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.

CLAUDE ALBRITTON
Department of Geological Sciences, Southern Methodist University, Dallas, Texas

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.

T. F. GASKELL
BP Ltd., London, England

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-

like ornithomimids, armored dinosaurs, and other reptiles characteristic of the late Cretaceous dinosaurian faunas of the Northern Hemisphere. In addition there were two spectacular discoveries: one of a huge sauropod dinosaur (a rarity in such late Mesozoic sediments), the other of a gigantic forelimb, some nine feet in length, of a bipedal theropod dinosaur. Nor were all the discoveries of fossil reptiles. At the old Flaming Cliffs locality there was made a sizable collection of Cretaceous placental mammals. All of this is told most interestingly, with verve and good humor, by the dedicated author. She also injects frequent sidelights on Mongolian people and their customs.

This book will be of particular interest to vertebrate paleontologists, but because of the nature of its subject matter it should attract many readers—scientists and laymen alike. A good story of treasure-hunting (and dinosaurs are treasures in our modern world) is bound to be interesting to many people. The story is abundantly illustrated by many excellent photographs.

This is not a large book, but it is designed in a wide format, which is advantageous for the best use of the photographic illustrations. The black-and-white drawings that decorate the chapter headings are unusual, but perhaps somewhat indefinite.

EDWIN H. COLBERT
Museum of Northern Arizona, Flagstaff

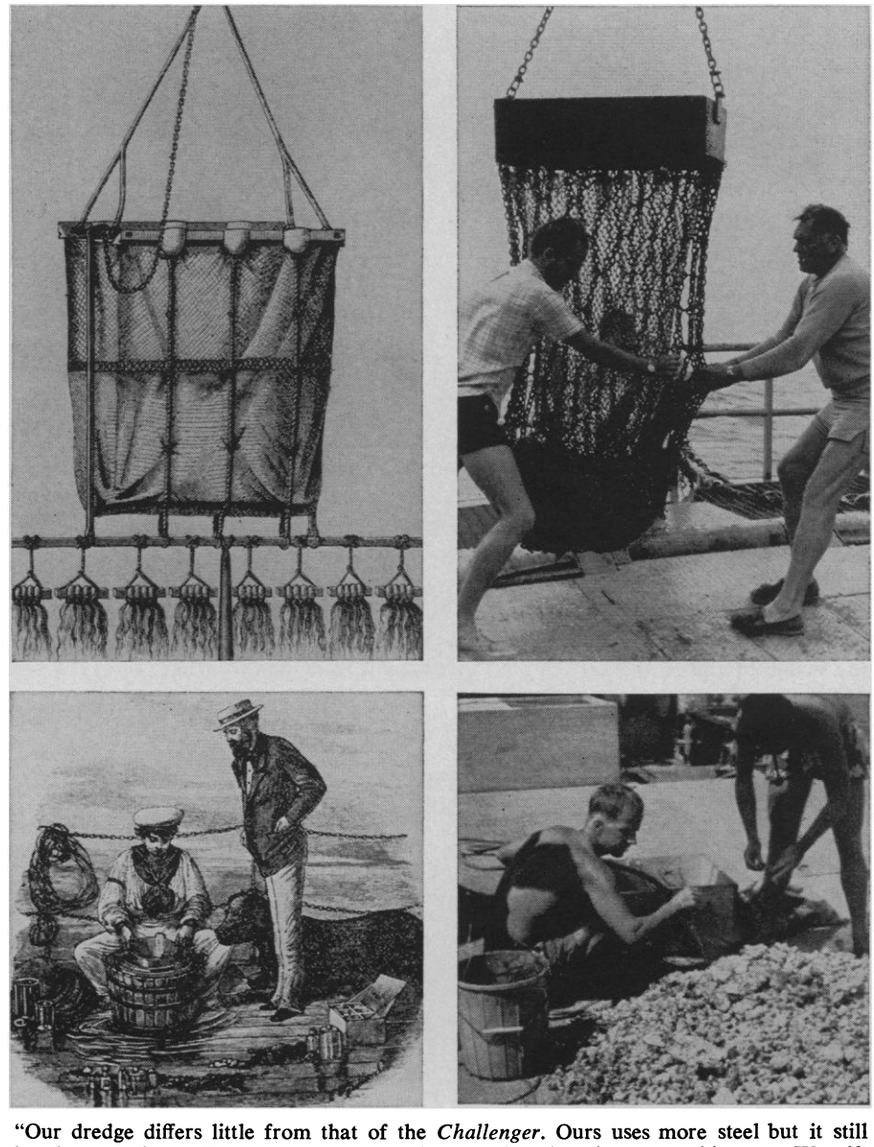
Hard Work at Sea

Anatomy of an Expedition. HENRY W. MENARD. McGraw-Hill, New York, 1969. xii + 260 pp. + plates. $6.95.

During the two and a half decades since World War II ended, American oceanographic expeditions have investigated much of the world's oceans. Results obtained during these expeditions and others financed by other countries have been published in such learned journals as *Science* and have led to a better understanding of the geologic history of the sea floor and of the interrelationship of continents and oceans (the new concept of global plate tectonics), the first-order relief features of the earth's crust. Rarely, however, is the reader of these articles able to appreciate the effort spent in gathering the data. This gap has been partially filled by Menard's well-written account of the Scripps Institution of Oceanography's *Nova* Expedition.

The expedition took place in the spring and summer of 1967. The area surveyed was Melanesia in the southwestern Pacific, a jumble of continental islands and small ocean basins marked by island arcs. Included in the scientific program were topographic studies, measurements of the variations of the magnetic and gravity fields, seismic reflection and refraction studies, dredging for rock samples, sediment studies, and measurements of heat flow. But this book is not just a description of the scientific accomplishments and failures; it catalogs the many frustrations one encounters prior to and during such expeditions. Such well-known calamities as rough weather, temperamental electronic gear, seasickness, lack of enough spares, and loss of gear are described.

For those of us who have gone to sea this book is a reminder of all the frustrations, great expectations, and accomplishments at sea; for those who



"Our dredge differs little from that of the *Challenger*. Ours uses more steel but it still breaks sometimes. Consequently we are happy when it brings something up. We sift the deposit just about as they did on *Challenger* but, although the British have lost none of their style, some American oceanographers do not seem to have grasped how to work on a ship." [From *Anatomy of an Expedition*; the drawings first appeared in *The Voyage of the Challenger* (1877), vol. 1, and *Report on the Scientific Results of the Voyage of H.M.S. Challenger* (1873–76), vol. 1, part 1, both by C. Wyville Thomson]