

technical secrecy is not the issue. The chemical formula and the recipes for the manufacture of LSD are in the public domain, as are the scientific facts and most of the engineering principles underlying the manufacture of nuclear weapons. In both cases, what we need to do is not to keep the technical processes secret but to make them boring. We need to make it clear to everybody that the manufacture of LSD and nuclear weapons is now a routine commercial business, no longer offering a serious intellectual challenge to bright young people. Books that present either LSD or nuclear bombs as a romantic adventure can be a danger to public health and safety.

We are here confronting an ethical dilemma that is at least 350 years old, the same dilemma that John Milton confronted in his historic battle for the freedom of the press in 17th-century England. Milton in his famous appeal with the title "Areopagitica," addressed to the English parliament in 1644, conceded to his enemies the point that books "are as lively and as vigorously productive as those fabulous dragon's teeth, and being sown up and down, may chance to spring up armed men." He conceded that the risks of letting books go free into the world could be lethal as well as irreversible. He argued that the risks must still be accepted, because the censorship of books was the greater evil. He lost the argument, and in his day the censors prevailed. In our day, the censors have lost their grip, but the ethical dilemma remains. Books have not lost their power to spring up armed men, to seduce and to destroy. The fact that this primer was declassified 26 years ago does not mean that we can spread it over the world without some responsibility for the consequences.

Perhaps I am making a mountain out of a molehill. If Serber should ever read this review he would probably say, "Shucks. It's not such a big deal." And perhaps he would be right. I hope so. With luck, this charming little book will be read only by elderly physicists and historians, people who can appreciate its elegance without being seduced by its magic.

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Macfarlane Burnet

The Seeds of Time. The Life of Sir Macfarlane Burnet. CHRISTOPHER SEXTON. Oxford University Press, New York, 1992. x, 301 pp. + plates.

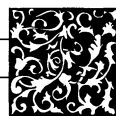
This is a biography of one of the 20th century's great biologists, whose influence was felt far beyond the bounds of his chosen

fields of endeavor, virology and immunology. It is an authorized biography, but unlike many of its genre it does not attempt to idolize or to deify its subject; the warts and blemishes are presented fairly. Indeed, Macfarlane Burnet's scientific accomplishments need no hyperbole. Trained in medicine in 1920s Australia, Burnet, innately shy and lacking in social graces, shrank from contact with patients and sought the isolation of the research laboratory. He early decided that he would accomplish great things, and hard work and a genius for generalization beyond the narrow bounds of the immediate problem vindicated this view. If Burnet had stopped with his work in virology and especially with influenza virus, he would have earned a place in the pantheon of biomedical scientists. His work on the genetic recombination of influenza virus and on bacteriophage in lysogeny helped to start the molecular biological revolution. For this work Burnet, still in his 40s, was knighted and received the Order of Merit and, among other awards, the Royal Medal of the Royal Society and the Lasker award.

Interest in the practical applications of his

research led Burnet to an interest in the immune response to viral infections, and the Darwinian biologist quickly became unhappy with the Lamarckian immunochemical theories of antibody production then extant. As early as 1941 he sought to bring biology back into immunology with his book *The Production of Antibodies*. But it was his 1949 revision of this book with Frank Fenner that placed him in the forefront of immunology. In it, with great imagination and prescience, he integrated into an ontogenetic theory the recently described (but not yet named) phenomenon of immunological tolerance, with broad predictions that Peter Medawar and colleagues verified experimentally. For this Burnet and Medawar shared the Nobel Prize in 1960. In a 1955 paper by Niels Jerne, Burnet saw the seeds of a grand solution to the problem of antibody production, which took the form of his clonal selection theory of 1957-59. Like so many of Burnet's speculations, this one stimulated a generation of researchers, and clonal selection has become the dogma of modern immunology.

The author of this book is a lawyer by vocation and a biographer by avocation. This



Vignettes: Problems in Teaching

The University of Avignon, in 1650, found itself faced by a candidate for the doctorate who had capacity but who had applied himself less closely to the pursuit of knowledge than to less exacting and more exciting extra-curricular activities. After some hesitation, it conferred the doctoral degree on him with the notation *sub spe futuri studii*, which I am told can be translated as "in the hope of future study."

—Jacob Viner, as quoted by William G. Bowen and Neil L. Rudenstine in *In Pursuit of the PhD* (Princeton University Press)

When I retired . . . I was asked to teach in two universities . . . I seemed to be a big success. But I was a "big success" in a way I found extremely dangerous. The students saw me, at the end of my life, working on very general problems and making observations about every discipline, be it social, medical, or scientific. Immediately they wanted to do the same thing, to come to grips from the start with problems on a worldwide scale, without being willing to work before thinking. Yet I'd tell them every day, "I want to stress that for forty years I was the most disciplined microbiologist possible, and not until I realized that I'd mastered that discipline could I permit myself to look at it from the outside." But they simply wouldn't accept my explanation. I believe that from then on I began to feel that I was a bad influence on them. Because my courses were going too well, I gave up teaching and from then on gave no more courses of that sort.

