

worry the details of canopy photosynthesis.

Fourth, a much wider range of scale-dependent ecological phenomena than those mentioned in the text should be considered. For example, what is the feedback between plant cover and precipitation in desert regions? What is the feedback between the area covered by deciduous trees and temperature in snowy boreal latitudes? How might the area of hilly, easily eroded upland terrain in boreal regions affect the extent of minerotrophic wetlands dominated by deciduous larches? How does the extent of contiguous flammable habitat (or "fired") affect the local frequency of wildfire? (See T. J. Givnish, *Evolution* 35, 101 [1981].) How does the extent of dusty regions in the Sahara lead to the fertilization of Amazonian forests?

Fifth, even though their biomass is relatively low, the pivotal role that certain animals can play in determining ecosystem function must be considered. Ungulates and termites mightily shape the structure and productivity of tropical savannas, and beavers set the tempo of disturbance and succession in many boreal wetlands. Multi-level effects that cascade through trophic webs may have equally important consequences. For example, baleen whales may play a critical role in regulating the productivity of the Antarctic Ocean by heavily grazing krill, which in turn consume planktonic algae, the primary producers. Similarly, marine fisheries that have crashed stocks of large food fish may be enhancing algal production and slowing the increase in global CO<sub>2</sub> levels by raising the population levels of small fish that eat zooplankton. These possibilities deserve exploration.

Finally, it is essential to incorporate the effects of the most important agent driving global change—human population growth and economic activity—directly in any analysis of the atmosphere-biosphere system. What are the effects on carbon exchange, transpiration, albedo, and rainfall of converting vast areas of rainforest to slash-and-burn fields? How do prairies and cornfields differ in their local and large-scale impacts on the biosphere? How do human activities affect the landscape pattern of natural and agricultural communities? (See D. J. Stanley and A. G. Warne, *Science* 260, 628 [1993].) What are the synergisms among the atmospheric changes wrought by human activities (for example, between increases in ozone and carbon dioxide concentrations)? And what are the implications for ecosystem function and biospheric processes of the mass extinctions of plant and animal species projected for the coming decades? The most important determinant of ecological

scaling laws—perhaps now, and certainly in the future—may be as much the human birthrate as the photosynthetic rate.

Thomas J. Givnish  
Department of Botany,  
University of Wisconsin,  
Madison, WI 53706

## The Binary Zoo

**The Realm of Interacting Binary Stars.** J. SAHADE, G. E. McCLUSKEY, JR., and Y. KONDO, Eds. Kluwer, Norwell, MA, 1993. vi, 451 pp., illus. \$140, £77, or Dfl. 225. Astrophysics and Space Science Library.

One of the great scientific accomplishments of this century has been the development of a reasonably comprehensive theory of the evolution of single stars. Since the late 18th century, however, we have known that some stars are in gravitationally bound systems of two or more stars. More recent observations have revealed that in fact most stars are members of such binary or multiple systems. These range from systems in which the stars are in actual contact to those in which the stars are about a million stellar radii apart.

From the 1940s to the 1960s, as the theory of single stars was becoming firmly established, compelling ground-based evidence accumulated indicating that many close binaries of diverse types are "interacting," primarily through transfer of mass or radiant energy. The interactions can be strong enough that they profoundly affect the evolution of the component stars. The advent of space astronomy, especially in the x-ray and ultraviolet, while elucidating some previously known systems, also revealed the existence of x-ray binaries, in which various end-state objects of stellar evolution, such as compact degenerate stars or even black holes, produce copious x-rays by accreting matter from a close companion star. We are now presented with, as the editors of this volume put it, a veritable "zoo" of interacting binaries.

Although the individual contributions to *The Realm of Interacting Binary Stars* vary in their accessibility to the nonexpert, most of the authors have made an effort to develop their topics from first principles. I think the paper by Trimble and the one by Meyer-Hofmeister and Ritter are particularly effective in this regard. I found myself wishing for a chapter of similar clarity that would bring all the disparate systems together in a coherent evolutionary picture. Unfortunately, such a picture simply does not exist at present.

I am impressed, as an informed outsider, both by the advances in knowledge that have been made and by the mysteries that remain. On the one hand, we know much more than we once did about cataclysmic variables, nova outbursts, type I supernovas, massive x-ray binaries, and stellar activity. On the other hand, we still do not understand the nature, origin, or fate of classically known systems like the relatively common W Ursae Majoris contact systems or of oddballs like  $\epsilon$  Aurigae. Among more recently discovered systems, we have considerable difficulty with the whole class of low-mass x-ray binaries and millisecond pulsars, and we do not even know the nature of the mass accreting object in exotic systems like SS433. Encouraging progress is being made in the areas of mass flow in Algols and the origins of binary stars, and new, more effective observation techniques are being developed.

Certainly there remains much work to be done, by observers and theorists alike, to achieve the same fundamental clarity about binary star evolution that we now possess for single stars. I think this book will be useful to those who strive to develop that understanding.

