

niches." Bush and Aho stress the many advantages helminths offer for community studies, among which is the existence of many replicas.

The book concentrates almost exclusively on endoparasitic helminths, and protozoans, microorganisms, and ectoparasites are not considered in any detail (except in the chapter by Price). Little is known of the community ecology of protozoans and microorganisms in contrast to the ectoparasites, many taxa of which are known to be much more host- and site-specific than most endoparasites. Hence community patterns different from those of endoparasites must be expected for them, and probably a greater importance of coevolution. Also, most studies discussed in the book are from northern cold-temperate environments, and latitudinal effects are little considered (again except in the chapter by Price). It is hoped that a volume (or volumes) dealing with ectoparasites and zoogeographical patterns will follow this one.

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The Problem of Time

The Physical Basis of the Direction of Time. H.-DIETER ZEH. Springer-Verlag, New York, 1989. viii, 166 pp., illus. Paper, \$35.

The arrow of time: what is the problem and how do you know if you've solved it? The problem most amenable to physical inquiry is the study of whether the various physical arrows imply one another. The physical arrows include the second law of thermodynamics, the expansion of the universe, CP violation, radiation reaction, and perhaps a quantum measurement arrow. For most of physics, knowing that you've solved a problem involves experiments and observations. This problem is seldom blessed with such criteria.

The most effort has been devoted to deriving the thermodynamic arrow from something else. Since the beginnings of statistical mechanics, the second law has been recognized as peculiar. For what other "law" of nature, after all, is there an entire discipline—fluctuation theory—devoted to its violation?

What then should imply the thermodynamic arrow? CP violation is so small an effect that one is hard put to see how it could dominate macroscopic physics. (Conceivably it could tip the balance in an unstable situation, just as P violation has been proposed to explain L-enantiomers.) The radiation

arrow is unlikely to have fundamental status, a viewpoint that seems reasonable in the light of time-symmetric radiation theories that acquire directionality through the (thermodynamically based) Wheeler-Feynman absorber theory.

This leaves "cosmological arrow" implies 'thermodynamical arrow' as the most plausible possibility. The trouble is that arguments for this thesis can be slippery. The most common mistake is the dogma of initial conditions, and the list of its errant adherents is a distinguished one. This dogma is the implicit and circular (when one is trying to derive the second law) assumption that initial conditions should be "arbitrary." Although this dogma was criticized two decades ago, you can still find it in works of some of our best thinkers. To his credit, Zeh is innocent of this sin, although he does miss the opportunity of exploring, in classical language, the interesting scenarios for a loosely time-symmetric universe, an opportunity that presents itself once the shackles of the initial condition dogma are removed.

What then is an argument for "cosmo implies thermo"? Dropping all fine points, I think what's happening is that the universe expands too fast for matter and radiation to relax. Matter has gotten caught in metastable states, like stars, whose entropy is far lower than that of a fully equilibrated state at, say, the current radius of the universe. Of the fine points I've dropped, the one I worry about is my implicit use of ensemble or coarse graining concepts in talking of our one-sample-point universe.

A strong point of Zeh's book is its treatment of many (but not all) of the significant topics needed for an informed, physical discussion of the arrow of time. A second strength is the presentation of a point of view founded on recent ideas of quantum gravity and the inclusion within this framework of globally time-symmetric scenarios.

There are several deficiencies. First there is a disregard of relevant physical data. For example, a well-known criticism of the absorber theory is that when one estimates the amount of matter needed to absorb—even if one accepts the theory of Wheeler and Feynman—there does not seem to be enough around. A similar shortage of matter also goes unmentioned in the treatment of Olber's paradox. Moreover, Zeh provides no discussion of whether the ideas he presents are experimentally testable. Wheeler has made a beautiful, if slightly overoptimistic, suggestion for measuring (by means of long-lived nuclides) the time left before the big crunch—if cosmo implies thermo. A physicist's book on the arrow of time should not ignore the potential for input from nature. Also lacking is serious old-fashioned

