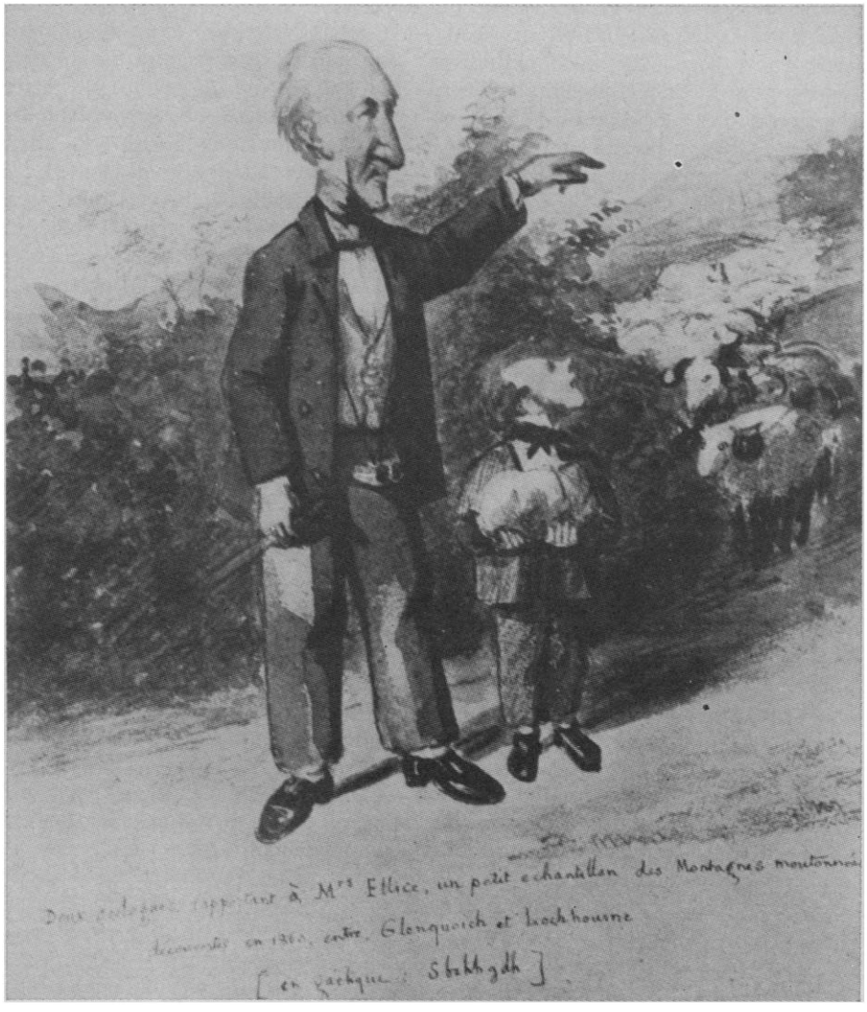
Early Days of a Science

Toward a History of Geology. Proceedings of a conference, Durham, N.H., Sept. 1967. CECIL J. SCHNEER, Ed. M.I.T. Press, Cambridge, Mass., 1969. vi + 474 pp., illus. $22.50.

The purpose of this work is to reconstruct the intellectual climate in which the geological sciences evolved; or, more specifically, "to recreate the world view which was available to young Charles Darwin, and out of which the theory of evolution was to emerge." Outgrowth of an interdisciplinary conference which brought together a distinguished international group of geologists and historians of science, the book contains 23 essays and two brief summaries.

Fifteen of the articles center upon the thought and contributions of individual scientists, including such well-known names as Palissy, Scheuchzer, Guettard, de Maillet, Desmarest, Sir James Hall, Werner, Hutton, William Smith, Humboldt, and Lyell. Not so widely known are Edward Jorden (1569–1632), physician-chemist who speculated on the origin of metals and on the source of the earth's internal heat, and Torbern Bergman (1735–1784), an early neptunist whose writings influenced the thinking of Werner, Kant, and Hutton.

