

times, cumbersome and limiting. These limitations notwithstanding, it is likely that this book will be widely read and enjoyed by chemists and nonchemists alike.

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## Evolutionary Trends

**The Evolution of Complexity by Means of Natural Selection.** JOHN TYLER BONNER. Princeton University Press, Princeton, NJ, 1988. xii, 260 pp., illus. \$40; paper, \$13.95.

Among the shadowy concepts intoxicating many an evolutionary thinker, perhaps the headiest is that of progress. From at least the Greeks on, there has been a tendency to array life's diversity, both past and present, in some directional pattern, as most famously canonized in the Great Chain of Being. Yet, though much eloquence and passion have been unleashed upon the subject, and simple-minded linear models have been rightly dispensed with, the existence of progress in biological evolution remains a matter of much debate.

In his latest book J. T. Bonner provides some fresh observations by approaching the problem from the perspective of developmental biology. After starting with a basic overview of Darwinian evolution, this ambitious little book ranges through such diverse topics as size increase in the fossil record, size and ecology, and even animal behavior. Though such breadth is thought-provoking, the combination of so many ideas with a sometimes freewheeling discourse left me longing for more coherence. This may not be so much a matter of Bonner's style, which is genteel and pleasantly chatty, as of the demands of trying to write a book geared to both peers and general readership on such a difficult and far-reaching topic. Gems of intellectual insight are there, in number, but they are often embedded in a matrix of description and basic information.

Most of the insight comes from Bonner's approaching "progress" by couching it in terms of complexity, avoiding much of the semantic confusion over definitions. Of course complexity itself can be a fuzzy concept, but Bonner is clear about what he means: increasing complexity is associated not only with increasing number of components but also with increasing number of kinds of components. This agrees with the current thinking on hierarchical systems in general, in which complexity is seen as measured in terms not only of number but of kinds of interactions. A massive interstellar

cloud has many interactions but is not very complex compared to an amoeba.

What emerges from this as the general theme of the book is that since the origin of life natural selection has increased the upper limit of complexity of individual organisms, as measured by kinds of cells (internal complexity), and of complexity of ecosystems, as measured by number and kinds of individuals (external complexity). The common nexus of both kinds of complexity is body size: with increasing body size, the number of cells and cell types per individual increases while the number of individuals and types of individuals decreases.

The main conclusions drawn from this are: (i) The increase in body size often seen in evolutionary time does not necessarily lead to greater net complexity at the resulting size. This is because, though internal complexity increases with size, there is a concurrent decrease in external complexity. (ii) The units of internal and external complexity are subject to counteracting selection for both isolation and integration.

These conclusions, and the themes behind them, struck me as hollow. Increasing body size demands increase in cell types owing to functional or constructional needs. Larger organisms are rarer and less diverse owing to ecological energetics. So what? The most intriguing connections, those between the hierarchical levels, are left untouched. Perhaps Bonner's approach is too reductionist (that is, cellular). A more holistic view is needed to capture emergent connections. Nevertheless, though Bonner's approach may falter in explaining the whys of complexity in evolution, this book is very good at explaining the hows of building complex organisms through both ontogenetic and evolutionary time. That, plus other snatches of insight, make it a worthwhile read for serious evolutionists. It would also be a good springboard for a lively upper-level course in evolution.

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## Books Received

**Acoustics of Solids.** A. I. Seltzer. Springer-Verlag, New York, 1988. xii, 235 pp., illus. \$59.

**Advances in Polyolefins.** The World's Most Widely Used Polymers. Raymond B. Seymour and Tai Cheng, Eds. Plenum, New York, 1987. xii, 568 pp., illus. \$95. From a symposium, Chicago, IL, Sept. 1985.

**Agricultural Research Systems and Management in the 21st Century.** K. V. Raman, M. M. Anwer, and R. B. Gaddagimath, Eds. NAARM Alumni Association, National Academy of Agricultural Research Management, Hyderabad, 1988. xii, 211 pp., illus. \$20. From a seminar, Hyderabad, India, Dec. 1987.

**Amino Acid Availability and Brain Function in Health and Disease.** Gerald Heuther, Ed. Springer-Verlag, New York, 1988. xviii, 487 pp., illus. \$141.50. NATO Advanced Science Institutes Series H, vol. 20. From a workshop, Göttingen, F.R.G., Sept. 1987.

**Antisense RNA and DNA.** Douglas A. Melton, Ed. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, 1988. xii, 149 pp., illus. Paper, \$20. Current Communications in Molecular Biology. From a conference, Cold Spring Harbor, NY, Dec. 1987.

**Applied Quantum Mechanics.** Richard K. Osborn. World Scientific, Teaneck, NJ, 1988. x, 184 pp., illus. \$42; paper, \$28.