discussion of "cosmo implies thermo." This may be okay if you are a believer in Zeh's version of quantum gravity, but in a book purporting to do more than propound the author's own ideas I would have welcomed—in fact the reason for my undertaking to review this book was mainly the hope for—a critique of the simple-minded "cosmo implies thermo" argument that I gave above. I also found the style of the book offputting. I can't blame the author for sounding like Immanuel Kant, and at times being just as hard to follow; it's the source language, I suppose. But I do take exception to an often dogmatic presentation of what are after all rather speculative ideas and to his glib dismissal of some of the ideas of others.

Let me say, however, that the deficiencies do not outweigh the strong points, and I recommend this book to those willing to devote serious effort to learning part of the subject.

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Books Received

AAAS Report XIV. Research and Development FY 1990. Intersociety Working Group. American Association for the Advancement of Science Committee on Science, Engineering, and Public Policy, Washington, DC, 1990. xvi, 292 pp., illus. Paper, \$15.

Absorption and Utilization of Amino Acids. 3 vols. Mendel Friedman, Ed. CRC, Boca Raton, FL, 1989. Vol. 1, xii, 257 pp., illus., + plates. \$139.50. Vol. 2, xii, 301 pp., illus. \$149.95. Vol. 3, xii, 321 pp., illus. \$149.95.

Adaptation and Environment. Robert N. Brandon. Princeton University Press, Princeton, NJ, 1990. xii, 214 pp., illus. \$29.95.

Advanced Organic Chemistry. Part A: Structure and Mechanisms. Francis A. Carey and Richard J. Sundberg. 3rd ed. Plenum, New York, 1990. xxx, 802 pp., illus. \$62.50.

Creativity and Work. Elliott Jaques. International Universities Press, Madison, CT, 1990. xii, 433 pp., illus. \$47.50. Emotions and Behavior Monographs, no. 9.

The Crosslinguistic Study of Sentence Processing. Brian MacWhinney and Elizabeth Bates, Eds. Cambridge University Press, New York, 1990. xviii, 489 pp., illus. \$37.50.

Crystal Growth in Science and Technology. H. Arend and J. Hullinger. Fds. Plenum, New York, 1989. viii, 430 pp., illus. \$92.50. NATO Advanced Sciences Institute Series B, vol. 210. From an institute/course, Erice, Italy, Sept. 1987.

Culture, Control, and Commitment. A Study of Work Organization and Work Attitudes in the United States and Japan. James R. Lincoln and Arne L. Kalleberg. With the collaboration of Mitsuyo Hanada and Kerry McBride. Cambridge University Press, New York, 1990. xii, 291 pp. \$44.50.

Einstein's Relativity in Metaphor and Mathematics. Enders A. Robinson. Prentice Hall, Englewood Cliffs, NJ, 1990. xvi, 400 pp., illus. \$29.95.

Environmental Causes of Human Birth Defects. T. V. N. Persaud. Thomas, Springfield, IL, 1990. xii, 182 pp., illus. \$34.75.

Fortune or Failure. Missed Opportunities and Chance Discoveries. Alexander Kohn. Basil Blackwell, Cambridge, MA, 1989. x, 199 pp., illus. \$24.95.

Foundations of Astronomy. Michael A. Seeds. 4th ed. Wadsworth, Belmont, CA, 1990. xviii, 654 pp., illus. \$44.75.

Fundamentals of Mathematical Evolutionary Genetics. Yuri M. Svirzhev and Vladimir P. Passekov. Kluwer, Boston, 1990. xvi, 395 pp., illus. \$129. Mathematics and Its Applications (Soviet Series), vol. 22.

Genetic Data Analysis. Methods for Discrete Population Genetic Data. Bruce S. Weir. Sinauer, Sunderland, MA, 1990. xiv, 377 pp., illus. \$48; paper, \$27.

