Webster, who refused to vote a single cent for the opening up of the American West because it would always be a howling wilderness and no use to anyone but savages. Edward Everett Hale, author of *The Brick Moon* (first mention of a manned Earth satellite, 1869), is correctly identified: "he later became the first, and doubtless the last, science-fiction writer to be chaplain to the U.S. Senate." And Clarke cannot ignore the recently appreciated fact that the leading early theorists of the liquid-fuel rocket and space mobility—Tsiolkovsky of Russia, Goddard of the U.S., and Oberth of Rumania—were each stimulated by a reading of Jules Verne's *From the Earth to the Moon* (1865).

Clarke is at his best in digesting the "first harvest" of gains in space science and technology during the past decade, despite the incorrect identification, in a picture caption, of the 20-nozzle Soviet booster for Gagarin's Vostok I as that of Sputnik I. His four sections of four chapters each contain the best available summary of scientific and imaginative theory regarding space potentials: Around the Earth; Around the Moon; Around the Sun; and Around the Universe. Collectively they offer a most persuasive rationale, at least to this reviewer, which may be rebutted only with difficulty by critics of the space venture, who might profit most by its reading.

The Promise of Space, Clarke freely admits, was calculated to help restore the long-term view to space mobility recently diminished by the initial cost of capital investment already made and by the temporary sublimation of the international "space race," which characterized the beginning of the space program and may not be required for the future. Clarke's message is clear enough: the U.S. space program, at least in its earlier days, was certainly prodded by "gusts of emotion."

Some of this criticism is valid; some in itself is emotion—understandably so, in the age of scientists who may see billions going into space when they cannot get thousands for their own pet projects. However, much is based on a total failure to grasp the long range implications of space flight. After all the lessons that the history of our age has given us, this failure is inexcusable; and to those who continue to make it, it may be disastrous.

Clarke suggests that every revolutionary idea—in politics, science, art, or whatever—seems to evoke three stages of reaction: (i) "It's completely impossible"; (ii) "It's possible but not worth doing"; and (iii) "I said it was a good idea all along." Whetner this volume will "smooth the transition" of astronautics from the second to the third stage in the United States, as Clarke intends, remains for the future historians to determine.

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Invertebrates

Chemical Zoology. MARCEL FLORKIN and BRADLEY T. SCHEER, Eds. Vol. 1, Protozoa. GEORGE W. KIDDER, Ed. xvi + 912 pp., illus., $38. Vol. 2, Porifera, Coelenterata, and Platyhelminthes. xx + 639 pp., illus., $29. Academic Press, New York, 1967–1968.

The editors in their introduction to this new series call attention to a principal problem encountered by the biochemist who attempts to extend his investigations to a variety of animal forms—namely, the scattered nature of the literature on the chemistry of the invertebrates. Providing a remedy for this situation constitutes the primary aim and principal justification for this new series.

Volume 1 does this very well indeed for the protozoa. A brief but adequate summary of protozoan taxonomy introduces the volume; it is followed by several chapters on the basic biochemistry of the protozoa, each of which surveys our present knowledge of the occurrence, nutritional requirements, and metabolism of a major class of chemical compounds. The chapter on low-molecular-weight nitrogenous compounds is both comprehensive and critical. The chapter on protozoan growth factors not only does ample justice to this topic but also discusses knowledgeably some of the problems encountered in attempts to cultivate protozoa. There are also adequate reviews of nucleic acids, lipids, and carbohydrates, but strangely enough there is no mention of the present status of our knowledge of protein biosynthesis among members of this phylum.

The remainder of the volume consists of reviews of more specialized aspects of protozoan biochemistry. There is a very welcome summary of the literature on the biochemical ecology of the protozoa and an interesting chapter on chemical aspects of membrane transport in protozoa, including a discussion of phagocytosis and pinocytosis. Chapters on carbohydrate accumulation and its relation to morphogenesis, on digestion and hydrolytic enzymes, on biochemical genetics, on the biochemistry of cilia and flagella, on the chemistry of host-parasite relationships, and on protozoan development complete the volume. The wisdom of including the rather lengthy chapter on protozoan development, which is devoted almost exclusively to morphology and contains only a smattering of anything which can be called chemistry, appears questionable, particularly since its inclusion must contribute to what is the one major fault of this book—its price.

Volume 2, which covers some of the lower invertebrates, utilizes essentially the same format as volume 1. Each phylum is introduced by a chapter on its taxonomy and general biology, followed by chapters devoted to the basic biochemistry of the group. Chapters on specialized aspects of the biochemistry of the phylum (luminescence, toxins, and so on) complete each section. About half of the volume is devoted to flatworms, with particular attention to parasite forms. The remainder of the book covers sponges, the coelenterates, and, very briefly, the mesozoa.

On the basis of these initial volumes the series can be highly recommended to advanced students and to investigators in both biochemistry and zoology.

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Paleopathology

Diseases in Antiquity. A Survey of the Diseases, Injuries, and Surgery of Early Populations. DON BROTHWELL and A. T. SANDISON, Eds. Thomas, Springfield, Ill., 1967. xx + 766 pp., illus. $39.75.

There has been an increasing interest in paleopathology in the past few years as new prehistoric skeletal populations have been described which contain pathologic specimens, and some of the recently developed techniques of medicine and anthropology have been applied to the examination of these remains. With an increasing emphasis on human genetics and demography, anthropologists are more inclined to consider prehistoric diseases and injuries as events affecting populations rather than individuals and to interpret them as selective forces acting upon continuously evolving breeding groups.

