

ship in the history of science, this book joins Ronald Rainger's fine new study of the American Museum of Natural History (*An Agenda for Antiquity*; University of Alabama Press, 1991) to show that careful studies of scientific work at museums can tell us much about science—how it gets done, where, why, by whom, and to what ends.

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## Plasmas Close at Hand

**Auroral Physics.** CHING-I. MENG, MICHAEL J. RYCROFT, and LOUIS A. FRANK, Eds. Cambridge University Press, New York, 1991. xx, 464 pp., illus., + plates. \$120. Based on a conference, Cambridge, U.K., July 1988.

The realization that a giant natural plasma physics laboratory was close at hand came 30-some years ago when the advent of satellites allowed discovery of the earth's magnetosphere. Almost simultaneously, analyses of extensive auroral data sets acquired during the International Geophysical Year 1957-58 showed that the visual aurora was one of the best tools for probing the nature of complex processes within the magnetosphere. An often-expressed but accurate analogy holds that the aurora playing on the polar atmosphere reflects dynamical processes operating in the magnetosphere and at the outer magnetospheric boundary in the same way in which the variable image on the phosphor of a cathode tube indicates changing electric and magnetic fields and particle trajectories in the body of the tube. As many of the 34 review papers in this book acknowledge, the state of the global visual aurora is a measure of the state of the magnetosphere and its interaction with the solar wind.

Indeed, analysis of auroral behavior soon after the IGY led to several insights that are still important to modern understanding of how energy from the solar wind transfers through the outer magnetosphere to enter the auroral ionospheres and the inner magnetosphere's trapping region, the Van Allen belts. In 1961, noting the strong control that sun-earth geometry exerts on both the visible aurora and the magnetosphere, J. W. Dungey proposed energy transfer into the magnetosphere via magnetic reconnection. It is now believed that 90 percent of the transfer is by this process, which converts kinetic energy of solar wind particles to magnetic energy stored temporarily in the tail of the magnetosphere. Concurrently,

and similarly influenced by observed patterns of auroral motion, W. I. Axford and C. O. Hines proposed a viscous-like interaction between the solar wind and the magnetosphere that involves the establishment of a large-scale electric field across the magnetospheric tail and a two-cell convective flow within the outer magnetosphere. That flow maps down through the geomagnetic field to the auroral atmospheres where it is seen in auroral motions. The auroral observations also led S.-I. Akasofu to recognize auroral (or magnetospheric) substorms—repeated impulsive events wherein the rate of energy transfer through the system increases radically.

A number of the papers in *Auroral Physics* demonstrate that parts of the field have matured. The characteristics of trapped and precipitating charged-particle distributions are now fairly well known, as are most details of auroral excitation processes. The interactions and feedback between the lower magnetosphere, the ionosphere, and the thermosphere are becoming increasingly well documented.

However, the cause and nature of the substorm remains a mystery, and many of the papers in this book deal directly or peripherally with this important issue. Substorms, lasting one to several hours, occur in both quiet and disturbed times, with a strength and frequency greatly enhanced when the interplanetary magnetic field is oriented in a way favorable to Dungey's reconnection process. Thus the condition of the solar wind is critical. Yet the substorm appears to be a process largely internal to the magnetosphere, initiated somewhere and somehow by a mechanism not yet understood. Authors in *Auroral Physics* discuss six or more different models of parts or all of the substorm, and others present data that bear on the problem.

Progress on the substorm problem has been slow these past 30 years. Part of the difficulty is uncertainty about where auroras map out into the magnetosphere. This book's first and last papers rightly stress the field's major need: better globally oriented observation of the aurora, the ionosphere, and the magnetosphere. The aurora is the easy part because the technology exists. The application of similar "imaging" techniques to yield global views of magnetospheric particle and current distributions and ionospheric currents is likely to bring significant advances in the years ahead.