Richard H. Durisen  
Department of Astronomy,  
Indiana University,  
Bloomington, IN 47405

## NMR for Beginners

**Fundamentals of Nuclear Magnetic Resonance.** JACEK W. HENNEL and JACEK KLINOWSKI. Longman Scientific and Technical, Harlow, Essex, U.K., and Wiley, New York, 1993. xii, 288 pp., illus. \$49.95 or £22.50.

Since its discovery in 1945 by Purcell, Torrey, and Pound at Harvard University and by Bloch, Hansen, and Packard at Stanford University, nuclear magnetic resonance (NMR) has become a powerful research tool in many different fields that touch our everyday lives. It has been used in the determination of the chemical structure of complex molecules of biological significance, the study of the basic properties of technologically important new materials such as high- $T_c$  (high transition-temperature) superconducting ceramics, and mineral exploration. Magnetic resonance imaging is now an important instrument in medical diagnostics. These widespread applications have made a basic understanding of NMR essential for students in many scientific disciplines outside of physics. There has long been a need for an

easy-to-understand introduction to NMR both for the beginning student and for new users of NMR in the biological, engineering, earth, and materials sciences. Hennel and Klinowski's *Fundamentals of Nuclear Magnetic Resonance* meets that need admirably.

Anyone who aspires to genuinely understand NMR today must have a good grasp of quantum mechanics. For readers who lack this background, the authors have provided a compact and accessible introductory chapter on the subject. The ensuing discussions of the magnetic properties of nuclei and nuclear paramagnetism lay the groundwork for the more interesting and practically oriented chapters on observation of NMR in liquids, dipolar interactions, and nuclear spin relaxation mechanisms. The reader is also introduced to correlation spectroscopy, pulse techniques, and Fourier transform spectroscopy. Important mathematical tools are summarized in the appendixes.

The advanced student of physics will require a fuller treatment of the microscopic interactions that determine the NMR spectra and relaxation processes than this book provides. Similarly, hands-on practitioners who need to understand the techniques of NMR probe design, low noise amplification, and automated data acquisition will find that experimental techniques are only mentioned here. Nevertheless, beginning physics students as well as aspiring applied chemists and medical imagers will find this to be an excellent introduction to NMR that can serve as a stepping-stone to more thorough treatments such as Anatole Abragam's classic *Principles of Nuclear Magnetism* or Maurice Goldman's *Quantum Description of High-Resolution NMR in Liquids*. The carefully compiled list of suggested reading is a good guide to the advanced literature.

Neil S. Sullivan  
Department of Physics,  
University of Florida,  
Gainesville, FL 32611-2085



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**Analog and Computer Electronics for Scientists.** Basil H. Vassos and Galen W. Ewing. 4th ed. Wiley, New York, 1993. xvi, 473 pp., illus. \$59.95.

**Analysis and Simulation of Chaotic Systems.** Frank C. Hoppensteadt. Springer-Verlag, New York, 1993. xviii, 305 pp., illus. \$49. Applied Mathematical Sciences, vol. 94.

**Ancient Light.** Our Changing View of the Universe. Alan Lightman. Harvard University Press, Cambridge, MA, 1993. xiv, 170 pp., illus. Paper, \$10.95. Reprint, 1991 ed. Adapted from *Origins: The Lives and Worlds of Modern Cosmologists*.

**Before Lascaux.** The Complete Record of the Early Upper Paleolithic. Heidi Knecht, Anne Pike-Tay, and Randall White, Eds. CRC, Boca Raton, FL, 1993. x, 304 pp., illus. \$75.

**Biocatalytic Production of Amino Acids and Derivatives.** J. David Rozzell and Fritz Wagner, Eds.

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**Biology of Whiptail Lizards (*Genus Cnemidophorus*).** John W. Wright and Laurie J. Vitt, Eds. University of Oklahoma, Norman, and Oklahoma Museum of Natural History, Norman, 1993. xiv, 417 pp., illus., \$29. Herpetologists' League Special Publication no. 3. From a symposium, Norman, OK, Aug. 1984.

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**Children in Time and Place.** Developmental and Historical Insights. Glen H. Elder, Jr., John Modell, and Ross D. Parke, Eds. Cambridge University Press, New York, 1993. xiv, 289 pp. \$49.95. Cambridge Studies in Social and Emotional Development.

**Cladistics.** A Practical Course in Systematics. Peter L. Forey et al. Clarendon (Oxford University Press), New York, 1992. xii, 191 pp., illus. \$52.50. Systematics Association Publications, 10. From a workshop, 1992.

**A Diderot Pictorial Encyclopedia of Trades and Industry.** Manufacturing and the Technical Arts in Plates Selected from *L'Encyclopedie, ou Dictionnaire Raisonné des Sciences, des Arts et des Métiers* of Denis Diderot. Charles C. Gillispie, Ed. Dover, New York, 1993. 2 vols. Unpagged. Paper. Each vol., \$17.95. Dover Pictorial Archive Series. Reprint, 1959 ed.