Three essays trace the development of geological ideas within geographical or political boundaries. V. V. Tikhomirov sketches the history of Russian geology from the earliest times to the middle of the 19th century. George W. White describes geological work done in the American Midwest prior to 1787, the year when the first book on the geology of the United States was published. The history of studies relating to the remarkable recent and continuing changes of sea level in Fennoscandia is related by Eugène Wegmann.



Roderick Impey Murchison (1792–1871) and Archibald Geikie (1832–1924), a caricature by Prosper Mérimée. In August 1860 the two geologists, who were engaged in mapping parts of the Scottish Highlands, visited at a home in Inverness-shire at which Mérimée was also a guest. In his autobiography Geikie, who apparently never saw this caricature, writes of Mérimée thus: "[His] chief occupation out-of-doors seemed to be sketching the scenery in water colour on course brown paper . . . his drawings . . . filled me with surprise that so accomplished a man of letters should spend his time in the production of such crude and inartistic efforts to represent the noble scenery around him." [From *Toward a History of Geology*]

Geology has had its full measure of controversies, and so as one might expect there are numerous references throughout the book to the quarrels between the neptunists and the plutonists and between the uniformitarians and the catastrophists. Three essays are concerned primarily with the analysis of controversial issues. In describing the debate of the early 19th century about the geological significance of Noah's flood, Leroy E. Page takes the position that the neptunist theory as conceived by Werner was no more influenced by the Bible than was Hutton's plutonist theory. Franck Bourdier tells how Geoffroy Saint-Hilaire, in the years between 1830 and 1844, attacked Cuvier's views on the fixity of species and in so doing became a leading proponent of evolutionary paleontology. The brief but acrimonious debate in 1856 and 1857 between Tayler Lewis, the classicist, who held that historical geology was heretical, and James Dwight Dana, the geologist, who rose to the defense of his discipline and profession, is recounted by Morgan B. Sherwood.

V. A. Eyles has contributed a bibliographic essay which demonstrates that geology was better developed and organized during the 18th century than has been recognized heretofore. Even so, certain fields remained in a state of confusion because of a lack of any acceptable systems for classifying the natural phenomena which fell under their purviews. One such field was systematic mineralogy, which, as John G. Burke explains, remained in an unsettled state until late in the 19th century, when physics and chemistry provided the necessary theoretical bases for mineral classification.

The book contains but little on the geological thought of the 17th and earlier centuries. Sister Suzanne Kelly reviews theories of the earth as expressed in cosmologies of the 15th, 16th, and early 17th centuries; and the editor in his introduction recounts some of the older history of geologic thought. The inclusion of Schneer's earlier paper

on the rise of geological thought in the 17th century would have been welcomed by the readers.

Illustrations include four plates showing delightful caricatures of famous geologists, including Haüy, Hutton, Buckland, Murchison, and Geikie. These pictures accentuate the temper of the book, which on the whole is gracefully written and which is enlivened by good humor in many of its passages. The idea of bringing together the scientists and the historians of science has proved eminently successful.

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The Interior of the Earth

The Earth's Crust and Upper Mantle. Structure, Dynamic Processes, and Their Relation to Deep-Seated Geological Phenomena. PEMBROKE J. HART, Ed. American Geophysical Union, Washington, D.C., 1969. xvi + 736 pp., illus. $18. Geophysical Monograph 13. Upper Mantle Project Scientific Report 21.

The Upper Mantle Project was proposed by V. V. Beloussov at the meeting of the International Union of Geodesy and Geophysics at Berkeley. A great deal of theoretical and practical work has taken place following the resolution to tackle the problem of the composition of the upper mantle, and a great deal has been learned about how the crust behaves in relation to the inside of the earth.

