with persuasive experimental results. So much analysis and application condensed into 430 pages makes it inevitable that the coverage of the subject will be spread thinly. However, graduate students and professionals in pulse-power science will find no better reference book.

Moon speaks without hesitation of body forces on the conductor material, which are given by the vector product of current density and magnetic-flux density. As an experimenter he is fully justified and undoubtedly right to do so. However, as a theorist, he does not echo the spirit of modern electromagnetism. It was Ampère who suggested that the ponderomotive, electrodynamic force acts on the conductor material and not on the "electric fluid." Our relativistic Lorentz force is supposed to attack the drifting conduction electron that has become the particle of the electric fluid. How the displaced electrons and the resulting negative space charge, hemmed in by the surface work function, finally react on the lattice has proved to be too much for mathematicians and hence was left out of the book.

There is no mention in the book of Jan Nasilowski's discovery of solid-state wire explosions (the explosion of a metal wire before it reaches the melting point of the metal by internal strain forces caused by a short and strong current pulse), of an experiment by Pano Pappas and its implications with respect to the seat of railgun recoil forces, nor of my work on the Ampère–Neumann electrodynamics. A few years are not enough for these fragments of information to surface in the flood of new scientific literature. Gone are the days when a demonstration, like Oersted's of the interaction of the electric current in a copper wire with a magnetic-compass needle, could be published, studied and repeated all over Europe in one short summer.

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Biophysical Aerodynamics and the Natural Environment

A. J. Ward-Smith
172 pp. Wiley, New York, 1985. $38.95

Biophysical aerodynamics is a study that crosses over many traditional fields of science. It is at least as old as Leonardo da Vinci's study of bird flight. It is at least as fresh as the 1973 discovery by Torkel Weis-Fogh that the small wasp *Encarsia formosa* employs a clap–fling mechanism for flight. *Biophysical Aerodynamics and the Natural Environment* is a survey of such studies.

The author, an aeronautical engineer, begins with a standard introduction to the basics of aerodynamics. Carefully avoiding overburdening the reader with details, he introduces atmospheric pressure, dynamic and kinematic viscosity, the Reynolds number, shear stress, the Bernoulli principle and the other terms important to aerodynamics. Even here he tantalizes the reader with the relevant range of the Reynolds number, with spores at the low end and birds at the other, separated by about ten orders of magnitude.

The strength of the book is the host of puzzles Ward-Smith presents. Why do falling water drops collide if they are similar in size, but avoid collision otherwise? As a water drop grows, why does it flatten, become concave on its bottom side, develop essentially into a bubble and then burst?

Ward-Smith explains how hexagonal plates and needles of ice fall broadside—an orientation that leads to the many halos, arcs and parhelia that one can often see in the sky. He examines the forces governing the fall of hail, pointing out that the large hailstones (up to 30 pounds) sometimes reported in the press are unlikely because their terminal speed of about 150 miles per hour would surely mean their destruction when they hit the ground.

A chapter is devoted to the dispersal of fruits and seeds. Tiny seeds, spores and pollen develop no lift but can be carried great distances by thermals and the wind. Dandelions wait patiently for the proper humidity, temperature and wind before releasing their plumed parachutes. The samaras of maples and sycamores have evolved into helicopter wings to slow their descent, so that they spread beyond the region of their parent.

Birds soar and glide in rising bubbles of hot air, broad uplifts or vertical velocity gradients, effortlessly altering their wing shapes and orientations for best advantage. They also are capable of hovering and of flying either quickly or slowly. When they fly in flocks, all but the lead bird position themselves so as to enjoy the upwash left by another bird.

Ward-Smith examines the flight of insects, laying to rest the old and incredible claim that the botfly can exceed the speed of sound. Seemingly nothing escapes his observations, not tumbling tumbleweeds, flying frogs and fish or gliding lemurs, not even pterodactyls. This book works well as an introduction to biophysical aerodynamics, whether for classroom use or as enjoyable reading at home.

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new books

Astronomy, Cosmology and Space Physics

Accretion Power in Astrophysics. J. Frank, A. R. King, D. J. Raine. 273 pp. Cambridge U.P., New York, 1985. $59.50. *Monograph*

Astrophysics of Active Galaxies and Quasi-Stellar Objects. Proc. Wksp., Santa Cruz, July 1984. J. S. Miller, ed. 519 pp. University Science Books, Mill Valley, Cal., 1985. $30.00

Constructing the Universe. D. Layzer. 313 pp. W. H. Freeman, New York, 1985. $27.95. *Lay readers*

Dynamics of Star Clusters. Proc. IAU Symp., Princeton, N.J., May–June 1985. J. Goodman, P. Hut, eds. 622 pp. Reidel, Boston, 1985. $69.00

New Aspects of Galaxy Photometry. *Lecture Notes in Physics 232.* Proc. Colloq., Toulouse, France, September 1984. J. L. Nieto, ed. 350 pp. Springer-Verlag, New York, 1985. $23.70

Progress in Stellar Spectral Line Formation Theory. *NATO ASI Series.* Proc. Wksp., Trieste, Italy, September 1984. J. E. Beckman, L. Crivellari, eds. 448 pp. Reidel, Boston, 1985. $59.00

Relativistic Astrophysics and Cosmology. Proc. Int. Sem. Theoretical Physics, San Feliu de Guixols, Spain, June–July 1983. X. Fustero, E. Verdaguer, eds. 320 pp. World Scientific, Singapore (US dist. Taylor and Francis, Philadelphia), 1984. $37.00

Comet Halley: Once in a Lifetime. M. Littmann, D. K. Yeomans. 175 pp. American Chemical Society, Washington, D.C., 1985. $19.95. *Lay readers*

Foundations of Radiation Hydrodynamics. D. Mihalas, B. W. Mihalas. 718 pp. Oxford U.P., New York, 1984. $75.00. *Text*

Physics of Planetary Interiors. G. H. A. Cole. 208 pp. Adam Hilger, Bristol, 1984. $16.00. *Monograph*

Atomic, Molecular and Chemical Physics

Atomic Physics 9. Proc. Int. Conf., Seattle, July 1984. R. S. Van Dyck Jr, E. N. Portson, eds. 600 pp. World Scientific, Singapore (US dist. Taylor and Francis, Philadelphia), 1985. $60.00

Autoionization: Recent Developments and Applications. A. Temkin, ed. 261 pp. Plenum, New York, 1985. $45.00. *Compendium*

Fundamental Interactions in Low-Energy Systems. *Ettore Majorana International Science Series 23.* Proc. Int. Course, Erice, Italy, March-April 1984. P. Dalpiaz, G. Fiorentini, G. Torelli, eds. 501 pp. Plenum, New York, 1985. $85.00