

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 far-sightedness 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 semi-popular 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