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