Book Reviews

Results of a Program in Oceanography

Initial Reports of the Deep Sea Drilling Project. A project planned by and carried out with the advice of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES). Vol. 1, covering leg 1 of the cruises of *Glomar Challenger*, Orange, Texas, to Hoboken, N.J., Aug.-Sept. 1968. Maurice Ewing *et al.*, participating scientists. Prepared for the National Science Foundation by the Scripps Institution of Oceanography, La Jolla, Calif., 1969 (available from the Superintendent of Documents, Washington, D.C.). xx + 672 pp., illus. $10.25.

This is the first volume in a series of reports on an oceanographic program that will contribute much to the solution of many important problems in the history of the oceans and of the earth as a whole. Marine geologists have long had to be content with the study of the most recent history of the ocean basins, since older deposits are generally covered with a blanket of young sediments. Even so, in part by the use of indirect geophysical methods, they have established the curious fact that, although oceans have been a permanent feature of the earth's surface since the beginning, the history recorded in oceanic sediments is only a relatively brief one. This paradox can be explained by recent revolutionary concepts regarding the nature and dynamics of the earth's crust, which have led to a revival of the old continental drift theory. The consequences of these ideas are now rapidly renewing all geological thinking on a global scale.

It is thus timely that in recent years the technology has become available to drill and obtain cores of deeply buried sediments in even the deeper parts of the ocean floors, and that organizational enterprise and farsighted funding policies have made it possible for scientists to take advantage of this technology. The Deep Sea Drilling Project was initiated through the efforts of four, later five, major oceanographic institutions, with contributions from scientists elsewhere, and has been actively supported by the National Science Foundation. Global Marine, Inc., of Los Angeles designed, built, and is operating the drilling vessel, *Glomar Challenger*, that has made this project possible. Nine cruises, each of two months' duration, have been completed in the Atlantic and Pacific oceans, and an extension program of 30 months has just begun. The report reviewed here covers the results of the first of these cruises, a period of learning and experimentation, no doubt, but nevertheless rich in results of great importance.

The purpose of the project is to supply oceanic sediment cores for further examination by interested investigators. In order to facilitate access to the core material, it is necessary to provide reasonably detailed descriptions, including photography, graphic logs, and analytical data. Moreover, since many of the potential individual research projects require the same background data, duplication of effort and waste of material can be avoided by supplying some of that information—for example, mineralogical analyses—as well. It naturally follows that, once this much information is available, the scientists compiling the data find themselves in an excellent position to draw some early conclusions.

This report contains both the core-description data and some interpretative sections. It is a Sears Roebuck catalog of tempting sedimentary material, documented by massive tables and graphs designed primarily to inform the reader about the material available for further study. Approximately 500 of the 672 pages are devoted exclusively to this purpose. The rest of the book contains more descriptive material interspersed with inferences and three summary articles.

The total volume of the data is staggering, especially if one considers that only slightly more than a year passed between the cruise and the publication of the report. Large, government-supported R & D projects are not noted for staying within cost estimates, for following original time schedules, or for accomplishing as much as plans proposed. The Deep Sea Drilling Project set enviable records on all three points. Large oceanographic expeditions are normally slow in publishing their data; decades passed before the results of such famous expeditions as *Challenger, Meteor, Snellius,* and *Discovery* were fully published. The Deep Sea Drilling Project needed one year and is confident that this interval can be shortened. Given the large volume of material and the short time in which it was gathered, the report is well organized and appears to be relatively free of errors. Librarians may be driven to desperation by the proliferation of sponsoring organizations on the title page and the absence of citable authors, but that is a minor point. As the volume of data grows—this cruise recovered 200 meters of core, and later ones have been successful in gathering more than 1000 meters per two months—it will become increasingly necessary to possess a sophisticated data-retrieval system; already in this volume, correlating different types of information is a painful and time-consuming task.

After a brief cruise narrative, the first part of the book treats the details of the setting of each drill site and describes the cores. The second part contains listings of specialized data, such as grain size, calcium carbonate content, the complete biostratigraphic information, or the x-ray diffraction mineralogical analysis. An evaluation of this part is made difficult by an almost complete absence of references to analytical methods and their reliability; one hopes that a summary publication on this subject can be issued in the near future, since so many data should not go unsupported by method descriptions and quality control statements. Some highly specialized sections of great interest discuss the analysis of the oils and caprock of the deepwater saltdomes in the Gulf of Mexico.

The third part, containing conclusions and interpretations regarding the sedimentation, biostratigraphic, and regional aspects of this part of the coring program, is of interest even to those who do not plan to utilize the core material for their own work. It makes this book indispensable for all geologists interested in the history of the

oceans, and, in addition, suggests numerous problems for further examination.