This impressive volume reflects this shift in emphasis in the interpretation

of archeologic pathology rather well. It is a collection of papers that cover the past 60 years of research and interpretation in paleopathology. Although most of the chapters are original contributions written for this volume, the editors have included several short classic papers by such authors as Moodie and Ruffer.

The opening chapters provide a much-needed caution against the overdiagnosing of prehistoric specimens. Wells describes some of the postmortem changes that occur under some burial circumstances that might be mistaken for pathologic conditions, while Gray's chapter dealing with "calcinosis intervertebralis" in Egyptian mummies clearly shows the pitfalls of attempting to evaluate some possibly pathologic conditions in mummies by radiographic examination alone, in the absence of gross or microscopic information.

Although most of the text discusses specific diseases and injuries from an anatomic point of view, there is a generous section dealing with parasitology and a fascinating section, well documented with historic references, on mental abnormalities in ancient societies.

The problem of the origin and prehistoric distribution of such widespread diseases as syphilis, yaws, tuberculosis, and leprosy is discussed by several of the authors from slightly different viewpoints. Hackett's hypothesis that venereal syphilis evolved from endemic syphilis, which in turn evolved from the treponeme responsible for yaws, is particularly interesting if somewhat speculative.

For the most part the text is well illustrated, although a very few of the photographs are so badly out of focus as to be virtually uninformative. The quality of the individual chapters by these various authors is generally rather high, imparting to the book an overall value that is commensurate with its cost. Certainly the most comprehensive collection of papers on paleopathology available, this book will be a necessity for anyone seriously involved in this field. It should also provide absorbing reading for anyone interested in the history of medicine or disease. It is the compiled record of man's medical ills over the past several hundred thousand years, from *Homo erectus* well into historic times.

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Rock Phenomenon

Diagenesis in Sediments. GUNNAR LARSEN and GEORGE V. CHILINGAR. Elsevier, New York, 1967. vi + 551 pp., illus. $30. Developments in Sedimentology, vol. 8.

This book comprises 12 chapters written by 13 invited authors from the United States, Germany, France, Australia, and Denmark. Sandstones and silica are treated by Dapples; argillaceous sediments by Müller; carbonate rocks (in the longest chapter, 143 pages) by Chilingar, Bissel, and Wolf; organic matter and coal, respectively by Degens and by M. and R. Teichmüller; mineral deposits by Amstutz and Bubenicek; subsurface waters by Degens and Chilingar; interstitial solutions by von Engelhardt; and phases of diagenesis by Fairbridge. There are in addition introductory and concluding remarks by the editors, Larsen and Chilingar. Chilingar in his contributions has drawn from much of the Russian literature.

Each of the chapters, apart from the introductory and concluding ones, is a comprehensive review, replete with cited references, of the literature on its subject. In general the reviews are of high quality, well written, and easy to read, although the style varies from author to author. Breadth of viewpoint is necessary in treatment of diagenesis because the boundaries of this phenomenon are poorly defined with respect to materials, reactions, and time. Recognizing the problem of definition, the editors write in their introduction that they have "attempted to throw some light upon the uncertainties that exist in defining the term diagenesis. [They] have found it necessary to leave the definition of diagenesis to individual contributors." While such leeway is desirable for freedom and independence of ideas, it has also yielded a profusion of terms which overlap widely in meaning, as can be seen from the glossaries which follow several of the chapters. Some 30 such terms (too many to be listed in a review) were noted to be synonymous in part with, or closely related to, the process of diagenesis.

In their summary of the volume, recognizing both the wide scatter of ideas about diagenesis and the vigor of each one, the editors write that "one of the main impressions gained . . . is that diagenesis is a field of geology in which research is undergoing a phase of very rapid development. . . . Another main impression is that there is not yet a universally accepted definition or delimitation of the term 'diagenesis.' " This reviewer will repeat his opinion, long expressed in college classes, that the basic difficulty in defining diagenesis arises from the practice, original and continued, of keeping the time of change (diagenetic) a major and often diagnostic ingredient of the definition. Of the essential factors in petrogenesis —materials, energies, and time—time is the least amenable to practical quantification, description, preservation in the record, and replication. Diagenesis is basically a geochemical or mineralogical process, or set of processes, ultimately definable with fair chemical-mineralogical precision. The result of the change (diagenetic), not the actual time at which the change occurred within the vague interval from prior to weathering until the rock is collected for study, is that which is worthy of definition.

Hence it is the discussions of the reactions and their results that constitute the major contribution of this book. Every serious student of sedimentary rocks and their processes, and economic geologists studying ore-containing sedimentary rocks, should have the book available. Many of us will use the copies from our institutional libraries because of the high price of the book. With considerable self-restraint, I refrain from repeating expressive comments heard at society meetings about the prices of books that certain publishers and their outlets charge.

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Climate and Landform

The Cycle of Erosion in Different Climates. PIERRE BIROT. Translated from the French edition (Rio de Janeiro, 1960) by C. Ian Jackson and Keith M. Clayton. University of California Press, Berkeley, 1968. 144 pp., illus. $5.50.

Originating as a series of lectures delivered in 1956, this book was first published in French in 1960. It was translated in order to provide the English and American geomorphologist with an account of the effects of climate on landforms, a topic that has been the focus of much European, especially French, research. It is, indeed, the only book in the English language that is concerned primarily with this subject. However, notwithstanding the translators' assertion that Birot has thoroughly revised the original text for