This multi-author compendium, better than most of its breed, is well arranged by its editors, and the numerous references made to its contents in recent literature attest to its usefulness to specialists. Its depiction of the struggle to develop a comprehensive under-

standing of the substorm also is of interest to plasma physicists at large—for what transpires in the earth's magnetosphere has broad application elsewhere, both in the laboratory and in the cosmos.

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## Superconducting Devices

**SQUIDS, the Josephson Effects and Superconducting Electronics.** J. C. GALLOP. Hilger, New York, 1991. x, 232 pp., illus. \$90. Adam Hilger Series on Measurement Science and Technology.

Since the discovery of high-temperature superconductivity, the superconducting quantum interference device (SQUID) has been repeatedly touted as one of the first major applications of the new materials. The many times this possibility has been suggested have produced probably an equal number of questioners in search of a book that describes what SQUIDS are, how they work, and how to use them. Here is the book.

A SQUID consists of one or two Josephson junctions joined together with a loop of superconductor, typically  $10^{-5}$  to  $10^{-4}$  meter in diameter. SQUIDS measure magnetic flux but can be configured to measure magnetic fields or magnetic gradients, as well as voltages or currents. *SQUIDS, the Josephson Effects and Superconducting Electronics* starts with the basics of superconductivity, including the modern theories of superconductivity and the Josephson effect, continues on through the principles of operation of the two types of SQUIDS (RF and DC), and finishes with a long description of applications of the SQUID. The discussion of applications is one of the most extensive to date. SQUIDS made from both low- and high-temperature superconductors are discussed. The book could be used as a textbook for a course on SQUIDS that covers all aspects from start to finish.

The first-time user of a SQUID quickly learns that the price of working with one of the world's most sensitive amplifiers is that its exceptional sensitivity to a signal also means exceptional sensitivity to all types of magnetic fluctuations, external noise, and miscellaneous other signals from nearby galaxies. The lore of SQUID use is extensive and must be learned before useful measurements can be made. Here this book is unique; the chapter "A practical guide to

using SQUIDS" compactly summarizes this unwritten body of knowledge and will be invaluable to the first time user and useful to the experienced user of SQUIDS as well.

The followers of SQUIDery have been traditionally divided into two sects: those who prefer to use the DC SQUID, which has two Josephson junctions and is driven by a dc current, and the converts to the RF SQUID, which has a single Josephson junction and is driven by an rf current. Each has its advantages, but the DC SQUID has been gaining favor in recent times because of its simplicity of operation and its superior noise performance. The author is from the RF school and it shows—the book could have benefitted from a more up-to-date and comprehensive discussion of the DC SQUID.

The field of SQUIDS is advancing rapidly, and any book describing the technology of making the devices will soon be out of date. For example, the description of high- $T_c$  SQUIDS, though written less than a year ago, is already a little outdated. On the other hand, since most of the book describes the physics and applications of SQUIDS, with less than a tenth of the text devoted to the details of the technology used to fabricate them, the book as a whole will not be outdated for a long time to come. So the next time someone asks for a good reference on SQUIDS, an excellent answer will be at hand.

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## Books Received

**Album of Science.** The Biological Sciences in the Twentieth Century. Merriley Borell. Scribner, New York, 1990. xiv, 306 pp., illus. \$80.

**Alcohol in Human Violence.** Kai Pernanen. Guilford, New York, 1991. xvi, 280 pp., illus. \$30. Guilford Substance Abuse Series.

**Amazon Conservation in the Age of Development.** The Limits of Providence. Ronald A. Foresta. University of Florida Press, Gainesville, 1991. x, 366 pp., illus. \$49.95.

**Animal Cell Bioreactors.** Chester S. Ho and Daniel I. C. Wang, Eds. Butterworth-Heinemann, Boston, MA, 1991. xvi, 494 pp., illus. \$115. Biotechnology Series, 17.

**Anthropogenic Climatic Change.** M. I. Budyko and Yu. A. Izrael, Eds. University of Arizona Press, Tucson, 1991. xvi, 487 pp., illus. \$60. Translated from the Russian by the authors.