The Geology of Egypt. Rushdi Said, Ed. Published for the Egyptian General Petroleum Corporation, Conoco Hurgada, and Repsol Exploration, S. A. by Balkema, Brookfield, VT, 1990. x, 734 pp., illus. \$85.

Growth Factors. From Genes to Clinical Application. Vicki R. Sara, Kerstin Hall, and Hans Löw, Eds. Raven, New York, 1990. xviii, 265 pp., illus. \$110. Karolinska Institute Nobel Conference Series. From a conference, Stockholm, Sept. 1989.

Hadronic Mechanics and Nonpotential Interactions. M. Mijatovic, Ed. Nova New York, 1989. xiv, 317 pp., illus. \$89. From a workshop, Skopje, Yugoslavia, Aug. 1988.

Handbook of Biological Confocal Microscopy. James B. Pawley, Ed. 2nd ed. Plenum, New York, 1990. xiv, 232 pp., illus. \$49.50. Based on a workshop, San Antonio, TX, Aug. 1989.

Handbook of Semiconductor Silicon Technology. William C. O'Mara, Robert B. Herring, and Lee P. Hunt, Eds. Noyes, Park Ridge, NJ, 1990. xx, 795 pp., illus. \$96. Materials Science and Process Technology Series.

Health and Society in Revolutionary Russia. Susan Gross Solomon and John F. Hutchinson, Eds. Indiana University Press, Bloomington, 1990. xiv, 256 pp. \$27.50. Indiana-Michigan Series in Russian and East European Studies.

Immunology. A Foundation Text. Basiro Davey. Prentice Hall, Englewood Cliffs, NJ, 1990. 168 pp., illus., + plates. Paper, \$33.

Inner Natures. Brain, Self, and Personality. Laurence Miller. St. Martin's, New York, 1990. xii, 289 pp., illus. \$19.95.

The Long-Term Adequacy of World Timber Supply. Roger A. Sedjo and Kenneth S. Lyon. Resources for the Future, Washington, DC, 1990. xvi, 230 pp., illus. \$30.

Making Connections. The Relational Worlds of Adolescent Girls at Emma Willard School. Carol Gilligan, Nona P. Lyons, and Trudy J. Hammer, Eds. Harvard University Press, Cambridge, MA, 1990. xiv, 334 pp. \$25; paper, \$10.95.

The Making of the Civilized Mind. Seymour W. Itzkoff. Lang, New York, 1990. 310 pp. \$57.95.

Mathematical Theory of Stellar Eclipses. Zdeněk Kopal. Kluwer, Boston, 1990. vi, 162 pp., illus. \$63.

Molecular Biology of the Islets of Langerhans. Hiroshi Okamoto, Ed. Cambridge University Press, New York, 1990. x, 352 pp., illus. \$80.

Mountain Environments. An Examination of the Physical Geography of Mountains. John Gerrard. MIT Press, Cambridge, MA, 1990. viii, 317 pp., illus. \$25.

The New York Environment Book. Eric A. Goldstein and Mark A. Izeman. Island Press, Washington, DC, 1990. xx, 268 pp., illus. \$24.95; paper, \$14.95. Natural Resources Defense Council.

Nuclear and Atomic Physics at One Gigaflop. C. Bottcher, M. R. Strayer, and J. B. McGrory, Eds. Harwood, New York, 1989. xiv, 325 pp., illus. Paper, \$46. Nuclear Science Research Conference Series, vol. 16. From a conference, Oak Ridge, TN, April 1988.

Numerical Analysis. An Introduction. Lars Eldén and Linde Wittmeyer-Koch. Academic Press, San Diego, CA, 1990. x, 347 pp., illus. \$39.95.

Oil Age Eskimos. Joseph G. Jorgensen. University of California Press, Berkeley, 1990. xx, 402 pp., illus. \$40.

Oncogenes. Geoffrey M. Cooper, Jones and Bartlett, Boston, 1990. xii, 323 pp., illus. \$50. Jones and Bartlett Series in Biology.