The material is voluminous, and there is much more to come. It is obvious that marine geologists must reserve large portions of their time, resources, and interest for the opportunities that this material presents. It is equally obvious that the energy, initiative, and monies devoted to acquiring the cores, which constitute a major share of the total effort devoted to oceanographic studies, must be matched by equal support for the research that this material permits. This will require the same degree of imaginative farsightedness on the part of the National Science Foundation that caused it to support the drilling project to begin with. This report provides a strong foundation and justification for continued effort.

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Three-Dimensional Geodetic Measurement

Mathematical Geodesy. MARTIN HOTINE. Environmental Science Services Administration, Washington, D.C., 1969 (available from the Superintendent of Documents, Washington, D.C.). xvi + 416 pp., illus. $5.50. ESSA Monograph 2.

Geodesists, concerned with measuring and mapping the earth's surface, have been traditionally thinking in terms of the two surface dimensions rather than the three dimensions of space. Maps are two-dimensional. This does not mean that elevations are not taken into account, but the way this is done reflects a characteristic bifurcation in geodesy: horizontal position and elevation are treated in completely different manners. This is quite natural, since the system of horizontal and vertical not only permeates our everyday life but also serves to orient the surveyor's instruments.

Carl Friedrich Gauss was inspired by his geodetic work when he founded, 150 years ago, the intrinsic differential geometry of surfaces, the surface being considered as a kind of two-dimensional space, abstracted from its three-dimensional environment. Subsequently, Bernhard Riemann generalized Gauss's conception of an intrinsic geometry from two to an arbitrary number of dimensions; and Riemannian geometry in four dimensions forms the mathematical background of Einstein's General Theory of Relativity, tensor calculus providing the technique.

At present the traditional bifurcation of geodesy is under fire from different sides. Theorists, dissatisfied with it for conceptual reasons, have insisted on a "three-dimensional geodesy" which treats the horizontal and the vertical on an equal basis. And in the last 10 or 20 years the mission of geodesy has extended into space and artificial satellites have introduced new measuring techniques for which a separation into horizontal and vertical no longer makes sense.

Martin Hotine was one of the most ardent and most influential champions of the three-dimensional concept. Shortly before his death he finished this comprehensive presentation of his ideas.

It is an unusually well written book. The reader will enjoy both a continuous, flawless line of mathematical reasoning and brilliant comments. He will learn a great deal about the mathematical and physical foundations of geodesy, about triangulation no less than about the use of the earth's gravity field and of satellite orbits.

Characteristic for the book and in no small measure contributing to its charm is its exquisite mathematical texture, which is three-dimensional differential geometry treated by means of general tensor analysis—the bifurcation of geodesy helped to create the weapon later to be turned against it. Tensor calculus permits a unified treatment of the various, often curvilinear, coordinate systems currently used and stresses the theoretical equivalence of all reference systems. It is thus excellently suited for the book's purpose, especially when handled with Hotine's virtuosity.

Hotine's book is frankly unconventional and intensely personal: "This book is an attempt to free geodesy from its centuries-long bondage in two dimensions. . . ." It is certainly the most fascinating attempt in this direction.

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Chinese Livestock

Domestic Animals of China. H. EPSTEIN. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England, 1969. xviii + 166 pp. + plates. 80 s.

H. Epstein of the Hebrew University in Jerusalem is the acknowledged authority on domestic mammals of Africa and the Near East; he visited China in 1963 at the invitation of the Chinese government to record by description and photograph the rapidly disappearing local breeds of domestic mammals in Manchuria, Inner Mongolia, Tibet, and China proper. The resulting semipopular book, enriched with a wealth of historical detail, is both a catalog and an encyclopedia.

Each species has a general introduction, which usually includes data on its earliest domestication and presence in China; then follows a description of each breed and its varieties with data on size, weight, growth rate, color, uses, and capacities, followed by its history insofar as it is known and sometimes interesting anecdotes about the animals. If pertinent, as in the case of pigs and dogs, historical information on the introduction of different varieties into Europe and America is included, and similar information is offered on any recent importation of several kinds of breeding livestock into China. There is thus a wealth of illustrated, well-documented (and well-indexed) information here that is not to be found elsewhere. Of Chinese domestic mammals, only cats are ignored, except for mention of Persian cats in Peking in the 18th century. Common cats, similar to the American and European alley variety, are present everywhere in China, generally at least one to a household, I am told by people who have lived there. True, there is no tradition of breeding of varieties of cats in China, but the total lack of mention of them is strange.

A single map is provided, and on it only the provinces are named. One is assumed, therefore, to know rivers, cities, towns, and the names of local areas; few of us do, and this lack of compensation for the natural ignorance of almost every reader is an annoyance.

I find it interesting that the Chinese, so systematically encyclopedic about so many matters, have never compiled a record of the varieties of their own domestic mammals. Now many of