**Beyond Natural Selection.** Robert Wesson. MIT Press, Cambridge, MA 1991. xvi, 353 pp. \$29.95. A Bradford Book.

**Biotechnology.** The Science and the Business. Vivian Moses and Ronald E. Cape. Harwood Academic, New York, 1991. xiv, 596 pp., illus. \$170; paper, \$48.

**Biotechnology of Plasma Proteins.** Hemostasis, Thrombosis, and Iron Proteins. A. Albertini *et al.* Eds. Karger, Basel, 1991. ix, 215 pp., illus. \$168. Current Studies in Hematology and Blood Transfusion, no. 58. From a symposium, Florence, Italy, April 1990.

**Bird Life of Mountain and Upland.** D. A. Ratcliffe. Line illustrations by Chris Rose. Cambridge University Press, New York, 1991. xii, 256 pp., illus. \$44.50. Bird Life Series.

**Brookings at Seventy-Five.** James Allen Smith. Brookings Institution, Washington, DC, 1991. x, 236 pp. + plates. \$29.

**Carcinogenic and Mutagenic Metal Compounds.** 3. Interrelation between Chemistry and Biology. Annex: Toxic Aluminum Compounds. Ernest Merian, Giorgio L. Bronzetti, and Werner Haerdi, Eds. Gordon and Breach, New York, 1991. xvi, 638 pp., illus. \$95. Current Topics in Environmental and Toxicological Chemistry, vol. 14.

**Chirality and Optical Activity in Organometallic Compounds.** Viatcheslav I. Sokolov. Gordon and Breach, New York, 1990. viii, 145 pp., illus. \$66.

**The Chronological Annotated Bibliography of Order Statistics.** Vol. 3, 1960–1961. H. Leon Harter. American Sciences Press, Columbus, OH, 1991. vi, 219 pp., illus. Paper, \$95. Series in Mathematical and Management Sciences, vol. 19.

**Diagnosing Learning Disorders.** A Neuropsychological Framework. Bruce F. Pennington. Guilford, New York, 1991. xvi, 224 pp., illus. \$25.

**Disease, Depopulation, and Culture Change in Northwestern New Spain, 1518–1764.** Daniel T. Reff. University of Utah Press, Salt Lake City, 1991. ix, 330 pp., illus. \$30.

**Distributions, Fourier Transforms and Some of Their Applications to Physics.** Thomas Schüker. World Scientific, Teaneck, NJ, 1991. xii, 167 pp., illus. \$28. World Scientific Lecture Notes in Physics, vol. 37.

**DNA Replication.** Roger L. P. Adams. IRL (Oxford University Press), New York, 1991. x, 86 pp., illus. Paper, \$13.95. In Focus.

**Ecology of Estuaries.** Vol. 2, Biological Aspects. Michael J. Kennish. CRC Press, Boca Raton, FL, 1990. x, 391 pp., illus. \$195.

**The Ecology of the Self.** Relocation and Self-Concept Change. Stefan E. Hormuth. Cambridge University Press, New York, 1991, and Editions de la Maison des Sciences de l'Homme, Paris. xvi, 218 pp., illus. \$49.50. European Monographs in Social Psychology.

**Emergent Computation.** Self-Organizing, Collective, and Cooperative Phenomena in Natural and Artificial Computing Networks. Stephanie Forrest, Ed. MIT Press, Cambridge, MA, 1991. x, 452 pp., illus. \$32.50. Special issue of *Physica D*. From a conference, Los Alamos, NM. A Bradford Book.

**Emulsion Polymer Technology.** Robert D. Athey, Jr. Dekker, New York, 1991. x, 304 pp., illus. \$110. Plastics Engineering.

