

BOOK REVIEWS

Plasma Initiation

Plasma Physics. An Introduction to the Theory of Astrophysical, Geophysical, and Laboratory Plasmas. PETER A. STURROCK. Cambridge University Press, New York, 1994. xii, 335 pp., illus. \$64.95 or £45; paper, \$24.95 or £17.95.

Introduction to Plasma Physics. ROBERT J. GOLDSTON and PAUL H. RUTHERFORD. Institute of Physics, Philadelphia, 1995. xviii, 491 pp., illus., + diskettes. \$196 or £98; paper, \$59 or £29.50.

Plasma Physics. An Introductory Course. RICHARD DENDY, Ed. Cambridge University Press, New York, 1995. xx, 513 pp., illus. Paper, \$39.95 or £24.95.

In teaching an introductory course in plasma physics, the urge is always to present topics that are correct, defensible, and encouraging. The result tends to be that the emphasis falls on free-standing, elegant pieces of theory that are brief and seem self-evident: linear waves in a cold plasma, adiabatic particle drifts, ideal magnetohydrodynamic equilibria, Debye screening of colliding charged particles, Landau damping as an initial value problem. What tends to get short shrift is just how messy and *sui generis* plasma experiments are likely to be, how labored and uncomfortable are the present fits of textbook theory to most observations, how much of a sense of humor is sometimes required to go on. Students can emerge misunderstanding the situation.

The three books under review are all conscientious attempts to start plasma students off in intellectually coherent directions. Sturrock's book originates in over 30 years of teaching the introductory plasma course at Stanford. The one by Goldston and Rutherford follows their course for "advanced undergraduates" at Princeton. The Dendy volume is a collective one, with diverse self-contained contributions from 20 British authors; pitched at a higher level, it is aimed more at advanced graduate students or recent Ph.D.s and amounts to the contents of a strenuous summer school. All three volumes are carefully written, artfully edited, earnest, and "mainstream."

Sturrock's text is the cleanest, the clearest, the most accessible, and perhaps the most oversimplified. It has numbered exercises and shows the hand of an experienced pedagogue. Of the three, it is the least

influenced by fusion research or other applications. Experimental results are few and qualitative, but pertinent.

Goldston and Rutherford cover much of the same material as Sturrock but with more of a fusion-research emphasis, as might be expected: cylindrical and toroidal geometry appears early and often, and there are more equilibria and "instabilities." Goldston and Rutherford, too, have numbered exercises that are thought-provoking and support the textual material.

The Dendy volume gains in topical interest what it loses in coherence from being a cafeteria of offerings by different authors. The titles of the individual chapters range from "Industrial plasmas" (P. C. Johnson) through "Gravitational plasmas" (J. J. Binney) to "How to build a tokamak" (T. N. Todd). The chapters aim at sampling very recent thinking on a wide variety of current topics, are not always pedagogic in tone, and are sometimes unabashedly speculative.

All three books are to be recommended for their smooth presentations, their literacy, and their occasional virtuosity. Their main lack, as far as this reviewer is concerned, is that there is seldom any statement of how fragile plasma physics still is, how far removed in style and substance from the more mature branches of physics. Particularly to one who spends part of his time in fluid mechanics, the style of much of plasma physics can sometimes seem reckless, uninformed, and suavely shallow. Why should ideal steady states be taken seriously as models of reality when they have been known for almost a century not accurately to represent hydrodynamic shear flows? If anyone knows, he or she should say. What should we make of a magnetofluid description whose viscous stress tensor is uncertain by orders of magnitude? Who can say that the Vlasov equation and the Vlasov equation with a collisional correction lead to "essentially" the same results, even over "short time scales"?

Electricity and magnetism have been an active research area for over two centuries, classical mechanics for over three. Their development and practical applications are not finished yet. Plasma physics, very much younger, spans the product space of the two, and also needs a great deal of support from statistical mechanics, kinetic theory, hydrodynamics, and atomic physics. Compared to what likely could be known about plasmas,

very little is. Textbooks and monographs ought to reflect the true state of development of the field they address. If modesty and uncertainty are in order, that should be their tone. These books are intelligent ones, but they are not always modest enough.

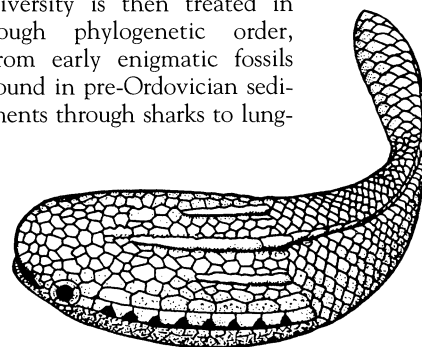
David Montgomery
Department of Physics,
Dartmouth College,
Hanover, NH 03755, USA

Other Books of Interest

The Rise of Fishes. 500 Million Years of Evolution. JOHN A. LONG. Johns Hopkins University Press, Baltimore, MD, 1995. 223 pp., illus. \$49.95.

