenty-five years."

If "mathematical community" is interpreted as referring solely to pure mathematicians and collegiate and graduate students of pure mathematics, then these volumes are a great success. The exposition is quite uniformly clear, occasionally delightfully exciting (to a mathematician), and excellent in lending historical orientation and showing the remarkable interplay that frequently exists between seemingly different branches of mathematics.

There is no reason why a particular series of mathematical expositions *should* be addressed to the wider community of scholars and scientists concerned with the applications of mathematics. Pure mathematicians do indeed have a communication—and subject-matter—barrier to overcome, even among themselves. I only want to inform the applied mathematician that he should expect to find applicable, but only very slightly applied, mathematics here.

The editor of the present volume has wisely left to the contributors decisions about how much mathematical background should be assumed, the extent to which details should be given, and so on. Accordingly, there is a wide variation in the length, depth, and style of the articles. Each is useful in its own way and should be judged for what it is, not for what it is not.

H. J. Bremermann traces the interesting and sometimes surprising history of the theory of functions of several complex variables from its inception at the turn of the century. Lawrence M. Graves deals with nonlinear functions from one Banach space to another, in particular with the implicit-function theorem; writers of texts on advanced calculus should perhaps take note. Einar Hille gives a brief introduction to semigroups, with some indication of their many mathematical and physical applications. In a joint article, I. I. Hirschman, Jr., and D. V. Widder discuss the genesis of the real inversion formulas of the Laplace and Stieltjes transforms and show their relation to totally positive matrices and variation-diminishing transforms. H. H. Schaefer gives a detailed treatment of the Lebesgue-Stieltjes integral, in which the theory of measure appears as a byproduct at the end rather than as a basic tool at the beginning. Guido Weiss presents the main aspects of classical harmonic analysis and some of the modern theory. Finally, Harold Wisdom discusses the history of a rather special problem, the inversion of semi-infinite Toeplitz operators, showing incidentally how several branches of analysis can become involved in the solution of a single problem.

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Ionospheric Research

The literature dealing with ionospheric research is so large and continues to grow at such a rapid rate that monographs summarizing our knowledge must be gratefully welcomed. R. C. Whitten and I. G. Poppoff have performed a useful service in providing this compact book, **Physics of the Lower Ionosphere** (Prentice-Hall, Englewood Cliffs, N.J., 1965. 240 pp., $7.50). By restricting their volume to that portion of the atmosphere within the height range from 50 to 150 kilometers, they have avoided treatment of many complex studies of the ionospheric F-region and the magnetosphere, and in considering the lower ionosphere, their point of view leans heavily towards a description of the physical and chemical properties of the atmosphere and of the ionization and recombination processes that occur in response to solar radiations.

A summary of the nature of the solar ionizing emissions precedes chapters that treat the pressure and density of the atmosphere and its chemical properties. The production and recombination of ionization are then considered, and material on measurements of atmospheric parameters and ionization profiles is presented. Electromagnetic propagation is discussed in terms of the conductivity equations, with emphasis on collision frequencies. The final chapter provides a brief description of sudden ionospheric disturbances, polar cap absorption, auroral effects, and the perturbations produced by nuclear bursts. Perhaps the following technical words chosen at random from throughout the book will give an impression of the contents: auroral temperature; bombardment; conductivity; photoionization; emission; polarizability; recombination; concentration; particle; collector plates; affinity; data; flux; and photons.

The list of references includes more than 400 items, most concerned with topics close to the author's own in-