Part 2, approximately two-thirds of the text (182 pages), deals with the characteristics of rock minerals. After a few general remarks and a short discussion of the silicates, the following groups are considered: silicates, feldspars, feldspathoids, micas (including talc and pyrophyllite), chlorites and clay minerals, pyroxenes, amphiboles, peridotites to serpentine, carbonates, sulphates, hydroxides, and a group of incidental minerals—silicates, phosphates, tungstates, and the like, with about six pages devoted to the uranium minerals (both primary and secondary). With each group there is an unnumbered table that gives the principal optical characteristics of the species in that group. Part 3 (36 pages) covers in some detail various methods of study and describes the observation of mineral sections as well as their analysis and the interpretation of the entire process. There are five synoptic tables —three deal with minerals, and two are indexes. A few recent developments, both here and abroad, are not considered, but I do not feel that this limits the volume's usefulness in a beginning course on the use of the petrographic microscope.

E. WILLARD BERRY
Department of Geology,
Duke University

Physics and Space Research

Gravitation and Relativity. Hong-Yee Chiu and William F. Hoffmann, Eds. Benjamin, New York, 1964. xxxviii + 353 pp. Illus. $15.75.

Until Einstein's death the weight of his personal authority was instrumental in determining the position and aims of the general theory of relativity as a branch of physical theory. Since that time the quickened emphasis on space research has forced the theory into the public domain for a number of groups of scientists and has resulted in wide-ranging discussion of its meaning and implications. This universe of discourse stretches from the traditionalists seeking to understand Einstein's physical ideas more fully, through the pure mathematicians interested primarily in theories of manifolds and differential equations, and on to the enthusiastic optimists in search of new pathways and a breakthrough to the Promised Land. The present volume, which represents the fruits of a seminar on the subject held in 1961 and 1962 under the auspices of the Goddard Institute for Space Studies, seems to be primarily an expression of the views of the latter group.

The book consists of 15 chapters by a total of six authors, together with an introductory article by the editors who attempt to provide a mean platform for the discussion. The individual chapters vary widely in purpose and in scholarly content, clearly being much influenced by their origin as seminar material. In a very rough classification the chapters by Anderson are expository in character; those by Dicke and by Weber are speculative on the experimental side; while those by Wheeler and Marzke are speculative on the theoretical side. Hughes discusses, in a somewhat more conventional manner, current ideas and experiments on mass (directional) isotropy in the universe and the equality of positive and negative electrical charge.

It is not the function of a reviewer to impose his personal views on the authors or the readers of a book. In the present case, however, the diverse and somewhat dithyrambic character of the different chapters makes an effective review of their contents difficult in the conventional sense. For this reason the purposes of the reader of this review may be as well served by an attempt to bring the discussion into focus within the context of a single point of view—that of the reviewer.

A basic problem that has been with us since the formulation of Einstein's theory in 1916 has been whether it represents a fundamental theory of time and space, or whether it is a theory of the influence of gravitational fields on the physical measurement of these quantities. In one way or another all of the chapters of this book stem from this problem and are limited by it. Therefore it is not unexpected to find oneself confronted throughout the volume with the usual variety of arguments that jumble together in an uncritical way ideas from Maxwell's linear theory of the electromagnetic field, Newton's linear theory of the gravitational field, and Einstein's nonlinear theory. Some attempt to sort out these ideas is made by Wheeler, but, although his arguments are interesting and explanatory, they do not seem to me to advance the problem much further toward resolution. The possible connections of Einstein's theory with quantum field theory, which are discussed by Anderson, are clouded by the difficulty that neither of the theories concerned has yet been given a sufficiently stable mathematical framework to sustain the attempt to weld them together.

In brief, I would recommend this volume to the sophisticated reader who can enjoy the liveliness of its approach and may even profit from stimulation by some of the ideas expressed. But it is not for the beginner who seeks enlightenment, nor for the mature scholar in quest of more profound analysis of difficult questions of principle.

E. L. HILL
School of Physics,
University of Minnesota

Introductory Textbook

Geology. William C. Putnam. Oxford University Press, New York, 1964. xii + 480 pp. Illus. $10.95.

The strongest impression that this book made on me was that a tremendous effort is involved in writing a good introductory text in geology. That effort is displayed by the abundant references, the excellent illustrations and photographs (which were chosen by his colleagues after the author's death last year and one of which is used on the cover of this issue of *Science*), and a careful exposition of the history of thought concerning each of the major subjects treated. In these areas this book is almost unrivaled in the field of geology.

The wit displayed here is in pleasant contrast to that in most geology textbooks. One can almost hear the chuckle from the classroom as Putnam slips in another witticism, with even the more cynical students enjoying it despite themselves.

Certain features of the book appeal to me less. Terms are carefully introduced in such profusion that, in some places, the text is encyclopedic; this tendency in recent textbooks disheartens me, although I appreciate its appeal to many. Putnam has made an earnest attempt to indicate the controversial nature of geology by leading the reader through discussions of diverse theories for the origin of such features as coral atolls, pediments, submarine canyons, and limestone caverns. He carefully notes that the final

answers are not always forthcoming, but somehow the reader is never successfully involved intellectually in the discussion. But this book only fails where other books have failed before. Perhaps the task is impossible.

