ods and is complete with sample problems and glossary, and the second illustrates the method with sample cases. Fitch's analysis has many biological implications, and several of these are treated directly (for example, the question of whether nucleotide interchanges are equally likely in all codons).

A number of authors deal with specific problems in vertebrate evolution. Keast examines the zoogeography of worldwide bird and mammal faunas and attempts to integrate approaches that are frequently viewed as alternative. Szalay is sharply critical of so-called phylogenetic taxonomic methods, and presents his own higher-category classification of the Eutheria. This is based on his interpretation of cranial as well as postcranial characters and on a fairly traditional evolutionary approach to classification. Luckett uses "sound principles of cladistic analysis" to analyze the phylogeny of amniote fetal membranes. The crux of any such analysis is the determination of character state transformations, and that requires several important assumptions. Marshall argues that the ecological roles of terrestrial carnivores in South America during the Cenozoic were shared by reptiles, birds, and mammals and that a "relay" of various groups occurred. Active competition between groups is postulated, with mammals of North American ancestry finally dominating. Other papers include a discussion of the distribution of the earliest tetrapods (Panchen), treatments of the origin of tetrapods and their appendages (Szarski, Schultze), a lengthy consideration of the effect of insularity on mammalian evolution (Sondaar), a brief paper on the adaptations for terrestrial life of a viviparous frog (Xavier), and a consideration of the phylogenetic implications of chromosomal evolution (Moreschalchi).

A final group of papers involves explorations in functional morphology in relation to phylogeny. Edwards discusses the evolution of terrestrial locomotion on the basis of his analysis of salamander locomotion and concludes that the first terrestrial gait was likely a traveling wave trot, rather than the slow walk that has been postulated by several workers. Pirlot examines wing design and the origin of bats, arguing that, unlike birds, bats took up a flapping flight initially rather than a running, jumping, and gliding pattern, as has been postulated for ancestral birds. Templin, Clark, and Smith add brief notes relating to different aspects of flying, mainly in bats. Dullemeijer and Barel present a stimulating philosophical discussion of the relation of functional morphology and evolution. They are skeptical concerning the way in which evolution is usually used to explain phenomena of functional morphology and argue that evolution is not essential for understanding functional morphology.

The volume contains some weak papers and some that are rambling and repetitive, but the many effective presentations make it required reading for vertebrate biologists interested in phylogenetic analysis.

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Geochronology

Precambrian of the Northern Hemisphere and General Features of Early Geological Evolution. L. J. SALOP. Translated from the Russian edition (Leningrad, 1973). G. M. Young, Transl. Ed. Elsevier, New York, 1977. x, 378 pp., illus., + tables. $59.25. Developments in Palaeontology and Stratigraphy, 3.

In this book the author is aiming at two targets. As the title indicates, he has set out not only to describe the Precambrian of North America and Eurasia but to use this knowledge to tackle the difficult problem of understanding the early development of the earth. Salop in fact has a still broader purpose in mind, for, to quote his own words, "Studies of Precambrian formations . . . are needed to elucidate the general laws of geological evolution." This is a field he has pioneered. In the early 1960's, when Precambrian geochronology was less well documented than it is today, he made some of the first attempts to rationalize Precambrian history. Even at the present time we are, I suspect, far from understanding general laws, though it seems to be increasingly clear that the processes at work in the early Precambrian differ from those at work in more recent times.

I found two features of the book particularly valuable. The first is the extensive account of the Precambrian of eastern Europe and of Siberia. Salop has picked out the highlights and provided an account amply supported by age determinations. The English translation prepared under the aegis of G. M. Young is excellent. Soviet readers of the original edition in Russian no doubt found the accounts of western Europe and North America just as useful. Naturally one can query points of detail and selection, but the result is a working summary of knowledge of the ancient rocks of the Northern Hemisphere.

The second feature I particularly appreciated is Salop's approach to the question of the Precambrian evolution of the earth. He sets out his conclusions as "empirical generalizations." As I understand this expression, these are conclusions based on an understanding of the older stratigraphical successions in three continents—successions summarized in valuable tables that must represent many years' work. These lead to a proposed geochronological scheme for the subdivision of the Precambrian, and bring out many similarities in coeval rocks from various stages in the Precambrian record. Here are two valuable concepts. The book is worth reading for these alone. Salop knows very well that he has not written the last word on these subjects, and quotes with appreciation Sederholm's comparison of Precambrian stratigraphy to Penelope's weaving. What is woven by day is unraveled every night. There is much in this book to ponder, and I would not be surprised if time vindicates many of Salop's conclusions—just as Penelope's patience was in the end rewarded.

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Emanations from the Sun

The Solar Output and Its Variation. Papers from a workshop, Boulder, Colo., Apr. 1976. Colorado Associated University Press, Boulder, 1977. x, 526 pp., illus. $8.95.

One might say that solar astronomy has been caught with its pants down. Suddenly there is widespread concern about changes in the earth's atmosphere and hence climate. The sun is the principal driving source of the global-scale atmospheric winds that carry warmth and cold into our daily lives. Climate is characterized by extreme variability, and it is difficult to separate internal and external influences. But more and more from several quarters comes the question, how constant is the solar output? Climate models suggest that a change of only 1 percent in the solar output, if extended over several decades, could produce significant change in global temperatures. Unfortunately, compared to other physical measurements, radiometry is imprecise, attaining a precision of only about 1 percent even in the laboratory. So deter-