**Dinosaurs Rediscovered.** New Findings which are Revolutionizing Dinosaur Science. Don Lessem. John Sibbick, illustrator. Simon and Schuster, New York, 1993. 368 pp., illus. Paper, \$12. Reprint of *Kings of Creation*, 1992.

**Ecology and Management of Breeding Waterfowl.** Bruce D. J. Batt et al., Eds. University of Minnesota Press, Minneapolis, 1992. xxii, 635 pp., illus. \$49.95. From a symposium, Winnipeg, Canada, Aug. 1987.

**The Ecology of Butterflies in Britain.** Roger L. H. Dennis, Ed. Derek A. A. Whiteley, illustrator. Oxford University Press, New York, 1992. xiv, 354 pp., illus. \$86.

**Fractals and Chaos in Geology and Geophysics.** Donald L. Turcotte. Cambridge University Press, New York, 1993. x, 221 pp., illus., + plates. Paper, \$27.95. Reprint, 1992 ed.

**From Sorceress to Scientist.** Biographies of Women Physical Scientists. Kevin Allison Nies. California Video Institute, Tarzana, CA, 1990. iv, 94 pp., illus. \$30; spiral bound, \$14.99. Lives of Women Scientists, vol. 1.

**Fundamentals of Complex Analysis for Mathematics, Science, and Engineering.** E. B. Saff and A. D. Snider. 2nd ed. Prentice Hall, Englewood Cliffs, NJ, 1993. xii, 468 pp., illus. \$65.

**Guide to the Bats of Argentina.** Guia de los Murciélagos de Argentina. Rubén M. Barquez, Norberto P. Giannini, and Michael A. Mares. Norberto P. Giannini, illustrator. Oklahoma Museum of Natural History, Norman, 1993. viii, 119 pp., illus. Paper, \$15.

**Hearing Loss.** Robert Thayer Sataloff and Joseph Sataloff. 3rd ed. Dekker, New York, 1993. x, 522 pp., illus. Paper, \$69.75.

**Inside NASA.** High Technology and Organizational Change in the U.S. Space Program. Howard E. McCurdy. Johns Hopkins University Press, Baltimore, MD, 1993. xvi, 215 pp., illus. \$32.95. New Series in NASA History.

**The Last Panda.** George B. Schaller. University of Chicago Press, Chicago, 1993. xx, 291 pp., illus., + plates. \$24.95.

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**The Nervous System.** Its Function and Its Interaction with the World. Lloyd D. Partridge and L. Donald Partridge. MIT Press, Cambridge, MA, 1993. xiv, 579 pp., illus. Paper, \$39. A Bradford Book.

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**Perspectives on Animal Behavior.** Judith Goodenough, Betty McGuire, and Robert A. Wallace. Wiley, New York, 1993. xviii, 798 pp., illus., + plates. \$59.95.

**Perspectives on Higgs Physics.** Gordon L. Kane, Ed. World Scientific, River Edge, NJ, 1993. xviii, 467 pp., illus. \$98; paper, \$48. Advanced Series on Directions in High Energy Physics, vol. 13.

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**The Quark Structure of Matter.** Maurice Jacob. World Scientific, River Edge, NJ, 1992. vi, 393 pp., illus. \$58. World Scientific Lecture Notes in Physics, vol. 50.

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**Renewable Energy.** A Concise Guide to Green Alternatives. Jennifer Carless. Walker, New York, 1993. viii, 168 pp., illus. \$19.95.

**The Role of Trees in Sustainable Agriculture.** Roslyn Tamara Prinsley, Ed. Jamie Allnutt, compiler. Kluwer, Norwell, MA, 1993. viii, 186 pp., illus. \$84. Forestry Sciences, vol. 43. From a conference, Albury, Victoria, Australia, Oct. 1991. Reprinted from *Agroforestry Systems*, vol. 20, nos. 1-2 (1992).

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**Sharks.** Silent Hunters of the Deep. Reader's Digest, Pleasantville, NY, 1993. 208 pp., illus. Paper, \$19.95. Reprint, 1986 ed.

**Tools, Language and Cognition in Human Evolution.** Kathleen R. Gibson and Tim Ingold, Eds. Cambridge University Press, New York, 1993. xii, 483 pp., illus. \$69.95. From a symposium, Cascais, Portugal, March 1990.

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**Vital Circuits.** On Pumps, Pipes, and the Workings of Circulatory Systems. Steven Vogel. Rosemary Anne Calvert, illustrator. Oxford University Press, New York, 1993. xii, 315 pp., illus. Paper, \$12.95. Reprint, 1992 ed.

**Vortex Dynamics.** P. G. Saffman. Cambridge University Press, New York, 1992. xii, 311 pp., illus. \$69.95. Cambridge Monographs on Mechanics and Applied Mathematics.