**Ethics and Law in Health Care and Research.** Peter Byrne, Ed. Wiley, New York, 1990. xii, 192 pp. \$47.95.

**The Fullness of Wings.** The Making of a New Daedalus. Gary and Dorsey. Penguin, New York, 1991. xiv, 350 pp., illus. Paper, \$9.95. Reprint, 1990 ed.

**A Functional Biology of Sea Anemones.** J. Malcolm Schick. Chapman and Hall (Routledge, Chapman and Hall), New York, 1991. xxii, 395 pp., illus. \$82.50. Functional Biology Series.

**The Future of Serials.** Patricia Ohl Rice and Jane A. Robillard, Eds. Haworth, Binghamton, NY, 1991. xii, 260 pp. \$29.95. Also published as *The Serials Librarian*, vol. 19, nos. 3/4. From a conference, St. Catherine's, Ontario, June 1990. Papers and reports of a workshop concerned with costs and other aspects of the management of serial publications in libraries.

**Gastrointestinal and Nutritional Manifestations of the Acquired Immunodeficiency Syndrome.** Donald P. Kotler, Ed. Raven, New York, 1991. x, 310 pp., illus. \$89.

**Genetics and Molecular Biology of Streptococci, Lactococci, and Enterococci.** Gary M. Dunny, Patrick Cleary, and Larry L. McKay, Eds. American Society for Microbiology, Washington, DC., 1991. viii, 310 pp., illus. \$69; to ASM members, \$59. Based on a conference, Minneapolis, MN, June 1990.

**The Growth and Decay of Ice.** G. S. H. Lock. Cambridge University Press, New York, 1991. xviii, 434 pp., illus. \$100. Studies in Polar Research.

**Huari Administrative Structure.** Prehistoric Monumental Architecture and State Government. William H. Isbell and Gordon F. McEwan, Eds. Dumbarton Oaks Research Library and Collection, Washington, DC, 1991. x, 321 pp., illus. \$48. Based on a meeting, Washington, DC, May 1985.

**Human Psychopharmacology.** Measures and Methods. Vol. 3. I. Hindmarch and P. D. Stonier, Eds. Wiley, New York, 1991. xiv, 224 pp., illus. \$96.

**The Human Retroviruses.** Robert C. Gallo and Gilbert Jay, Eds. Academic Press, San Diego, CA, 1991. xviii, 421 pp., illus. \$79.50.

**Hydrogen Bonding in Biological Structures.** G. A. Jeffrey and W. Saenger. Springer-Verlag, New York,

1991. viii, 569 pp., illus. \$79.

**Lower-Dimensional Systems and Molecular Electronics.** Robert M. Metzger, Peter Day, and George C. Papavassiliou, Eds. Plenum, New York, 1991. xiv, 742 pp., illus. \$149.50. NATO Advanced Science Institutes Series B, vol. 248. From a meeting, Spetses Island, Greece, June 1989.

**Management of Nutrition in Forests Under Stress.** H. W. Zörtl and R. F. Hüttl, Eds. Kluwer, Boston, MA, 1991. xii, 668 pp., illus. \$325. From a symposium, Freiburg, Germany, Sept. 1989. Reprinted from *Water, Air, and Soil Pollution*, vol. 54.

**Managing Global Genetic Resources.** Forest Trees. Committee on Managing Global Genetic Resources: Agricultural Imperatives, National Research Council. National Academy Press, Washington, DC, 1991. xvi, 228 pp., illus. \$24.95.

**Medical Innovation at the Crossroads.** Vol. 2, The Changing Economics of Medical Technology. Annetine C. Gelijs and Ethan A. Halm, Eds. National Academy Press, Washington, DC., 1991. xiv, 210 pp., illus. \$24.95. From a workshop, Dec. 1989.

**Neuronal Cooperativity.** Jürgen Krüger, Ed. Springer-Verlag, New York, 1991. xii, 302 pp., illus. \$98. Springer Series in Synergetics, vol. 49.