—René Dubos, in *The World of René Dubos: A Collection from His Writings* (Gerard Piel and Osborn Sergerberg, Jr., Eds.; Holt)

Even in this blasé age, bright young students in elementary physics classes, after hearing about electromagnetic waves, will ask the rude question; "What is waving?" and the better the instructor the less answer is provided.

—Lawrence B. Slobodkin, in *Simplicity and Complexity in Games of the Intellect* (Harvard University Press)

makes the work all the more impressive, since it is rare to find a competent scientific biography written by a layman, and indeed the directions of Burnet's life in science are well laid out. But what seems lacking is a rendering of Burnet the man: his private life, his relationships with wife, children, and friends. The author had lengthy interviews with Burnet for over a year, and in light of this extensive contact the absence of a more personalized view may say more about Burnet than would a detailed account. Only in the chapter describing Burnet's last years does the individual emerge partly; it is an aging, conservative, and somewhat crotchety man whose portrait may not do justice to the younger Burnet.

The book is well and carefully written, and the detailed notes and *curriculum vitae* in the appendixes will be useful to scientists and historians alike. We have here a fine account of what hard work, perseverance, self-confidence, and a wide-ranging imagination can accomplish in science.

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Some Other Books of Interest

Biology of Ticks. Vol. 1. DANIEL E. SONENSHINE. Oxford University Press, New York, 1992. xx, 447 pp., illus. \$95.

Noting that the last general text on ticks was published in 1962 and that subsequent works on the subject have been specialized or limited in scope, the author intends with this new work to fill the "clear need for an up-to-date, general text" on this group of acarines. After a general introduction that outlines the fundamental characteristics of and history of research on ticks, the treatment begins with chapters on their evolution and systematics (with special attention to genera that are medically or economically important) and their life cycles. Part 2 of the book is an Outline of Tick Body Structure, with a chapter each on external anatomy, the integument, and general features of internal anatomy. The 16 chapters that constitute the remainder of volume 1 deal with particular structures and functions, proceeding from mouthparts and foregut through the circulatory, respiratory, nervous, and reproductive systems to genetics, pheromones, embryology, neuroendocrine regulation, and water balance. The volume concludes with a list of literature cited and a general index (excluding authors). A brief table of contents for the projected second

volume, which will cover ecology, behavior, host-parasite interactions, and diseases borne or caused by ticks, is included.

—Katherine Livingston

Biochemistry and Molecular Biology of Fishes. Vol. 1, Phylogenetic and Biochemical Perspectives. P. W. Hochachka and T. P. Mommsen, Eds. Elsevier, New York, 1991. xx, 361 pp., illus. \$130.

While the primary literature in fish biochemistry and molecular biology has been rapidly increasing in quantity and quality, according to the editors of this new series, "researchers and students in this area always find themselves combing the literature on general (rat-dominated) biochemistry before discovering short and usually incomplete and disappointing coverage of the situation in the piscine setting." This "review series" is intended to alleviate the situation by providing such seekers with "a pertinent information source from theoretical and experimental angles." The inaugural volume consists of 13 papers, beginning with an account of physiologically relevant properties of water by Clegg and Drost-Hansen. There follow two papers on evolution, of the fish genome generally (Ferguson and Allendorf) and of mitochondrial enzyme systems (Campbell and Anderson). Recent advances in the study of vision and bioluminescence are then discussed by McFall-Ngai and Toller. The next four papers deal with hormonal pheromones (Stacey and Sorenson), urea synthesis (Mommensen and Walsh), maintenance of solute (sodium, chloride) balance (Wright), and metabolism of carbon dioxide and ammonia (Walsh and Henry). Discussions of mechanisms involved in buoyancy (Phleger) and locomotion (Johnston and Altringham) follow. In two papers concerned with temperature regulation, Block discusses the evolution of endothermy in certain groups (tunas, lamnid sharks) and Hochachka considers the more common "ectothermy option." A discussion by Siebenaller of enzymatic adaptations to hydrostatic pressure ends the coverage. Species and subject indexes complete the volume.

—Katherine Livingston

Books Received

Accidental Empires. How the Boys of Silicon Valley Make Their Millions, Battle Foreign Competition, and Still Can't Get a Date. Robert X. Cringely. Addison-Wesley, Reading, MA, 1992. xii, 324 pp. \$19.95.

Ancient Road Networks and Settlement Hierarchies in the New World. Charles D. Trombold, Ed. Cambridge University Press, New York, 1992. xvi, 277 pp., illus., + plates. \$69.95. New Directions in Archaeology.