The organization of the text seems a bit curious. Putnam says in the preface that the plan resulted from years of teaching the subject but that the construction of each chapter allows the topics to be treated in almost any order. This seeming virtue has one unfortunate aspect, however. The very fact that the chapters stand alone indicates a partial failure to run unifying concepts through the text. Such closely related topics as structure, earthquakes, and mountains are treated in chapters 6, 9, and 15, respectively. Furthermore Putnam properly nominates the concept of the enormity of geologic time as the most important contribution to culture made by geologists, but he discusses this fundamental subject in the very last chapter.

Particularly noteworthy inclusions are a long chapter on petroleum geology and a 25-page section on the life of the past. Conventional topics treated rather lightly include ore deposits and some of the classical concepts of the development of landscapes by stream erosion. In discussing the origin of mountains, Putnam treats convection currents and phase changes but ignores the "un-American" concepts of continental drift and gravitational gliding.

This book, which can be highly recommended to geologists and nongeologists alike, should rapidly make the best-seller list of general geology textbooks and thereby firmly establish the publisher, Oxford University Press, in the field of geology.

BATES MCKEE
Department of Geology,
University of Washington, Seattle

Chemistry

International Encyclopedia of Chemical Science. Edited by A. T. Clifford *et al.* Van Nostrand, Princeton, N.J., 1964. viii + 1331 pp. Illus. $32.50.

Approximately 100 pages at the end of this volume are devoted to four multilingual indices—German, Spanish, French, and Russian—in which scientific words from each language are listed with their English equivalents. Glancing through these lists, one is impressed by the international character of science as indicated by the repeated identity of scientific words in the two languages under comparison. One is also impressed, however, by the fact that little advantage is gained in printing such a list of identities. If the reader, after locating the English equivalent, is supposed to have sufficient command of the language to understand the item in the text, there is little to justify the inclusion of such a list in the volume. Although this list of a limited number of foreign terms may be the reason for calling the encyclopedia an "international" encyclopedia, it does not appear to be a sufficient reason to justify the use of the word "international" in the title.

Perhaps the most useful area covered in this encyclopedia is the effort to provide reasonable definitions or descriptions of reactions, laws, tests, and theories which are named after individuals. Chemistry abounds with reactions and tests named after individuals, and there are times when one does not know where to look for a reasonable description. Some of the descriptions given here are too brief, but they at least provide a lead to the area of chemistry involved so that one can seek additional information in a more authoritative work.

Because I have published a number of papers in the area of stereoisomerism and optical resolution as well as papers on the reactions involved in the synthesis of enantiomorphic forms, I decided to look up some of these subjects in this encyclopedia. Under stereoisomerism one finds "isomerism due to stereochemical differences," which really will not help the uninformed, if they do not know the meaning of "stereo." The heading isomerism is not too clear, but it does refer to conformation. Under conformation there is a reasonable discussion of optical isomerism. The information is in the book, but it certainly is not where most chemists will look for it. Perhaps I should have looked first under optical isomerism; but under that heading there is no reference to either stereoisomerism or conformation, and the definition of optical isomers—"Two or more compounds which have the same chemical composition and the same two dimensional structural formulas"—does not provide sufficient information for the uninformed reader. Racemic mixtures and racemic compounds are not clearly differentiated, and the definition of the latter is not satisfactory.

Some "discoveries" seem to be difficult to "undiscover," and such items as Alabamine and Illinium are given for the early discovery of elements 85 and 61, without any indication about whether the discovery was confirmed by others.

This volume will be useful in a reference library, especially for those who are not specialists in the area concerned, but individuals will probably not make sufficient use of the encyclopedia to justify the purchase of a personal copy.

WALLACE R. BRODE
3900 Connecticut Ave., NW,
Washington, D.C.

Stratigraphy

Geology of Japan. Fuyuji Takai, Tatsuro Matsumoto, and Ryuzo Toriyama, Eds. University of California Press, Berkeley, 1963. x + 279 pp. Illus. $10.

In the preface of this volume, the editors carefully point out that "As a basic foundation for various fields of geology, the stratigraphy is stressed in this book." Eighteen Japanese geologists have contributed to what is, essentially, a comprehensive survey of the stratigraphy and biostratigraphy of Japan. Nine of the 11 chapters are detailed accounts of the Silurian and Devonian, the Carboniferous, the Permian, the Triassic, the Jurassic, the Cretaceous, the Paleogene, the Neogene, and the Quaternary Systems. In most of these chapters the authors cover such topics as the history of investigation, the general distribution of rock types, the fauna and flora, facies and tectonic movements, and paleogeography. One chapter is devoted to pre-Tertiary igneous activity, metamorphism, and metallogenesis. This emphasis on stratigraphy has resulted in a book that is somewhat difficult to read for general geologic background, unless one uses it in conjunction with a more general work such as *Geology and Mineral Resources of Japan* or a geologic map of Japan. The stratigrapher and paleontologist, however, will find this a very successful effort to bring together Japanese research in their fields. Two useful appendices,