



Zapotec pottery of the San José phase (1150–850 B.C.). [From *Zapotec Civilization*; painting by John Klausmeyer]

based on “ecological functionalism” or “selectionist” approaches, and, while crediting each with explanatory value, they fault them for failing to recognize the capacity of aggressive, charismatic leaders to shape the course of history. Along with cultural and natural forces, the actions of such individuals are seen as producing rapid change followed by periods of relative stability in, as anthropologists refer to them, generalized “stages” or “levels” of egalitarian band, ranked chiefdom, and stratified state integration. Because individual action during the periods of rapid transition is singular, the authors acknowledge that action theory has limited value for a comparative study of evolutionary process. The value of action theory, as Marcus and Flannery put it, is that it “responds to complaints that most evolutionary theory makes humans little more than cogs in a machine.”

In the end this book leaves us with the perplexing problem of accounting for the fact that, despite the unique actions of its leaders, every civilization of antiquity, from Mexico to Mesopotamia, appears to have advanced through a similar sequence of stages and to have evolved quite comparable political and economic institutions. What, we ask, were the cultural and environmental limits to self-serving individual action in effecting this evolutionary change? This is a question addressed at length by Leslie White almost a half a century ago. Unfashionable as they may be in certain intellectual circles at the moment, such questions are of much broader interest to the general public than that of Zapotec prehistory, for they touch on issues of universal social and cultural behavior. We can, however, begin to answer them fruitfully and move toward a comparative study of evolutionary process only when we

have at hand studies of other civilizations as thorough and thoughtful as that which Marcus and Flannery have presented us for the ancient Zapotec.

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## Evolutionary Virology

**Molecular Basis of Virus Evolution.** ADRIAN J. GIBBS, CHARLES H. CALISHER, and FERNANDO GARCÍA-ARENAL, Eds. Cambridge University Press, New York, 1995. xx, 603 pp., illus. \$94.95 or £65.

The rapid evolution of viruses has important consequences for our everyday lives, and probably for the lives of all other living organisms on Earth. Understanding and controlling influenza, herpes, AIDS, hemorrhagic fever, and many other viral diseases depends on our understanding of viral evolution, particularly at the molecular level. At the same time, evolutionary biologists are realizing that the rapid evolution of viruses provides an unprecedented opportunity to observe and study evolutionary processes directly. Molecular systematics has become the common ground of virologists and evolutionary biologists in the effort to understand where viruses come from, how they interact with their hosts through time, how they evolve, and how they can be utilized and controlled. This book provides an important summary of these molecular systematic investigations of wild viral populations, as well as some insights into the early stages of the marriage between virology and evolutionary biology.

The large number of informative chapters on particular viral groups demonstrates the productivity of the relationship between virologists and evolutionary biologists. For instance, molecular systematic studies are now used routinely to identify, characterize, and monitor new viral outbreaks, often before the virus is even isolated (as in the recent hantavirus outbreak in the United States). Nonetheless, there are also indications that these two kinds of biologists still have a lot to learn from each other. As an example, consider the explanation, given in several chapters, for the differences in the shapes of the phylogenetic trees of different viruses. Samples of some viruses taken through time (such as influenza A orthomyxovirus) produce trees with one dominant, continuing lineage and many short side-branches that quickly ter-

minate; thus, at any one time, there is one principal genotype with relatively minor variation among multiple isolates. Samples of other viruses, such as HIV, produce trees with increasing diversity through time, with continuing divergence among the many branches. The widespread explanation is that the divergent trees are produced because there has “been little or no selection against any lineage,” whereas the single-lineage trees are “the result of herd immunity selection for the line that is most antigenically novel” (p. 4). But is this explanation sufficient? Why would immunoselection prevent influenza from diverging along different pathways instead of promoting such diversification? Is there really only one viable region of genotypic space at any time? Population bottlenecks and genetic recombination are among the possible (but not articulated) contributing explanations for the differences in the trees. Even if the recombination rate is relatively low in influenza (as is thought to be the case), it may be sufficiently high to maintain a cohesive lineage, given the global nature of influenza epidemics and opportunities for multiple infection. The amount of recombination realized through time is a function of both molecular and populational processes. In contrast to influenza, opportunities for recombination among divergent lineages in HIV are much less commonplace (although not unknown). The differences in transmission between HIV and influenza thus affect opportunities for recombination, which in turn would affect the shape of the phylogenetic trees. The old dogma that genetic recombination is rare or absent in RNA viruses (except for shuffling elements of segmented genomes) is probably responsible for the prevailing view that excludes a role for recombination in determining the viral tree shapes. The chapter on recombination and its evolutionary effect on viruses with RNA genomes by Michael Lai effectively dispels this myth, even though the implications of his message have not yet been fully assimilated.