Beyond Beef. The Rise and Fall of the Cattle Culture. Jeremy Rifkin. Dutton (Penguin), New York, 1992. xii, 353 pp. \$21.

The Changing Visual System. Maturation and Aging in the Central Nervous System. P. Bagnoli and W. Hodoss, Eds. Plenum, New York, 1991. x, 420 pp., illus. \$105. NATO Advanced Science Institute Series A, vol. 222. From a workshop, San Martino al Cimino, Italy, May 1991.

Deserts as Dumps? The Disposal of Hazardous Materials in Arid Ecosystems. Charles C. Reith and Bruce M. Thompson, Eds. University of New Mexico Press, Albuquerque, 1992. xviii, 330 pp., illus. \$39.95.

Egg Incubation. Its Effects on Embryonic Development in Birds and Reptiles. D. Charles Deeming and Mark W. J. Ferguson, Eds. Cambridge University Press, New York, 1992. xiv, 448 pp., illus. \$195.

The First Americans. Search and Research. Tom D. Dillehay and David J. Meltzer. CRC Press, Boca Raton, FL, 1991. x, 310 pp., illus. \$49.95.

The Gravitational Force Perpendicular to the Galactic Plane. A. G. Davis Philip and Phillip K. Lu, Eds. L. Davis, Schenectady, NY, 1992. x, 182 pp., illus. \$25. From a meeting, Danbury, CT, May 1989.

Handbook of Borderline Disorders. Daniel Silver and Michael Rosenbluth, Eds. International Universities Press, Madison, CT, 1992. xxiv, 744 pp., illus. \$75.

In Pursuit of the PhD. William G. Bowen and Neil L. Rudenstine. Princeton University Press, Princeton, NJ, 1992. xxii, 442 pp., illus. \$35.

Irregular Atomic Systems and Quantum Chaos. Jean-Claude Gay, Ed. Gordon and Breach, Philadelphia, 1992. x, 360 pp., illus., + plates. Paper, \$35. Partially reprinted from *Comments on Atomic and Molecular Physics*, vol. 25.

Koobi Fora Research Project. Vol. 3, The Fossil Ungulates: Geology, Fossil Artiodactyls, and Palaeoenvironments. J. M. Harris, Ed. Clarendon (Oxford University Press), New York, 1991. xvi, 384 pp., illus. \$185.

Lanthanides and Actinides. Simon Cotton. Oxford University Press, New York, 1991. x, 192 pp., illus. \$39.95.

Manufacturing Systems. Foundations of World-Class Practice. Joseph A. Heim and W. Dale Compton, Eds. National Academy Press, Washington, DC, 1992. x, 273 pp., illus. \$34.95; paper, \$19.95.

New Perspectives on Cybernetics. Self-Organization, Autonomy and Connectionism. Gerturdis van de Vijver, Ed. Kluwer, Norwell, MA, 1991. vi, 252 pp. \$115. Synthese Library, vol. 220.

Observing the Erotic Imagination. Robert J. Stoller. Yale University Press, New Haven, CT, 1992. xii, 228 pp. \$35; paper, \$12. Reprint, 1985 ed.

The Physical Chemistry of Solids. Richard J. Borg and G. J. Dienes. Academic Press, San Diego, CA, 1991. xiv, 584 pp., illus. \$69.95.

Quantum Mechanics. Franz Schwabl. Springer-Verlag, New York, 1992. xiv, 407 pp., illus. \$39. Translated from the German ed. (Berlin, 1988) by Ronald Kates.

The Relations of Particles. Lev B. Okun. World Scientific, River Edge, NJ, 1991. viii, 159 pp., illus. \$38; paper, \$18.

The Science of Musical Sounds. Johan Sundberg. Academic Press, San Diego, CA, 1991. x, 237 pp., illus. \$44.95. Cognition and Perception. Translated from the Swedish edition (Stockholm, 1989).

The Total Synthesis of Natural Products. Vol. 8. John ApSimon, Ed. Wiley Interscience, New York, 1992. xii, 704 pp., illus. \$150.

Using the Microscope. A Guide for Naturalists. Eric V. Gravé. Dover, New York, 1992. xviii, 202 pp., illus. Paper, \$9.95. Reprint of *Discover the Invisible* (1984).

Venus Geology, Geochemistry, and Geophysics. Research Results from the USSR. V. L. Barsukov et al., Eds. University of Arizona Press, Tucson, 1992. xviii, 421 pp., illus. \$75.

The Wave Theory of Difference and Similarity. Stephen W. Link. Erlbaum, Hillsdale, NJ, 1992. xvi, 373 pp., illus. \$59.95. Scientific Psychology.

Work, Health, and Productivity. Gareth M. Green and Frank Baker, Eds. Oxford University Press, New York, 1991. xvi, 311 pp., illus. \$39.95. From a conference, Queenstown, MD, Oct. 1987.