

## Fixing Extragalactic Distances

**Supernovae as Distance Indicators.** NORBERT BARTEL, Ed. Springer-Verlag, New York, 1985. vi, 226 pp., illus. Paper, \$13.70. Lecture Notes in Physics, vol. 224. From a workshop, Cambridge, Mass., Sept. 1984.

Supernovae are the brightest and most spectacular objects that occur in galaxies. Because of their high luminosities they are potentially valuable distance indicators. To investigate this possibility in detail the Harvard-Smithsonian Center for Astrophysics sponsored a workshop the proceedings of which contain a number of excellent papers on radio and optical observations of supernovae and on theoretical models of supernova explosions.

In recent years particularly rapid progress has been made in the detection of supernovae at radio wavelengths. Unfortunately, no clear pattern has yet emerged that allows one to relate the optical and radio properties of supernovae. Furthermore, radio observations by Kronberg and his collaborators now appear to have established that starburst galaxies, such as Messier 82, are particularly active producers of supernovae. Owing to absorption by interstellar dust these supernovae had not previously been observed at optical wavelengths. At the workshop Bartel presented the first very long baseline interferometer observations of the expansion of young extragalactic supernovae.

The workshop produced a consensus that massive supernovae of type II exhibit a wide range in maximum luminosities and are therefore not suitable as distance indicators. Cadonau, Sandage, and Tammann argue that supernovae of type I, with a dispersion of only 0.3 mag at maximum light, are excellent distance indicators. Wheeler and Sutherland show that type I supernovae may be modeled by carbon-deflagration models of stars that have carbon-oxygen white dwarf progenitors. From a discussion of the amount of  $^{56}\text{Ni}$  that decays into iron in such supernovae they find that the Hubble parameter must lie in the range 40 to 70 km sec $^{-1}$  Mpc $^{-1}$ . Unfortunately this beautifully simple picture is destroyed by ugly new facts presented by Panagia. He shows that there are, in fact, two distinct types of supernovae of type I, which differ in luminosity by a factor of about 3. Furthermore the faint subtype does not exhibit the absorption feature at 6150 Å that is seen in the bright subtype. All of the faint type I supernovae so far observed occur in spiral galax-

ies. The hope therefore remains that the species of type I supernovae that occurs in elliptical galaxies may still turn out to be a standard candle that can be used to measure extragalactic distances.

SIDNEY VAN DEN BERGH  
*Dominion Astrophysical Observatory,  
Victoria, British Columbia,  
V8X 4M6 Canada*

## The Theory of Supermanifolds

**Supermanifolds.** BRYCE DEWITT. Cambridge University Press, New York, 1984. xiv, 316 pp. \$59.50. Cambridge Monographs on Mathematical Physics.

Einstein's general theory of relativity explains the physical phenomenon of gravitation in terms of the geometry of space-time, which is viewed as a manifold in the standard mathematical sense. Ever since this theory was formulated, physicists have dreamed of a unified geometrical explanation of all the basic phenomena of nature. Within the last decade, the advent of supersymmetric field theories such as supergravity and superstring theory has brought this dream much closer to reality. These theories require that space-time itself be viewed as only a small part of a larger geometric object called superspace. Supermanifold theory is the branch of mathematics that develops the geometry of objects like superspace. It provides the mathematical foundation for supergravity and superstrings in the same way in which classical differential geometry provides the foundation for general relativity. Formally, it is an extension of classical differential geometry in which the coordinates on a manifold may take values in a graded algebra ("Grassmann algebra") that is larger than the algebra of real numbers and contains anticommuting elements.

Despite the strong geometric flavor of supergravity, even specialists in the field frequently rely only on a formal analogy between supergravity and general relativity and are unaware that supermanifold theory can be developed as a rigorous branch of mathematics. DeWitt has done a great service in providing a careful and detailed exposition of this theory. Although mathematicians may not find the book sufficiently rigorous, physicists will find in it clear and complete treatments of many issues that are often glossed over in the research literature. These include the concept of the "body" of a supermanifold, which explains the

relation between superspace and physical space-time; the relation between integration over a supermanifold and integration over its body; precise definitions of tensors, forms, and similar geometric structures on supermanifolds; and the connection between Lie supergroups and superalgebras. The geometry of supergroups and their coset spaces is worked out in detail, and the supergroups and superalgebras of the Kac classification are constructed, although the completeness of the classification is not proven.