**Applied Time Series Analysis for Business and Economic Forecasting.** Sufi M. Nazem. Dekker, New York, 1988. x, 431 pp., illus. \$89.75.

**The Autopsy.** Medical Practice and Public Policy. Rolla B. Hill and Robert E. Anderson. Butterworths, Stoneham, MA, 1988. xxvi, 294 pp., illus. \$39.95.

**Bacterial Energy Transduction.** Christopher Anthony, Ed. Academic Press, San Diego, CA, 1988. xvi, 517 pp., illus. \$98.

**Biotechnologically Derived Medical Agents.** The Scientific Basis of Their Regulation. John L. Gueriguian, Vittorio Fattorusso, and Duilio Poggolini, Eds. Raven, New York, 1988. xii, 195 pp., illus. \$45. From a conference, Paris, Sept. 1987.

**Bombay Lectures on Highest Weight Representations of Infinite Dimensional Lie Algebras.** V. G. Kac and A. K. Raina. World Scientific, Teaneck, NJ, 1987. xii, 145 pp. \$55; paper, \$28. Advanced Series in Mathematical Physics, vol. 2. Based on a lecture series, Bombay, India, Dec. 1985-Jan. 1986.

**Boundary Value Problems in Linear Viscoelasticity.** J. M. Golden and G. A. C. Graham. Springer-Verlag, New York, 1988. xiv, 266 pp., illus. \$72.50.

**Carbonate Rock Depositional Models.** A Microfacies Approach. Albert V. Carozzi, Prentice-Hall, Englewood, NJ, 1989. xx, 604 pp., illus. \$68.

**Causation, Chance, and Credence.** Vol. 1. Brian Skyrms and William L. Harper, Eds. Kluwer, Norwell, MA, 1988. xii, 284 pp., illus. \$69. University of Western Ontario Series in Philosophy of Science, vol. 41. From a conference, Irvine, CA, July 1985.

**Central D<sub>1</sub> Dopamine Receptors.** Menek Goldstein, Kjell Fuxe, and Irving Tabachnick, Eds. Plenum, New York, 1988. viii, 183 pp., illus. \$49.50. Advances in Experimental Medicine and Biology, vol. 235. From a symposium, New York, Dec. 1986.

**Cerebral Cortex.** Vol. 7, Development and Maturation of the Cerebral Cortex. Alan Peters and Edward G. Jones, Eds. Plenum, New York, 1988. xviii, 518 pp., illus. \$75.

**Chloride Channels and Their Modulation by Neurotransmitters and Drugs.** Giovanni Biggio and E. Costa, Eds. Raven, New York, 1988. xvi, 384 pp., illus. \$85. Advances in Biochemical Psychopharmacology, vol. 45. From a conference, Villasimius, Italy, May 1987.

**Computer Simulation in Cell Radiobiology.** Andrej Yu. Yakovlev and Aleksandr V. Zorin. Springer-Verlag, New York, 1988. vi, 133 pp., illus. Paper, \$16.30. Lecture Notes in Biomathematics, vol. 74. Translated from the Russian.

**Contemporary Reviews in Neuropsychology.** Harry A. Whitaker, Ed. Springer-Verlag, New York, 1988. xiv, 172 pp. \$36. Springer Series in Neuropsychology.

**Contingencies of Value.** Alternative Perspectives for Critical Theory. Barbara Herrnstein Smith. Harvard University Press, Cambridge, MA, 1988. xii, 229 pp. \$22.50.

**Control of Breathing During Sleep and Anesthesia.** W. A. Karczewski et al., Eds. Plenum, New York, 1988. x, 246 pp., illus. \$59.50. From a symposium, Warsaw, Poland, Sept. 1987.

**The Control of Human Retrovirus Gene Expression.** B. Robert Franza, Jr., Bryan R. Cullen, and Flossie Wong-Staal, Eds. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, 1988. xviii, 324 pp., illus. \$55. From a conference, Cold Spring Harbor, NY.

**Control of Plant Diseases.** Costs and Benefits. B. C. Clifford and E. Lester. Blackwell Scientific, Palo Alto, CA, 1988. xiv, 263 pp., illus. \$111.25. From a meeting, Manchester, U.K., Dec. 1984.

**Craniofacial Development.** Peter Thorogood and Cheryl Tickle. The Company of Biologists, Cambridge, U.K., 1988 (distributor, Biochemical Society Book Depot, Colchester, U.K.). iv, 257 pp., illus., + plates. \$75. Development, vol. 103 supplement. From a meeting, Bath, U.K., Sept. 1987.

**Creation.** The Story of the Origin and Evolution of the Universe. Barry Parker. Plenum, New York, 1988. xiv, 297 pp., illus. \$22.95.