The group of organisms loosely called "fishes" contains over half of all vertebrates (about 25,000 extant species). Not only do these species exhibit astonishing diversity in structure, behavior, and physiology but clades within the "fishes" gave rise to terrestrial vertebrates and hence to modern amphibians, reptiles, birds, and mammals. Some clades of fishes are more closely related to tetrapods than they are to other aquatic fishlike taxa. Deciphering the pattern of fish evolution thus makes a major contribution to our understanding of vertebrate diversity as well as provides insight into the origin of terrestrial life.

This book is a colorfully and copiously illustrated semi-popular description of fish evolution that focuses on the fossil record of fishes. A brief introductory section explains the process of fossilization, continental drift, principles of phylogenetic analysis, and basic features of vertebrate anatomy relevant to understanding the descriptions of fossil taxa in subsequent chapters. Fish diversity is then treated in rough phylogenetic order, from early enigmatic fossils found in pre-Ordovician sediments through sharks to lung-



"*Astrapsis* is one of the oldest vertebrates known from North America, and was initially described from fragmentary plates of bone from the Late Ordovician Harding Sandstone of Colorado by Charles Doolittle Walcott. In recent years more complete material has been found enabling this new reconstruction of the fish." [From *The Rise of Fishes*; after the work of David Elliott]



Vignettes: Limited Capacities

The difference between the amoeba and Einstein is that, although both make use of the method of trial and error or elimination, the amoeba dislikes erring while Einstein is intrigued by it: he consciously searches for his errors in the hope of learning by their discovery and elimination.

—Karl Popper, 1979, as quoted by Raphael Sassower in *Cultural Collisions: Postmodern Technoscience* (Routledge)

Long before the Star Trek writers conjured up warp fields, Einstein warped spacetime, and, like the Star Trek writers, he was armed with nothing other than his imagination. Instead of imagining twenty-second-century starship technology, however, Einstein imagined an elevator. He was undoubtedly a great physicist, but he probably never would have sold a screenplay.

—Lawrence M. Krauss, in *The Physics of Star Trek* (BasicBooks)

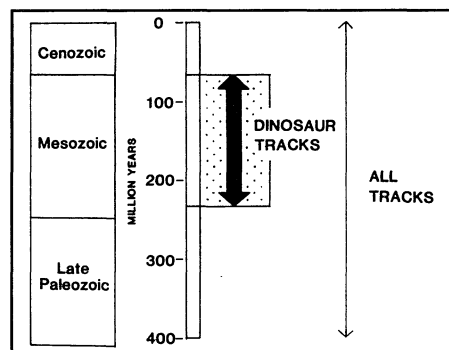
fishes and taxa currently believed to be close tetrapod relatives. While this survey does provide a general overview, coverage is uneven, with description of the clade containing 95 percent of fish diversity (ray-finned fishes) occupying only about 10 pages of text. Furthermore, the use of cute descriptive phraseology (“ray-finned fishes: a winning formula”; “a small step for fish-kind, but a great step for man”; “big teeth, strong fins”) represents needless post-hoc rationalization of historical pattern and unsupported functional speculation, both of which detract from the work.

George V. Lauder
Department of Ecology and
Evolutionary Biology,
University of California,
Irvine, CA 92717, USA

Dinosaur Tracks and Other Fossil Footprints of the Western United States. MARTIN LOCKLEY and ADRIAN P. HUNT. Artwork by Paul Koroshetz. Columbia University Press, New York, 1995. xxii, 338 pp., illus. \$29.95 or £21.50.

This semi-popular book explains the rudiments of fossil footprints as found in the western United States, with off-road excursions into the biology, habits, and biogeography of the presumed track-makers. Most vertebrate paleontologists will find this familiar ground, though much is usefully collected in one place. The book surveys tracks from the early Paleozoic to the Pleistocene and is unabashed in its advocacy of the (oft-neglected) importance of footprints. Its strengths include the attention it gives to history, site geography, and taxonomy. Given the level of the book, the primary literature is not as fully referenced as a specialist

would find useful, and several active controversies are presented a bit unevenly. There is little attention paid to the use of actualistic ichnology in interpreting fossil



“Vertebrates have been leaving tracks on land since the Devonian period, about 400 million years ago. Even so, much of trackmaking history falls in the Mesozoic ‘age of dinosaurs.’” [From *Dinosaur Tracks and Other Fossil Footprints of the Western United States*]

footprints, so, for example, studies of extant track-makers, as well as of the role of sediment incompetence in the formation and deformation of footprints, are underplayed.

Kevin Padian
Department of Integrative Biology and
Museum of Paleontology,
University of California,
Berkeley, CA 94720–3140, USA

Books Received

Android Epistemology. Kenneth M. Ford, Clark Glymour, and Patrick J. Hayes, Eds. AAAI Press, Menlo Park, CA, and MIT Press, Cambridge, MA, 1995. xvii,

316 pp., illus. \$25. Based on a workshop, Perdido Key, FL, May 1991.