Notational conventions, especially concerning signs and indices, require special attention and care in this subject, and they receive it in this book. New notations are explained clearly and in great detail when introduced in the text.

This book was originally intended as a two-volume collaboration with other authors, covering not only supermanifold theory but also its application to supergravity. The elementary applications that are beautifully treated in chapter 5 made me regret that this plan was not carried out. These include the extension of ordinary Hilbert space theory that is needed when operators may have Grassmann eigenvalues, the classical mechanics of Grassmann variables and its quantization by both canonical and path integral methods, and an introduction to supersymmetric quantum mechanics. I hope that eventually a book on supergravity will appear that makes full use of the theory of supermanifolds.

No author's decisions about what material to cover and what to omit can please all readers, and I have two minor complaints. First, several different definitions of a supermanifold exist in the literature: in addition to DeWitt's, those of Rogers, Berezin-Leites, and Kostant are popular. All these definitions are suitable for physical applications, but they are quite technical, and physicists who want to make use of supermanifold theory are often unsure which version is most convenient for their purposes. A detailed comparison of the various definitions in DeWitt's clear style would have been appreciated by these physicists. Second, Riemannian supermanifolds are given more attention in the book than their usefulness would seem to warrant. A discussion of supermanifolds obeying the curvature and torsion constraints of  $N = 1$  supergravity would have been preferable.

Supermanifold theory promises to become even more important in particle physics with the recent explosion of interest in the geometry of superstrings

This book will appeal to researchers in this field as well as to the general audience of physicists and mathematicians seeking assurance that supermanifolds are mathematically respectable objects rather than formal tricks with "anticommuting numbers."

JEFFREY M. RABIN

*Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637*

## Adaptations

**The Colonisation of Land.** Origins and Adaptations of Terrestrial Animals. COLIN LITTLE. Cambridge University Press, New York, 1984. viii, 290 pp., illus. \$99.50.

Study of the adaptations of terrestrial groups of animals and plants and their origins from aquatic stocks has long been a classic example of the confluence of different biological disciplines, particularly physiology and biochemistry, functional morphology, and paleontology. Among animal groups, the origin of terrestrial vertebrates and the apparently related question of the history of movement from salt water to freshwater in primitive gnatostome fishes have been an especially rich vein for workers such as Baldwin, Berrill, Romer, and Watson, and among invertebrates the mollusks and arthropods have received considerable attention. In recent years, however, notwithstanding an excellent volume edited by Panchen, the subject as a whole has received less attention, perhaps in part owing to the decline of comparative approaches to organ-level physiology.

Little, who is an authority on molluscan osmoregulation, has now produced the first really thorough review of the relevant characteristics of the various animal groups that have colonized the land environment, including taxa from flatworms to vertebrates. It is a long and careful literature review with a single concluding synthetic section. Little emphasizes the common problems faced by invaders from the water: osmoregulation and nitrogen excretion, respiration, behavior, and sensory adaptations, reproduction, and (to a lesser extent) biomechanics in the absence of a strongly supporting fluid medium. He gives an interesting counterpoint to the discussion in a treatment of the filter or plankton feeders, larger forms with hydrostatic skeletons, and most notably the echinoderms and cephalopod mollusks that have never managed to invade land. He delves into the relative success of differ-

ent groups, measured by species diversity or biomass. And he also takes up the collateral question of the problems faced by terrestrial groups in reinvading fresh or salt water.

