Book Reviews

Geodesy's New Tool

Introduction to Satellite Geodesy. Ivan I. Mueller. Ungar, New York, 1964. xxii + 415 pp. Illus. $15.

The general field of theoretical and practical geodesy is experiencing revolutionary changes. To a considerable extent, these changes are the result of the technical progress in rocketry—specifically, of the ability to launch close-to-earth artificial satellites. Such satellites provide geodesy with a new tool.

The revolutionary importance of geometrical satellite geodesy must be assessed on the basis of the fact that a strictly geometrical solution provides geodesy, for the first time in its history, with the means to create a three-dimensional, worldwide reference system, with a minimum of a priori hypothesis—in particular, without reference to either the direction or magnitude of the force of gravity. In addition, the corresponding three-dimensional triangulation is oriented in a dependable and uniform manner with respect to the direction of the rotational axis of the earth. This is accomplished by replacing the classical, two-dimensional Laplace condition, which, for practical reasons, is only sporadically executed, by three-dimensional celestial orientation for each line of observation.

In gravimetric geodesy, satellite orbits provide the means for sampling, in a systematic manner, the potential field beyond the physical earth. This is achieved by determining the geometry of orbits, which in turn can be considered instantaneous and continuous analog presentations of certain characteristics of the potential field of the earth.

The two approaches will eventually provide geodesy with the information necessary to establish a uniform, worldwide reference system that is representative of the geometry of the physical surface of the earth and of the gravitational vector field associated with its mass distribution. These geodetic applications of artificial satellites, and to a lesser extent of the moon, are discussed in chapter 2.5 of *Introduction to Satellite Geodesy*. This chapter, which contains a condensed presentation of the subject matter, is an excellent introduction to satellite geodesy.

Mueller provides not only a textbook for students who seek formal instruction in modern geodesy, but equally significant, he provides the necessary fundamental information, and sufficient references, for those who wish to pursue their studies in depth, an increasingly important service in view of the recently initiated U.S. Geodetic Satellite Program.

In the first section, the author treats solar eclipses and occulations. The rather detailed presentation, approximately one-third of the book, is written mainly in support of the curriculum at Ohio State University where the author is associate professor in the Department of Geodetic Science. Little practical geodetic significance is associated with these methods today. Nevertheless, the theory of eclipses reveals interesting geometrical principles and serves as a worthwhile introduction to the more important second section of the book which deals with the gravimetric and geometric principles on which the geodetic use of close-to-earth artificial satellites is based.

A review of close satellite theory is presented in terms of Newtonian laws of motion and dynamics as they pertain to a central spherical field. Perturbations, especially asymmetries of the gravitational field and atmospheric drag, are treated as forms of disturbing functions leading to intermediary orbits. The presentation, in its analysis, closely follows Kaula's approach.

In chapters 2.3 and 2.4, observational techniques and some generalities about corresponding data reduction principles for artificial satellites are described. Mueller discusses the visual methods applied by the Moonwatch Program of the Smithsonian Astrophysical Observatory and then considers the more precise photogrammetric instrumentation systems, including theodolite-type and still cameras. Electronic methods described include equipment based on the interferometry principle and on the Doppler effect and various ranging systems based on the phase-shift effect of electromagnetic wave modulation.

A summary of the contents is best accomplished by quoting the author: "Originality in the wider sense is not to be expected, and indeed, would defeat the object of the book, which aims at making it easier for the student to read with profit the numerous more technical treatises listed in the Bibliography." The extensive bibliography lists more than 500 references.

In general, the book presents the fundamentals of the new branch of satellite geodesy and will enable the reader to acquire a background of the calculus and physics necessary to combine the numerous disciplines involved in the exploitation of artificial satellites for geodesy.

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Mathematics

Philosophy of Mathematics. Stephen F. Barker. Prentice-Hall, Englewood Cliffs, N.J., 1964. xvi + 111 pp. Illus. Paper, $1.50.

This small but very compact book is one volume in the Foundations of Philosophy Series edited by Elizabeth and Monroe Beardsley. The aim of the series is to exhibit some of the main problems in the various fields of philosophy, as they stand at the present stage of philosophical history. *Philosophy of Mathematics* achieves the goal of the series with remarkable success. The main current philosophical problems in mathematics are clearly presented, and the various solutions are critically evaluated.

The book consists of five chapters. In the first chapter, the author, Stephen Barker, develops the distinctions made in Kantian philosophy between *a priori* and *empirical* (*a posteriori*) knowledge and between *analytic* and *synthetic* knowledge. He then examines

and attempts to determine the type of knowledge characteristic of each field. Readers who have struggled to understand the distinctions in knowledge, as they are presented by Kant in his *Critique of Pure Reason*, will find Barker's explanations much clearer than the original. One may question whether the type of knowledge characteristic of the various fields of mathematics is the central problem today in the philosophy of mathematics. One may also wonder at the preeminence given to Kant to the neglect of other outstanding philosophers who developed theories of knowledge. The restrictions are no doubt intentional and reflect Barker's convictions.