Although (or perhaps because) the book reveals some large remaining gaps between virologists and evolutionary biologists, it is very productive reading material for anyone interested in viral evolution. Evolutionary biologists will find that viruses have much to offer on the molecular basis of evolutionary processes, the possibilities for in vivo and in vitro experimental evolutionary systems, and applications of evolutionary theory. At the same time, virologists will get a view of the power and potential of molecular systematics and see why evolutionary biology should be a required component of any molecular biology program. Perhaps this book will also help reverse the longstanding descriptive emphasis in molecular

biology and at the same time jar evolutionary biologists from their overwhelming focus on eukaryotes.

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## Also Noteworthy

**Marx, Deceased.** A Novel. CARL DJERASSI. University of Georgia Press, Athens, GA, 1996. xii, 219 pp. \$21.95.

Carl Djerassi of *Cantor's Dilemma* and *The Bourbaki Gambit* (see *Science* 246, 829 [1989] and 269, 109 [1995]) continues his novel-writing career, this time with characters whose claims to fame lie in the sphere of literature rather than science. But the author's first avocation pokes through from time to time: Not only is the prosciutto "microtome-cut," the protagonist has achieved acclaim as the author of a novel about a scientist and another character is developing a cookbook by means of retrosynthesis.

**Level 4.** Virus Hunters of the CDC. JOSEPH B. MCCORMICK and SUSAN FISHER-HOCH, with Leslie Alan Horvitz. Turner, Atlanta, GA, 1996. 379 pp. + plates. \$22.95 or C\$29.95.

Written by two epidemiologists affiliated with the Centers for Disease Control, this is an account of some 30 years of travels to Zaire, Senegal, South Africa, Brazil, Pakistan, China, and elsewhere to investigate outbreaks of disease caused by exceptionally deadly organisms ("level 4" refers to the highest mandated level of containment in the laboratory). Legionnaires' disease, Ebola, Lassa fever, and AIDS are among the diseases on which the authors have made field observations. The book is being promoted in connection with a TBS documentary featuring the first author.

**Feynman's Lost Lecture.** The Motion of Planets Around the Sun. DAVID L. GOODSTEIN and JUDITH R. GOODSTEIN. Norton, New York, 1996. 191 pp., illus., + CD, boxed. \$35 or C\$45.

The lecture in question is a proof of the law of ellipses, one of five lectures by Richard Feynman that were left out of the famed three-volume *Feynman Lectures on Physics* (1963–65). The text of the lecture (transcribed from a tape and also presented here as a compact disc) occupies 25 pages of the work. Preceding it are some historical back-

ground "from Copernicus to Newton," some reminiscences of Feynman, and David Goodstein's reconstruction of Feynman's proof with new illustrations to compensate for the lack of the unavailable originals.

**Cecilia Payne-Gaposchkin.** An Autobiography and Other Recollections. KATHERINE HARAMUNDANIS, Ed. Second edition. Cambridge University Press, New York, 1966. xxii, 227 pp., illus. £35; paper, \$19.95 or £32.95.

Payne-Gaposchkin (1900–1980) was an astronomer who in spite of the disadvantage of being a woman at Harvard in her era made important contributions to the understanding of stellar atmospheres. This biographical work is essentially a reprinting of the 1984 edition (reviewed in *Science* 224, 727 [1984]), which brought together Payne-Gaposchkin's "The Dyer's Hand" (70 pp.) and essays by the historian Peggy Kidwell and the astronomers Jesse L. Greenstein and Katherine Haramundanis, the latter the subject's daughter. For this edition the astronomer Virginia Trimble has provided a new introduction presenting some reflections on the life and personality of Payne-Gaposchkin, whom she knew, and on the careers of some other women astronomers; Trimble takes up some issues, such as the significance of personal appearance, that are often avoided in such examinations.

**Darwin's Black Box.** The Biochemical Challenge to Evolution. MICHAEL J. BEHE. Free Press, New York, 1996. xii, 307 pp., illus. \$25.

This book is an argument by a biochemist on the faculty of Lehigh University that evidence provided by "the fundamental science of life, modern biochemistry," supports the view that our world is the product of intelligent design. Writing in a sometimes folksy style ("After the youngster grows a bit and sets his mind to getting born, one thing he wants to do is produce B cells"), the author expounds some suborganismal biology and reviews some debates relevant to evolution, seeing in this material many challenges to Darwinism. On scientists' reluctance to embrace the conclusion he reaches, the author writes, "Scientific chauvinism is an understandable emotion, but it should not be allowed to affect serious intellectual issues."

Katherine Livingston

## Books Received

**Afterglow of Creation.** From the Fireball to the Discovery of Cosmic Ripples. Marcus Chown. University

Science, Sausalito, CA, 1996. xiv, 222 pp., illus. \$28.50.