Beyond Einstein. The Cosmic Quest for the Theory of the Universe. Michio Kaku and Jennifer Thompson. 2nd ed. Anchor (Doubleday), New York, 1995. xii, 227 pp., illus. Paper, \$12.95 or \$C16.95.

Bioelectromagnetism. Principles and Applications of Bioelectric and Biomagnetic Fields. Jaakko Malmivuo and Robert Plonsey. Oxford University Press, New York, 1995. xxiv, 482 pp., illus. \$98.

The Communications Miracle. The Telecommunication Pioneers from Morse to the Information Superhighway. John Bray. Plenum, New York, 1995. xx, 379 pp., illus. \$28.95.

Commuting Stress. Causes, Effects, and Methods of Coping. Meni Koslowsky, Avraham N. Kluger, and Mordechai Reich. Plenum, New York, 1995. xii, 232 pp. \$39.50. Plenum Series on Stress and Coping.

Dictionary of Endocrinology and Related Biomedical Sciences. Constance R. Martin. Oxford University Press, New York, 1995. vi, 785 pp., illus. \$75; paper, \$49.95.

A Dictionary of Epidemiology. John M. Last, Ed. 3rd ed. Oxford University Press, New York, 1995. xviii, 180 pp., illus. \$35; paper, \$16.95.

Enabling Technologies for Petaflops Computing. Thomas Sterling, Paul Messina, and Paul H. Smith. MIT Press, Cambridge, MA, 1995. xii, 180 pp., illus. Paper, \$26.95. Scientific and Engineering Computation.

The End of Evolution. A Journey in Search of Clues to the Third Mass Extinction Facing Planet Earth. Peter Ward. Bantam, New York, 1995. xviii, 302 pp., illus. Paper, \$12.95 or \$C17.95. Reprint, 1994 ed.

Force and Geometry in Newton's Principia. François De Gandt. Princeton University Press, Princeton, NJ, 1995. xiv, 297 pp., illus. \$49.50. Translated from the French edition by Curtis Wilson.

Forensic Neuropsychology. Conceptual Foundations and Clinical Practice. Jose A. Valciukas. Haworth, Binghamton, NY, 1995. xiv, 341 pp. \$39.95. Haworth Criminal Justice, Forensic Behavioral Science and Offender Rehabilitation.

Genius Talk. Conversations with Nobel Scientists and Other Luminaries. Denis Brian. Plenum, New York, 1995. xii, 423 pp., illus. \$28.95.

Handbook of Mathematical Formulas and Integrals. Alan Jeffrey. Academic Press, San Diego, 1995. xxiv, 410 pp., illus. Paper, \$19.95.

Introduction to Solid State Physics. Charles Kittel. 7th ed. Wiley, New York, 1995. xii, 673 pp., illus. \$79.95.

Life Scientists. Their Convictions, Their Activities, and Their Values. Gerard M. Verschuuren. Genesis, North Andover, MA, 1995. x, 273 pp., illus. \$34.50.

The Microprocessor. A Biography. Michael S. Malone. Telos (Springer-Verlag), Santa Clara, CA, 1995. xx, 333 pp., illus. \$29.95.

Nonstandard Logics and Nonstandard Metrics in Physics. William M. Honig. World Scientific, River Edge, NJ, 1995. xviii, 280 pp., illus. \$55; paper, \$32. Series on Knots and Everything, vol. 10.

Of Microbes and Molecules. Food Technology, Nutrition and Applied Biology at M.I.T., 1873–1988. Samuel A. Goldblith. Food and Nutrition, Trumbull, CT, 1995. xvi, 329 pp., illus. \$49.

Picturing Plants. An Analytical History of Botanical Illustration. Gill Saunders. Published in association with the Victoria and Albert Museum, London by the University of California Press, Berkeley, 1995. 152 pp., illus. \$29.95.

Quantum Mechanics. Concepts and Applications. John D. McGervey. Academic Press, San Diego, 1995. xiv, 408 pp., illus., + diskette. \$54.95.

Resonant Anomalous X-Ray Scattering. Theory and Applications. G. Materlik, C. J. Sparks, and K. Fischer, Eds. North-Holland, New York, 1994. xii, 675 pp., illus. \$200 or Dfl. 350. From a conference, Malente, Germany, Aug. 1992.

The Science of the Mind. 2001 and Beyond. Robert L. Solso and Dominic W. Massaro, Eds. Oxford University Press, New York, 1995. xii, 339 pp., illus. \$35.

A Treatise on the Theory of Bessel Functions. G. N. Watson. Cambridge University Press, New York, 1995. viii, 804 pp., illus. Paper, \$29.95. Reprint, 1944 ed. Cambridge Mathematical Library.

Without Miracles. Universal Selection Theory and the Second Darwinian Revolution. Gary Cziko. MIT Press, Cambridge, MA, 1995. xiv, 385 pp., illus. \$30.