An OPSS Primer. Introduction to Rule-Based Expert Systems. Porter D. Sherman and John C. Martin. Prentice Hall, Englewood Cliffs, NJ, 1990. xii, 194 pp., illus., + disk. \$48.

Orcas of the Gulf. A Natural History. Gerard Gormley. Sierra Club, San Francisco, 1990. xiv, 205 pp., illus. \$24.95; paper, \$10.95.

Out of the Everywhere. Isaac Asimov. Doubleday, New York, 1990. xvi, 240 pp. \$19.95.

Pedophilia. Biosocial Dimensions. Jay R. Feierman, Ed. Springer-Verlag, New York, 1990. x, 594 pp., illus. \$45.

Petroleum Basin Studies. P. M. Shannon and D. Naylor. Graham and Trotman (Kluwer), Boston, 1989. viii, 206 pp., illus. \$149.

Photobiology of Low-Power Laser Therapy. T. I. Karu. Harwood, New York, 1989. xii, 189 pp., illus. Paper, \$90. Laser Science and Technology, vol. 8.

Photoproduction of Pions on Nucleons and Nuclei. A. A. Komar, Ed. Nova Science, New York, 1989. x, 358 pp., illus. \$96. Proceedings of the Lebedev Physics Institute, vol. 186. Translated from the Russian edition (1988) by Al Peabody.

Refractive Nonlinearity of Wide-Band Semiconductors and Applications. A. A. Borshch, M. Brodin, and V. Volkov. Harwood, New York, 1990. xiv, 441 pp., illus. Paper, \$70. Laser Science and Technology. An International Handbook, vol. 9.

Regression Estimators. A Comparative Study. Marvin H. J. Gruber. Academic Press, San Diego, CA, 1990. xii, 348 pp. \$49.95. Statistical Modeling and Decision Science.

Relativistic Heavy-Ion Collisions. Rudolph C. Hwa, Chong-shou Gao, and Ming-han Ye, Eds. Gordon and Breach, New York, 1990. xvi, 316 pp., illus. Paper, \$90. China Center of Advanced Science and Technology (World Laboratory) Symposium/Workshop Proceedings, vol. 7. From a symposium/workshop, Beijing, People's Republic of China, June 1989.

The Self-Concept. European Perspectives on Its Development, Aspects, and Applications. Louis Oppenheimer, Ed. Springer-Verlag, New York, 1990. viii, 160 pp., illus. Paper, \$34. Recent Research in Psychology. Based on a workshop, Budapest, 1988.

Tomorrow's Doctors. The Path to Successful Practice in the 1990s. Benjamin H. Natelson. Insight (Plenum), New York, 1990. xiv, 288 pp., illus. \$19.95.

Tracers in the Ocean. H. Charnock *et al.*, Eds. Princeton University Press, Princeton, NJ, 1990. vi, 236 pp., illus. Paper, \$19.95. From a meeting, London, May 1987. Reprint, 1988 ed.

The Transformation of Corporate Control. Neil Fligstein. Harvard University Press, Cambridge, MA, 1990. xii, 391 pp. \$35.

Transition Metals in Total Synthesis. Peter J. Harrington. Wiley-Interscience, New York, 1990. xviii, 484 pp., illus. \$59.95.

Western Apache Language and Culture. Essays in Linguistic Anthropology. Keith H. Basso. University of Arizona Press, Tucson, 1990. xxii, 196 pp., illus. \$32.50.



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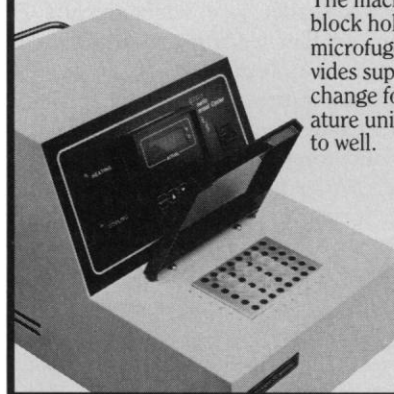
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