**Biotechnology.** Proteins to PCR. A Course in Strategies and Lab Techniques. David W. Burden and Donald B. Whitney. Birkhäuser Boston, Cambridge, MA, 1995. xvi, 317 pp., illus. Spiralbound, \$39.50.

**Chemistry Imagined.** Reflections on Science. Roald Hoffmann and Vivian Torrence. Smithsonian Institution Press, Washington, DC, 1996. 168 pp., illus. Paper, \$19.95. Reprint, 1993 ed.

**Chickadees, Tits, Nuthatches, and Treecreepers.** Simon Harrap and David Quinn. Princeton University Press, Princeton, NJ, 1996. 464 pp., illus. \$49.50.

**The Crystal as a Supramolecular Entity.** Gautam R. Desiraju, Ed. Wiley, New York, 1996. xii, 314 pp., illus. \$125. Perspectives in Supramolecular Chemistry, vol. 2.

**Culture of Immortalized Cells.** R. Ian Freshney and Mary G. Freshney, Eds. Wiley-Liss, New York, 1996. xx, 389 pp., illus. Paper, \$52.95. Culture of Specialized Cells.

**Evolving the Mind.** On the Nature of Matter and the Origin of Consciousness. A. G. Cairns-Smith. Cambridge University Press, New York, 1996. viii, 329 pp., illus. \$24.95.

**The Exponential Distribution.** Theory, Methods and Applications. N. Balakrishnan and Asit P. Basu, Eds. Gordon and Breach, Langhorne, PA, 1996 (distributor, International Publishers Distributor, Brooklyn, NY). xxvi, 638 pp., illus. \$119.

**The Frontal Lobes and Voluntary Action.** Richard Passingham. Oxford University Press, New York, 1996. xxiv, 299 pp., illus. Paper, \$28. Oxford Psychology, no. 21.

**History of Science in the United States.** A Chronology and Research Guide. Clark A. Elliott. Garland, New York, 1996. x, 543 pp. \$83. Garland Reference Library of Social Science, vol. 1711.

**Humanity's Descent.** The Consequences of Ecological Instability. Rick Potts. Morrow, New York, 1996. vi, 325 pp., illus. \$25.

**Introduction to Crystallographic Statistics.** Uri Shmueli and George H. Weiss. International Union of Crystallography, and Oxford University Press, New York, 1995. x, 172 pp., illus. \$85. IUCr Monographs on Crystallography, 6.

**Knowing Machines.** Essays on Technical Change. Donald MacKenzie. MIT Press, Cambridge, MA, 1996. xii, 338 pp., illus. \$35. Inside Technology.

**The Lives to Come.** The Genetic Revolution and Human Possibilities. Philip Kitcher. Simon and Schuster, New York, 1996. 383 pp., illus. \$25.

**Mathematica in Theoretical Physics.** Selected Examples from Classical Mechanics to Fractals. Gerd Baumann. Springer-Verlag, New York, 1996. xii, 348 pp., illus., + diskette. \$59.

**Modern Astrodynamics.** Fundamentals and Perturbation Methods. Victor R. Bond and Mark C. Allman. Princeton University Press, Princeton, NJ, 1996. xii, 250 pp., illus. \$35 or £27.50.

**Physics and National Socialism.** An Anthology of Primary Sources. Klaus Hentschel, Ed. Ann M. Hentschel, translator. Birkhäuser Boston, Cambridge, MA, 1996. cii, 406 pp., illus., + supplementary material. \$139.50. Science Networks, vol. 18.

**Psychology of Pain.** Suzanne M. Skevington. Wiley, New York, 1996. xii, 348 pp., illus. \$46.95.

**Scientific Knowledge.** A Sociological Analysis. Barry Barnes, David Bloor, and John Henry. University of Chicago Press, Chicago, 1996. xiv, 230 pp., illus. \$38; paper, \$15.95.

**Social Aspects of Obesity.** Igor de Garine and Nancy J. Pollock, Eds. Gordon and Breach, Langhorne, PA, 1995 (distributor, International Publishers Distributor, Brooklyn, NY). xxiv, 314 pp., illus. \$50, paper, \$25. Culture and Ecology of Food and Nutrition, vol. 1.

**Structural Geology of Rocks and Regions.** George H. Davis and Stephen J. Reynolds. Wiley, New York, 1996. xiv, 776 pp., illus. \$81.95.

**Translational Control.** John W. B. Hershey, Michael B. Mathews, and Nahum Sonenberg, Eds. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1995. xiv, 794 pp., illus. \$95. Monograph 30.

**What's Happening in the Mathematical Sciences, 1995–1996.** Barry Cipra. Paul Zorn, Ed. American Mathematical Society, Providence, RI, 1995. vi, 111 pp., illus. Paper, \$12. Vol. 3.