All of this is familiar in parts, but Little's review is more than a convenient summary. The broad range of data that he covers turns out no longer to support the easy generalizations that have long dominated this field of work. One view that needs to be revised is the simple scenario for the relationship between environment and the pattern of nitrogen excretion that predicts excretion of ammonia in the water and urea or uric acid on land. In oligochaetes, for example, "The ratio of urea to ammonia changes with nutritional state, but is probably more related to the control of acid-base balance than to availability of water." Also, with respect to respiration Little notes a fact of which biologists have become increasingly aware—that elimination of carbon dioxide is a more complex problem than uptake of oxygen. But most important of all, he demonstrates that it is no longer sufficient to consider the various subjects of classical physiology in isolation from each other. This fine review clears the way for future biologists who will take up this fascinating subject in the light of modern advances and produce the next generation of generalizations.

KEITH S. THOMSON

*Peabody Museum of Natural History, Yale University, New Haven, Connecticut 06520*

## Books Received

**Equations of Mathematical Physics.** V. S. Vladimirov. Mir, Moscow, 1984 (U.S. distributor, Imported Publications, Chicago). 464 pp., illus. \$10.95. Translated from the Russian edition (Moscow, 1981) by Eugene Yankovsky.

**Erythrokinetics.** Radioisotopic Methods of Investigation and Mathematical Approach. Maria Ważewska-Czyżewska. Published for the National Library of Medicine and the National Science Foundation by the National Center for Scientific, Technical and Economic Information, Warsaw, 1984 (available as PB 84-201979 from the National Technical Information Service, Springfield, Va.). 221 pp., illus. \$15.

**Ethylene and Plant Development.** J. A. Roberts and G. A. Tucker, Eds. Butterworths, Boston, 1985. x, 416 pp., illus. \$99.95. From a conference, Sutton Bonington, March 1984.

**Evaluation of Short-Term Tests for Carcinogens.** Report of the International Programme on Chemical Safety's Collaborative Study on In Vitro Assays. John Ashby *et al.*, Eds. Elsevier, New York, 1985. x, 752 pp., illus. \$139. Progress in Mutation Research, vol. 5.

**Evolutionary Aspects of Gonadotropins.** Edited by Institute of Endocrinology, Gunma University. Center for Academic Publications Japan, Tokyo, 1984 (U.S. distributor, International Specialized Book Services, Beaverton, Ore.). 210 pp., illus. \$28. Gunma Symposia on Endocrinology, vol. 21. From a symposium, Maebashi, Japan, Dec. 1983.

**The Evolving Universe.** Donald Goldsmith. 2nd ed. Benjamin/Cummings, Menlo Park, Calif., 1985. xiv, 562 pp., illus., + plates. \$31.95.

**Experimental Behavioral Ecology and Sociobiology.** In Memoriam Karl von Frisch 1886-1982. Bert Hölldobler and Martin Lindauer, Eds. Sinauer, Sunderland, 1985. xiv, 488 pp., illus. \$55; paper, \$30. From a symposium, Mainz, Germany, Oct. 1983.

**Histocompatibility Testing 1984.** E. D. Albert, M. P. Baur, and W. R. Mayr, Eds. Springer-Verlag, New York, 1984. xxviii, 764 pp., illus. \$98. From a conference, Munich, May 1984.

**Hot-Electron Transport in Semiconductors.** L. Reggiani, Ed. Springer-Verlag, New York, 1985. xvi, 275 pp., illus. \$43.50. Topics in Applied Physics, vol. 58.

**Human Intelligence.** Perspectives and Prospects. Robert Kail and James W. Pellegrino, Freeman, New York, 1985. x, 224 pp., illus. \$19.95; paper, \$12.95. A Series of Books in Psychology.

**The Hypothalamus of the Rhesus Monkey.** A Cytoarchitectonic Atlas. Ruth Bleier. Photomicrographs and plates prepared by Inge Siggelkow. University of Wisconsin Press, Madison, 1985. xiv, 122 pp., \$50.

**I'll Take Tomorrow.** The Story of a Courageous Woman Who Dared to Subject Herself to a Medical Experiment—the First Successful Heart-Lung Transplant. Mary Gohlke with Max Jennings. Evans, New York, 1985. 204 pp. \$12.95.

