Mapping of Glacier Ice

Radioglaciology. V. V. BOGORODSKY, C. R. BENTLEY, and P. E. GUDMANDSEN. Reidel, Dordrecht, 1985 (U.S. distributor, Kluwer, Hingham, MA). xii, 254 pp., illus. $54. Translation of the Russian edition (1983).

Three of the world's foremost radioglaciologists have pooled their experience to write *Radioglaciology*, a comprehensive review of the practical use of radars in the mapping of glacier ice. The inside covers, with outline maps of Antarctica labeled respectively in English and Russian, reflect that the book has been published in both languages.

The principal use of radar in glaciology is to sound (measure the depth of) glacier ice. Over a broad range of radio frequencies polar ice masses are essentially transparent, a fact first proved in the 1950's. The first four chapters of *Radioglaciology* briefly review the geographical, physical, crystallographic, and technological aspects of radar depth sounding of glaciers. Chapter 1 reviews the world distribution of glaciers and the geophysical methods available for depth sounding. Chapter 2 discusses the morphology of glacier ice. The third chapter describes the crystalline structure and electrical properties of ice of all kinds and the propagation of electromagnetic waves in glaciers from the point of view of geometrics and optics. Chapter 4 discusses some of the practical considerations involved in the design of radar equipment and lists the specifications of and discusses the technical capabilities of most existing radar sounding systems. Chapter 5 briefly discusses data acquisition methods.

These five chapters serve as a preamble to a review of scientific results (in chapter 6), that makes up two-thirds of the book. The chapter opens with a detailed review of efforts to measure the electrical parameters of ice and continues with the results of various field programs. The topics considered include subglacial topography, physiography, and geology, internal layering, and glacier movement.

As the authors indicate, their book is mainly concerned with Antarctic studies. Northern Hemisphere investigations are well represented by references but are considered in only about 20% of the regional discussions in the book. All told the authors have summarized several hundred sources of information. The references are exhaustive and well organized, and great care has been taken to reproduce photographic data faithfully.

Radioglaciology brings together a wide range of topics related to radio sensing of glacier ice. It was evidently completed in 1982, and some of it is out of date. This particularly affects chapter 5, which has missed several developments in data acquisition methodology. Also, given that the book is primarily devoted to Antarctic studies, a detailed location map of Antarctica would have been useful. The authors have intended their book as a summary volume aimed at "glaciologists, geophysicists, radiophysicists and other readers interested in the polar regions." It will be of value principally to serious glaciologists and polar scientists.

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Exact Astronomy

Measuring the Universe. Cosmic Dimensions from Aristarchus to Halley. ALBERT VAN HELDEN. University of Chicago Press, Chicago, 1985. viii, 203 pp. $30.

The subject of Van Helden's book is the changing perception of the scale of the universe among astronomers from the ancient Greeks to the middle of the 18th century. It reflects the nature of astronomy over this long tract of time that he is largely concerned with the size of the solar system and only briefly with the heavens beyond. A single problem considered over a very broad time scale and in widely different intellectual and cultural contexts is now an unfashionable organizing principle for a book written by a professional historian of science. Van Helden, however, has produced an authoritative and, in spite of the technical nature of the material, very readable account. Along the way, this "single" problem became entangled with a great many astronomical questions; it was not, in fact, single at all. Further, there is a wider intellectual dimension, for the scale of the cosmos in relation to the familiar measures of everyday life has always been an important component in humans' perception of their place in the natural world.

Thus, the story impinges on a number of topics that have engaged historians. Changing conceptions of the solar system and of its organizing principles are traced through Ptolemy and Copernicus to what Van Helden pointedly calls "Kepler's synthesis"—awarding to Kepler a laurel that is traditionally awarded to Newton but that Kepler, in his own way, also merits. The instrumental work of Tycho and of Galileo leads naturally to a discussion of the development of the telescope in the 17th century and, most important in this context, of the introduction of the eyepiece micrometer, which gave the telescope a role in astronomical measurement. The story ends with hardheaded professionalism: the technical achievements of Cassini, Flamsteed, and Halley, together with the French expedition of 1672 to Cayenne to measure the parallax of Mars, and thence of the sun. A consensus had been achieved prior to the critical observations of the transits of Venus in 1761 and 1769, and it is with this consensus that Van Helden closes.

The success of the book derives from Van Helden's competent handling of the technical issues, combined with his sensitivity to their wider intellectual implications. It should appeal, correspondingly, to anyone interested in the history of exact astronomy and to those with broader interests in the history of ideas.

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Mathematical Physics

Regular and Chaotic Motions in Dynamic Systems. G. VELO and A. S. WIGHTMAN, Eds. Plenum, New York, 1985. viii, 310 pp., illus. $52.50. NATO Advanced Science Institutes Series B, vol. 118. From a school, Erice, Sicily, July 1983.

The past 20 years have witnessed a surge of interest in and understanding of the behavior of dynamical systems. The lectures in the present volume review many of the advances made during this period.

Much of the present work in dynamical systems has its origins in the research by Poincaré on celestial mechanics at the end of the last century. The first chapter of the book under review is a survey by A. Wightman that explores these historical connections and in the process introduces techniques and terminology that reappear in later chapters. One of Poincaré's startling discoveries was that homoclinic orbits are present in Hamiltonian systems. These are orbits arbitrarily close to which one finds other orbits that display very complicated behavior. In fact the behavior of these nearby orbits is so complicated that it is, in a well-defined mathematical sense, as random as the sequence of heads and tails obtained by flipping a coin infinitely many times. Upon discovering these orbits, and realizing the complications they implied, Poincaré was moved to remark: "One will be struck