events within the epithelial cell are presented in this volume. Most of the excitement in the book stems from the first dozen papers, in which a variety of electrophysiologic approaches are presented. These methods were designed to define the ionic content, membrane permeability, and ion transport rates of epithelial cells; they range from simple determinations of transmembrane potential differences to sophisticated noise and impedance analysis. Computerized voltage clamp studies of epithelia are described that enable the simultaneous determination of the current-voltage relationships of the total tissue and of the cellular membranes. Analysis of the kinetics of ionic channel fluctuations in the apical membrane by determination of the inherent electrical noise is discussed as an approach to the study of the mode of action of inhibitors and competitors of the transported species. The widespread use of ion-selective microelectrodes has opened new areas of investigation into epithelial ion transport. Three papers discuss the use of ion-sensitive microelectrodes to define the role of neutral, coupled sodium chlorine transport in the absorption or secretion of fluid (Frizzell *et al.*, Armstrong *et al.*, and Giebisch *et al.*). Half a dozen others describe electrophysiologic approaches to high-resistance epithelia, such as urinary bladder and frog skin (Helman, Frömter *et al.*, Finn *et al.*, Clausen and Wills, Lewis and Wills, and Civan). The heavy emphasis on electrophysiology is only partially counterbalanced by the last four papers in the book, which report on other approaches to the analysis of ion transport. Included in this group is a paper by Taylor on a topic of current intense research, the role of intracellular calcium in the control of the sodium permeability of the cell's apical membrane.

The heavy emphasis on electrical approaches to the study of ion transport by epithelia may deter those readers unfamiliar with the techniques. However, the study of epithelia has advanced to new levels of sophistication and this book constitutes an up-to-date appraisal of the state of epithelial electrophysiology. The recent attempts to get into the "black box" have been successful and exciting; it is rewarding indeed to see that the diverse boxes are equipped with the similar transporters arranged in a fashion determined by the functional requirements of the organ.

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## Gravitation

**Theory and Experiment in Gravitational Physics.** CLIFFORD M. WILL. Cambridge University Press, New York, 1981. x, 342 pp. $75.

The development of extremely precise gravitational experiments during the past two decades has helped to stimulate theoretical work aimed at classifying the various gravitational theories, general relativity among them, as well as clarifying the empirical foundations on which any theory of gravity rests. Clifford Will has been a major contributor to this enterprise, and he provides a masterly survey in this book.

The early chapters of the book describe the experiments designed to test the fundamental nature of space-time and matter and their theoretical significance. Among these are the Eötvös-type experiments that compare the free fall of bodies of different mass and internal constitution. A priori there is no reason to expect that the contributions to the mass of nuclear matter from the strong, electromagnetic, and weak interactions should respond identically to a gravitational field. The experimental result that different materials all fall with the same acceleration limits the viable theories of gravitation. Other experiments, among them tests for a possible anisotropy of inertial mass, investigations of the position invariance of local experiments, and searches for the secular variation of the fundamental physical constants, are assessed, and it is shown how these tests may be used to delineate the class of viable theories of gravitation.

The book reconstructs the line of reasoning that leads to the conclusion of many theorists that the only completely viable theory of gravity must be a metric theory. The remainder of the book focuses on metric theories of gravity and the formalism used to compare their predictions in the weak-field, low-velocity approximation. Will has been one of the leaders in the development of this parameterized post-Newtonian formalism during the last ten years. His treatment of the subject is the most detailed summary of the PPN formalism currently available, thus making the book a valuable reference for those working in gravitational physics. The next several chapters deal with the application of the PPN formalism to the understanding of a variety of solar system, geophysical, and laboratory experiments. These chapters may also be profitably read without a detailed knowledge of the PPN formalism by those wishing to obtain the flavor of modern experimental gravitation.

An entire chapter is devoted to the binary pulsar, a system in which a pulsar, an extremely accurate cosmic clock, orbits an unseen companion. The discovery of this system by the detection of its pulses of electromagnetic radiation provided a new testing ground for relativistic gravity in which post-Newtonian effects are an order of magnitude larger than in our solar system.

With its short orbital period, about eight hours, the secular effects of the binary pulsar are amplified to orders of magnitude larger than the largest in the solar system. For example, the rotation of the orbit of Mercury by 43 seconds of arc per century had long been the single most accurate test of general relativity; this same "periastron shift" in the binary pulsar is approximately four degrees per year! The book does not provide a detailed procedural account of gravitational experiments, but it gives a thorough enough explanation of them to enable a reader to appreciate their significance in the development of the theory.

Will's book consolidates much of the literature on experimental gravity and should be invaluable to researchers in gravitation and those who wish to obtain a detailed working knowledge of the "theoretical underpinnings of experimental gravity."

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### Books Received

**Amorphous Semiconductor Technologies and Devices, 1982.** Y. Hamakawa, Ed. OHM, Tokyo, and North-Holland, Amsterdam, 1981 (U.S. distributor, Elsevier North-Holland, New York). xii, 380 pp., illus. $124. Japan Annual Reviews in Electronics, Computers and Telecommunications.

**Anaesthesia and Postoperative Care in Uncommon Diseases.** Papers from a meeting, 1980. C. Conseiller and 12 others, Eds. Librairie Arnette, Paris, and Excerpta Medica, Amsterdam, 1981 (U.S. distributor, Elsevier North-Holland, New York). 442 pp., illus. $74.50.

**Antarctic Law and Politics.** F. M. Auburn. Indiana University Press, Bloomington, 1982. xx, 362 pp. $32.50.

**Blood.** The River of Life. Jake Page and the Editors of U.S. News Books. U.S. News Books, Washington, D.C., 1982. 164 pp., illus. $18.75. The Human Body.

**The Brain.** Mystery of Matter and Mind. U.S. News Books, Washington, D.C., 1982. 160 pp., illus. $18.75. The Human Body.

**$B_{12}$.** David Dolphin, Ed. Wiley-Interscience, New York, 1982. Two volumes. Vol. 1, Chemistry. xvi, 672 pp., illus. Vol. 2, Biochemistry and Medicine. xvi, 506 pp., illus. The two-volume set, $130.

**Chlorinated Dioxins and Related Compounds.** Impact on the Environment. Proceedings of a workshop, Rome, Oct. 1980. O. Hutzinger, R. W. Frei, E. Merian, and F. Pocchiari, Eds. Pergamon, New York, 1982. xii, 658 pp., illus. $75. Pergamon Series on Environmental Science, vol. 5.

**Design of Amplifiers and Oscillators by the S-Parameter Method.** George D. Vendelin. Wiley-Interscience, New York, 1982. xiv, 190 pp., illus. $25.

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