ionic regulation, on which Lockwood is a recognized authority. Respiration and metabolism are dealt with in chapter 6, while related subjects of energy input into an organism, feeding and digestion, are not discussed until chapter 9. Chapters on the neuromuscular system and the sense organs intervene. This arrangement is not too distracting, however, since each chapter is independent. By and large the illustrations are adequate though not exciting. I would buy this book for my own library, but I question its basic value to the student.

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Cosmological Theory

Relativity and Cosmology. H. P. ROBERTSON and THOMAS W. NOONAN. Saunders, Philadelphia, 1968. xxxiv + 460 pp., illus. $16.50.

In an excellent tribute to the late H. P. Robertson, his lecture notes have been edited and augmented by one of his students as "co-author." Many physicists and former friends of the Caltech mathematical physicist will find this book a useful summary of his important contributions and an outstanding textbook for advanced courses. The introductory pages, including a foreword by William A. Fowler, give some impression of the "senior author," but neglect his work for the armed forces in England and France during and after World War II, and the now famous Robertson Panel on Unidentified Flying Objects. Except for a 10-line excerpt from his lecture notes on the rotating-disk paradox, the humorous side of Robertson's character does not show in the text (as it did on the wall decorations of his kitchen, or in his salty remarks on poker games after a hard day's work on Air Force photographs).

However, I suspect that Robertson, a meticulous mathematician, would have preferred to keep his theoretical work serious, brief, and to the point, in the manner in which Noonan presents it in this book. The rigorous treatment, in vector and matrix notation, starts with Euclidean space and classical electromagnetism, and proceeds with special relativity and Riemannian geometry to general relativity and a detailed treatment of its consequences. These include the three classic tests (advance of planetary orbit perihelion, gravitational deflection, and gravitational redshift of light), the Poynting-Robertson effect on small particles (updated to include the effect of the solar wind), gravitational waves, the effects of changing stellar mass, and several experiments possible with artificial satellites (orbital precession, clock rate differences, and others). All of these are expressed in specific equations derived rigorously, often with numerical values compared with actual or possible observational results, and clear indication of approximations made or unknown parameters in the most general formulation.

Although the history of the development of special relativity is outlined in more detail than is known to most modern physicists (experiments by Fizeau, Hoek, Hammer, Sagnac; Thomas precession; the Michelson-Morley, Kennedy-Thorndike, and Ives-Stillwell experiments; the Minkowski universe; and Birkhoff's gravitational theory), nothing is said about Milne's kinematical relativity or the recent Brans-Dicke scalar theory. However, the upper limit of velocity of material particles (c) set by the principle of causality is noted—the recently popular "Tachyon theory" of E. Sudarshan and others thus being eliminated.

The text generally emphasizes mathematical rigor, occasionally to the detriment of physical insight. For instance, the Lorenz transformation can be derived without complex mathematics from the relativity principle and the postulate that light has velocity c relative to any inertial frame, but the authors omit this conceptually simple derivation (and the diagram showing observers O and P, each considering himself at the center of a spherical wave front resulting from a light pulse released as they passed each other with relative velocity v). In the conceptual vein, Robertson and Noonan dispose of the twin paradox by using a simple Minkowski diagram showing the 18-year gap in the journeying twin's time scale as that twin reverses velocity ($0.6c$) 15 light-years away. Similar, notable demonstrations are given of the gravitational redshift, the inconsistency of gravitation and special relativity, the equivalence of gravitation and acceleration, the generalized Doppler effect and Planck's constant, cosmological constant and curvature, and cosmological distances.

In the last five chapters, all dealing with cosmology, Noonan augments Robertson's notes very effectively and follows his mentor's efforts to find observational tests of the various relativistic models. He uses observational data as of 1965 (and notes 1967 additions in an appendix), including the Hubble constant 100 km/sec-Mpc, quasars with redshift of 2, and the background 3°K radiation, but does not note all their implications (for instance, the "disproof" of steady-state theory by the 3°K background).

The metrics and geometries of eight cosmological models are derived and summarized in a table. Astronomically observable quantities (redshift, bolometric distance, angular size, and counts to various limiting magnitudes) are related to cosmological parameters and discussed briefly, and the inescapable conclusion is drawn that observations to date cannot confirm any one cosmological model.

Most of the calculations are illustrated with schematic diagrams that add greatly to the clarity. One of the more detailed diagrams that I found particularly interesting illustrates the trajectories of test particles and photons near the Schwarzschild singularity. There are a useful list of symbol definitions, a good bibliography, and an excellent ten-page abstract of the text, chapter by chapter, in an appendix designed to help the reader find particular topics and to follow the line of reasoning. I am sure that Robertson would be proud of this product of the many years he devoted to relativity and cosmology.

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Some Aquatic Animals

Australian Inland Waters and Their Fauna. Eleven Studies. A. H. WEATHERLEY, Ed. Australian National University Press, Canberra, 1967. xvi + 287 pp., illus. $A10.50.

Australian Freshwater Life. The Invertebrates of Australian Inland Waters. W. D. WILLIAMS. Sun Books, Melbourne, 1968. x + 262 pp., illus. Paper, $A2.50.

Australia remains, as the editor of *Australian Inland Waters and Their Fauna* has noted, terra incognita as far as biology is concerned. This book, which includes contributions from ten Australian specialists, is valuable in reducing our ignorance of the