**Neuropeptide Technology.** Gene Expression and Neuropeptide Receptors. P. Michael Conn, Ed. Academic Press, San Diego, CA, 1991. xviii, 570 pp., illus. \$89; spiral bound, \$49.95. Methods in Neurosciences.

**New Developments in Fundamental and Applied Radiobiology.** C. B. Seymour and C. Mothersill, Eds. Taylor and Francis, Philadelphia, 1991. xii, 448 pp., illus. \$88. From a meeting, Dublin, Ireland, Sept. 1990.

**Pharmacy Ethics.** Mickey Smith *et al.*, Eds. Pharmaceutical Projects Press, New York, 1991. xvi, 555 pp., illus. \$59.95; paper \$27.95.

**Phase Transition in Ferroelastic and Co-Elastic Crystals.** An Introduction for Mineralogists, Material Scientists and Physicists. Ekhard K. H. Salje. Cambridge University Press, New York, 1990. xvi, 366 pp., illus. + appendixes + index. \$69.50. Cambridge topics in Mineral Physics and Chemistry, 1.

**Point Processes and Their Statistical Inference.** Alan F. Karr. 2nd ed. Dekker, New York, 1991. xvi, 490 pp. \$110. Probability: Pure and Applied.

**Probably More Than You Want to Know About Fishes of the Pacific Coast.** Robin Milton Love. Really Big Press, Santa Barbara, CA, 1991. iv, 215 pp., illus. Paper, \$12.95.

**Resident Peoples and National Parks.** Social Dilemmas and Strategies in International Conservation. Patrick C. West and Steven R. Brechin, Eds. University of Arizona Press, Tucson, 1991. xviii, 443 pp., illus. \$29.95.

**Response of Plants to Multiple Stresses.** Harold A. Mooney *et al.*, Eds. Academic Press, San Diego, CA, 1991. xiv, 422 pp., illus. \$69.95. Physiological Ecology.

**Science Education in the United States.** Issues, Crises and Priorities. S. K. Majumdar *et al.*, Eds. Pennsylvania Academy of Science, Easton, 1991. xx, 550 pp., illus. \$39.95.

**Scientific Knowledge in Controversy.** The Social Dynamics of the Fluoridation Debate. Brian Martin. State University of New York Press, Albany, NY, 1991. viii, 266 pp. \$49.50; paper, \$16.95. SUNY Series in Science, Technology, and Society.

**Seeds of Change.** A Quincennial Commemoration. Herman J. Viola and Carolyn Margolis, Eds. Smithsonian Institution Press, Washington, DC, 1991. ii, 278 pp., illus. \$39.95; paper, \$24.95.

**The Sun.** An Introduction. Michael Stix. Springer-Verlag, New York, 1991. xiv, 390 pp., illus. Paper, \$69. Astronomy and Astrophysics Library. Corrected reprint, 1989 ed.

**A Theory of Language and Information.** A Mathematical Approach. Zellig Harris. Clarendon (Oxford University Press) New York, 1991. xii, 428 pp. \$69.

**Thiophene and Its Derivatives.** Part 4. Salo Gronowitz, Ed. Wiley, New York, 1991. xii, 517 pp., illus. \$280. An Interscience Publication. The Chemistry of Heterocyclic Compounds.

**Third Reference Catalogue of Bright Galaxies.** Vol. 2. Gerard de Vaucouleurs *et al.* Springer-Verlag, New York, 1991. viii, 723 pp., illus. \$79.

**Windows on the Brain.** Neuropsychology's Technological Frontiers. R. A. Zappulla *et al.*, Eds. New York Academy of Sciences, New York, 1991. vii, 251., illus. \$65. Annals of the New York Academy of Sciences, vol. 620. From a conference, New York, May 1987.

**Worldwide Variation in Human Growth.** Phyllis B. Eveleth and James M. Tanner. 2nd ed. Cambridge University Press, New York, 1991. xii, 397 pp., illus. \$89.50; paper, \$42.50.