The upper mantle is believed to be much less uniform both laterally and in depth than most previous diagrams of the inside of the earth depicted it as being. A great deal of new knowledge has been obtained with the help of improved seismograph observing arrays located to listen for clandestine nuclear explosions. Magnetic observations over the oceans have provided extensive world coverage which has indicated large tears in the earth's surface and has led to theories of continental sea floor spreading.

The orbits of satellites have provided new values for the regional gravity anomalies over the earth's surface. The satellites themselves are allowing much more accurate position fixing at sea, and this in turn will improve the accuracy of seaborne gravity-meter results.

The Earth's Crust and Upper Mantle gives an up-to-date account of all the measurements that have been made. Many authors, all experts in their own field, have been chosen to allow coverage all over the world for each type of measurement. The book follows very well *The Earth's Mantle* (Academic Press), which was published two years ago and gave an account of what was known at that time. The present volume brings everything up to date and includes some authors from the previous book.

Although the Upper Mantle Project officially ends this year, the enthusiasm it has generated will certainly ensure that work with international cooperation continues. Plans have already been made to carry on worldwide cooperation and to identify the problems most worthy of attack.

It is possible that the rift valleys and the deep ocean trenches may have an important bearing on movements of large masses of surface earth material. It is probable that these features are present-day offshoots of the splitting apart that almost certainly has taken place in the past.

The Deep Sea Drilling Project, which has now been extended by the National Science Foundation, is collecting exciting new results from the ocean-covered part of the earth's surface. It is to be hoped that during the course of this project methods of reentry will be perfected so that some of the harder rocks underlying the sediments can be sampled. It is even hoped by some that in the foreseeable future the drilling techniques will be so perfected that sampling of the mantle rock will be possible.

Hart's impressive volume covers the theoretical aspects of present geophysical problems as well as the up-to-date measurements. Although a great deal has been learned in the past few years there are still many questions; for example it is not certain whether the platy surface fragments of the earth have been changing place, breaking up and drifting for the whole life of the earth, or whether this is a comparatively new phenomenon that is representative only of the last few hundred million years of the earth's history. Further study and better understanding of the heat balance of the crust and upper mantle may demonstrate that a long time was needed to bottle up enough heat to give plasticity to the upper mantle.

The Upper Mantle Project has been a great success in bringing together the International Union of Geological Sciences and the International Union of Geodesy and Geophysics with all their participating groups, and this volume is a worthy record of the work that has been done.

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Excavating in Mongolia

Hunting for Dinosaurs. ZOFIA KIELAN-JAWOROWSKA. Translated from the Polish. M.I.T. Press, Cambridge, Mass., 1969. xiv + 178 pp., illus. $7.95.

Kielan-Jaworowska's book is a thoroughly readable and informative account of three Polish-Mongolian paleontological expeditions to the Gobi desert, of which she was the leader. There was a preliminary survey trip in 1963, followed by two well-equipped and productive expeditions in 1964 and 1965. A dozen or more scientists participated in each of these expeditions. Travel was by heavy-duty field cars and trucks. Camps were set up at various places in the Mongolian desert, and the expedition members worked hard and long, searching for and excavating fossils, particularly of Cretaceous dinosaurs. Much of the work was carried out in the fabled Nemegt Basin, which within these past two decades has yielded a wealth of dinosaurian skeletons, but there were trips to other localities as well, including the famous Flaming Cliffs of Bain Dzak (or Shabarakh Usu), where expeditions from the American Museum of Natural History, and subsequently from the Soviet Academy of Sciences, had recovered numerous skeletons of the primitive ceratopsian dinosaur, *Protoceratops*, as well as numerous dinosaur eggs, and skulls of Cretaceous placental mammals.

The Polish and Mongolian paleontologists suffered the usual trials attendant on field work in remote desert regions: heat in the day and cold at night, the ever-present problem of water, high winds and sandstorms, and lesser annoyances. But in spite of the difficulties they carried through their campaigns with spectacular success. Various Cretaceous dinosaur skeletons were collected; several examples of the gigantic tyrannosaur, *Tarbosaurus*, bird-