The second and third chapters deal with Euclidean and non-Euclidean geometry. The nature and role of the postulates, definitions, axioms, and theorems of Euclidean geometry are discussed against the background of the types of knowledge presented in the first chapter. Since many aspects of Euclidean geometry are quite familiar to the general reader, this chapter, with its many concrete and apt illustrations, provides interesting reading. On the other hand, non-Euclidean geometry is somewhat sketchily presented and requires professional competence with the subject in order to appreciate the author's analysis.

Cardinal numbers (finite and transfinite) and real numbers are discussed in the fourth chapter. One expects and finds here the viewpoints of Peano, Cantor, Frege, Russell, and Whitehead. An attempt is made to classify the thinking of these mathematicians (and that of a few others) in the standard philosophical categories: for example, nominalism, conceptualism, intuitionism, and realism. The exposition of cardinal numbers and the statement of the difficulties inherent in the concept of the transfinite are both excellent. The philosophical tenets of the nominalists, conceptualists, and others are stated briefly and clearly, but the analysis of these attitudes is reserved for the next chapter.

The final chapter deals with the paradoxes of set theory, the consistency and completability of deductive systems, and the currently prominent mathematical philosophies: formalism, logicism, and intuitionism. The author's incisive analysis of each of the three major philosophies ends in a genial compromise: the house of mathematics has many mansions, and in it many games are played. Of the latter fact, most mathematicians have a priori, empirical, analytic, and synthetic knowledge.

The editors hope that the material in the book will be used to supplement lectures in undergraduate philosophy courses. Experience indicates that there are not too many mathematicians who are philosophers and fewer philosophers who are mathematicians. Moreover, philosophy (even philosophy of mathematics) is presently ignored by young men who regard it as an old man's preoccupation. This book may well be one small step in making philosophy of mathematics a young man's interest, if not his vocation.

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Pharmacology

Molecular Pharmacology. The mode of action of biologically active compounds. vol. 1. E. J. Ariëns, Ed. Academic Press, New York, 1964. xxii + 503 pp. Illus. $17.

Volume 1 of *Molecular Pharmacology*, edited by E. J. Ariëns, justifies the notion that pharmacology is more than a basis for therapeutics, that it is a science in its own right. In this first volume of a planned four-volume treatise, the molecule becomes the functional unit in the search for explanations of drug action. Although the drug molecule is, in almost all cases, a well-characterized entity, the complexes or configurations in the organism with which drugs interact are almost without exception poorly defined or unknown. Because we do not have definitive information concerning the nature of the objects that interact with the drug, pharmacologists have found it necessary to introduce the descriptive term, *receptor*, in order to discuss drug action on a molecular level. Just as physicists found the concept of the neutrino necessary to account for certain atomic phenomena and geneticists used the concept of a gene to organize and describe their experimental data, pharmacologists have found the receptor a valuable model around which the descriptive data of pharmacology could be systematized and theories of drug action constructed and experimentally tested.

This volume, which consists of five essays written by G. A. J. van Os, A. M. Simonis, J. M. van Rossen, and Ariëns, is an exhaustive treatise on drugs, receptors, and their interactions. Receptor theory has made it possible to bring a large variety of experimental observations under a common denominator, and thus the theory has served and continues to serve a purpose. The book is logically and effectively organized into three sections. Section 1 deals with the processes that determine the concentration of the drug in the biophase at the receptor site.

Section 2, the major portion of the book, is concerned with drug-receptor interactions of various types and varying degrees of complexity. There is a detailed discussion of classical structure-activity relationships, and emphasis is placed on the inherent difficulties involved in the attempt to understand the totality of intermolecular processes occurring between drug and receptor molecules on the basis of conventional "blackboard" chemical formulas. A more sophisticated view of the molecule, which includes the spatial arrangement of atoms, the charge distribution, and the relative location of reactive groups, is called for. The dose-response relationship which is fundamental to pharmacology is analyzed in great detail. Questions of competitive interaction, drug affinity, intrinsic activity, and stereospecificity, as they relate to the interaction of the drug with receptors, are also considered. The physicochemical nature of the receptors is dealt with insofar as it is known. It is somewhat poignantly pointed out that whereas with enzymes it is possible to use highly purified preparations which may retain their enzymatic activity, receptors can only be studied *in situ*—that is, as a part of their natural environment since no stimulus can be induced on an isolated receptor.

Section 3 deals with nonlinear and complex relationships between stimulus and effect, such as all-or-none responses and threshold phenomena. Questions of drug sensitization, tachyphylaxis, tolerance, resistance, and cumulation are also considered in this section.

One of the principal virtues of this work derives from its organization. The theoretical basis of each topic is first