son with trunk length. This may suit them well for squatting-feeding on the ground. But we need not infer that in gorillas long forelimbs and short hindlimbs evolved entirely during a term of terrestriality. Orangutans, which are highly arboreal, possess much longer forelimbs and shorter hindlimbs than gorillas do. Further, the structure of the shoulder, thorax, hands, and feet of gorillas attests to a prolonged arboreal heritage in their lineage. It is most likely that knuckle-walking, the characteristic terrestrial hand posture of gorillas and chimpanzees, is a compromise adaptation of elongate, previously flexible, arboreally adapted hands to terrestriality. The giant gelada that Simons favors as a base of inference (in lieu of overwhelming evidence from living hominoids that he dismisses as "dogma") had fingers approximately as long as those of Recent baboons. They could hardly be associated with knuckle-walking.

Simons concludes that the antecedents of man may have been bipedal from the moment they left the trees (p. 282), but he does not discuss evidence that leads him to this view. As I have argued previously in *Science* (**166**, 953–61 [1969]), we might indeed profit by digressing from exclusive consideration of open-country paleohabitats in order to search hypothetical arboreal contexts for the origins of hominid bipedalism.

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Biogenesis

The Origin of Life by Natural Causes. M. G. RUTTEN. Elsevier, New York, 1971. xx, 420 pp., illus. $34.50.

The Life Puzzle. On Crystals and Organisms and on the Possibility of a Crystal as an Ancestor. A. G. CAIRNS-SMITH. University of Toronto Press, Toronto, 1971. viii, 166 pp., illus. $6.50.

The origin of life is a very broad topic, drawing information from nearly all fields of science. A book on that subject can be expected to take up most of the following topics: the history of the problem, the origin of the solar system, meteorites, the primitive atmosphere and its transformation to one containing molecular oxygen, pre-Cambrian geology and microfossils, prebiotic synthesis of small molecules, polymerization, organization of polymers into the first living organism, early evolution and metabolism, and life in other solar systems. This is almost too much for one author to cover adequately, and so most books in this area emphasize only a few of these topics.

Rutten's volume emphasizes pre-Cambrian geology. It is an updated and greatly enlarged version of the late author's 1962 book, *The Geological Aspects of the Origin of Life.* The chapters dealing with geology are excellent, at least from the standpoint of the nongeologist. The early pre-Cambrian microfossils are discussed in some detail and with suitable caution. There is a clear account of the states of oxidation of the banded-iron formations and the uranium-gold–bearing reefs and their implications about the presence of O_2 in the atmosphere. The history of molecular oxygen in the atmosphere is taken up at some length with a strong input of the author's ideas. This is a very speculative subject, and at present one model seems as good as another. The material in the nongeological chapters is not covered adequately, nor is the same standard of caution evident as with the geology.

This book is a good introduction to geology and the geological aspects of the origin of life for the nongeologist. For the geologist, it brings together various aspects of pre-Cambrian geology as they bear on the origin of life and the history of the atmosphere. It gives only a brief account of prebiotic chemistry and how the organic polymers organized into the first living organism.

The second volume deals almost entirely with the problem of how the first organism arose from the primitive soup. It is an expanded version of a paper by the author (*J. Theoret. Biol.* **10**, 53 [1966]). It is written in a very simple style, as if the author intended it for the general public. However, nonscientists will find this book difficult reading.

The most popular model of the first living organism is a molecule of nucleic acid with the associated apparatus (presumably protein enzymes) that can self-replicate and synthesize a few enzymes. Cairns-Smith discusses at length the impossibility of making a significant amount of an enzyme by a random synthesis, even if the synthesis took place rapidly over the entire earth, because of the extremely large number of possible isomers. And if this improbability were overcome by some nonrandom synthesis, then even larger improbabilities would arise in organizing a simplified version of the present nucleic acid protein synthesizing system. A simplified version is not likely to be very accurate in its self-replication, but a very accurate system is required or the organism will mutate itself out of existence. On the other hand, if the replication is too accurate then no evolution can take place. An example of this is the production of crystals from a supersaturated solution (such as aqueous NaCl) with a seed crystal. The reproduction is extremely accurate in this case, but little or no variability is possible in the product. But the crystallization of clay minerals is not so accurate or uniform. Some clay minerals with suitable cation substitutions do not have these substituted cations distributed at random. The substituted cations instead form patches between the silicate layers of the clay mineral. The patchy areas in one layer are said to determine the composition of the layer above and also the succeeding layers. A pattern of patches might therefore be reproduced rather easily, and a "mutation" in the pattern might also be reproduced. From there on the discussion becomes rather vague, especially as to how the reproducing and "mutable" clay mineral system could evolve into the present nucleic acid protein system. Nevertheless, this is an interesting idea. Unfortunately, no experiments have been done to test it. Perhaps this book will stimulate some.

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Geoscience

The Nature of the Solid Earth. A symposium, Cambridge, Mass., April 1970. EUGENE C. ROBERTSON, JAMES F. HAYS, and LEON KNOPOFF, Eds. McGraw-Hill, New York, 1972. xvi, 678 pp., illus. $13.50. McGraw-Hill International Series in the Earth and Planetary Sciences.

During the past 25 years, only a few Americans have had an impact on the earth sciences comparable to that of Francis Birch, who retired from full-time teaching duties as Sturgis Hooper Professor of Geology at Harvard University two years ago. Birch's contributions have been mainly in the physics of the earth's interior, physical properties of rocks, heat flow from the earth's interior, and evolution of the solid earth, but no field of earth sci-