**Neutron Contamination from Medical Electron Accelerators.** Recommendations of the National Council on Radiation Protection and Measurements. National Council on Radiation Protection and Measurements, Bethesda, Md., 1984. vi, 128 pp., illus. Paper, \$14. NCRP Report No. 79.

**New Approaches to Research on Cereal Carbohydrates.** Robert D. Hill and Lars Munck, Eds. Elsevier, New York, 1985. xii, 415 pp., illus. \$101.75. Progress in Biotechnology, vol. 1. From a conference, Copenhagen, Denmark, June 1984.

**New Approaches to Vaccine Development.** Rosemary Bell and G. Torrigiani, Eds. Schwabe, Basel, 1984 (distributor, World Health Organization, Geneva). viii, 519 pp., illus. Paper. From a meeting, Geneva, Oct. 1983.

**Nonhuman Primate Models for Human Growth and Development.** Elizabeth S. Watts, Ed. Liss, New York, 1985. x, 327 pp., illus. \$46. Monographs in Primatology, vol. 6. From a symposium, Atlanta, Aug. 1982.

**Nonlinear System Theory.** John L. Casti. Academic Press, Orlando, Fla., 1985. xii, 261 pp. \$45. Mathematics in Science and Engineering, vol. 175.

**Normal Human Aging.** The Baltimore Longitudinal Study of Aging. Nathan W. Shock *et al.* National Institutes of Health, Bethesda, Md., 1985 (available from the Superintendent of Documents, Washington, D.C.). xxii, 400 pp., illus., + appendixes. \$18. NIH Publication No. 84-2450.

**Notes on Radiation Effects on Materials.** J. N. Anno. Hemisphere, Washington, D.C., 1984. x, 342 pp., illus. Paper, \$24.95.

**The Nuclear Connection.** A Reassessment of Nuclear Power and Nuclear Proliferation. Alvin Weinberg, Marcelo Alonso, and Jack N. Barkenbus. Paragon House, New York, 1985. viii, 295 pp., illus. \$27.95; paper, \$19.95. A Washington Institute Book.

**Nutrient Requirements of Dogs.** 2nd ed. National Academy Press, Washington, D.C., 1985. viii, 79 pp. Paper, \$10.25.

**Permafrost.** Fourth International Conference, Final Proceedings. (Fairbanks, Alaska, July 1983.) National Academy Press, Washington, D.C., 1984. xvi, 413 pp., illus. \$32.50.

**Phase Transformations and Material Instabilities in Solids.** Morton E. Gurtin, Ed. Academic Press, Orlando, Fla., 1984. x, 217 pp., illus. \$17. Publication No. 52 of the Mathematics Research Center, The University of Wisconsin-Madison. From a conference, Madison, Wis., Oct. 1983.

**Physical Methods on Biological Membranes and Their Model Systems.** F. Conti *et al.*, Eds. Plenum, New York, 1985. x, 459 pp., illus. \$65. NATO Advances Science Institutes Series A, vol. 71. From an institute, Alto Villa Milicia, Italy, Sept. 1982.

**Physicians of Western Medicine.** Anthropological Approaches to Theory and Practice. Robert A. Hahn and Atwood D. Gaines, Eds. Reidel, Boston, 1984 (distributor, Kluwer, Hingham, Mass.). x, 345 pp. \$54. Culture, Illness, and Healing.

**Physics of Highly Charged Ions.** R. K. Janev, L. P. Presnyakov, and V. P. Shevelko. Springer-Verlag, New York, 1985. x, 330 pp., illus. \$52. Springer Series in Electrophysics, vol. 13.

**Picosecond Optoelectronic Devices.** Chi H. Lee, Ed. Academic Press, Orlando, Fla., 1984. xiv, 406 pp., illus. \$60.

**Plant Diseases.** Infection, Damage and Loss. R. K. S. Wood and G. J. Jellis, Eds. Blackwell Scientific, Palo Alto, Calif., 1984. viii, 327 pp., illus. \$44. From a symposium, Dec. 1982.

**The Plutonium Business and the Spread of the**

(Continued on page 573)