back to jawless fishes. Further, current research compellingly shows that the basal ganglia are involved in the initiation and control of voluntary movement, as evidenced notably by the movement disturbances in such diseases involving the human basal ganglia as Parkinson's disease and Huntington's disease. The basal ganglia may be involved in non-motor functions as well (no one denies this possibility), but I know of no one other than MacLean who now believes them to be the neural seat for the control of species-typical types of behaviors.

With respect to the limbic system, the evolutionary story MacLean tells is again wrong. The limbic system did not, for example, appear first in early mammals. Reptiles, birds, mammals, and amphibians all possess a septum, an amygdala, and a hippocampal complex (though the hippocampal complex in non-mammals looks very different from that in mammals). Further, reptiles, birds, mammals, and amphibians may all possess a cingulate cortex. The evidence is currently not decisive on this point, but MacLean's version of the story (namely that only mammals possess cingulate cortex) is not nearly as well substantiated as he makes it out to be. As to the functions of the limbic system, the evidence refutes MacLean's ideas that the amygdala is only involved in feeding, the septum in reproduction, and the hippocampus in the correlation of interoceptive and exteroceptive information. MacLean assigns to the cingulate cortex the functions of parental behavior, which he regards as uniquely mammalian. This ignores the fact that some reptiles, such as crocodiles, and all birds engage in parental behavior, not to mention the possibility suggested by paleontological data that some extinct reptiles, namely dinosaurs, also engaged in parental behavior.

Finally, MacLean is also not quite right in saying that neocortex first appeared with modern mammals. Evidence based on study of primitive mammals clearly suggests that neocortex was present in the earliest mammals. Further, even in non-mammals such as birds, reptiles, and bony and cartilaginous fishes there are parts of the cerebral hemispheres that are not part of the basal ganglia and are involved in such typically neocortical functions as perception, decision-making, learning, tool use, and concept formation (particularly in birds). In non-mammals, these cerebral areas do not have the same architecture as neocortex, which accounts for why they were not recognized for what they were until recently.

Apart from the problems with the triune-brain idea itself, what can be said about this book as such? In short, the ideas and data in it are outdated; only a handful of papers from the '80s are cited. Further, the book is not entirely about the triune-brain idea. To be sure, that is the main story, but MacLean takes the opportunity to present his thoughts, conclusions, and speculations about a variety of topics related to human behavior. Consequently, we get his ideas about the evolution and neural basis of such things as conscience (it's in the prefrontal lobes), crying and laughter (he is not really sure, but he thinks it's limbic), and mathematical skill (he thinks the cerebellum could be involved). In many of his comments, MacLean criticizes other scientists for not pursuing the appropriate research questions or humankind in general for its foolish ways. On one matter I found my feelings quite in register with his—the blight that was prefrontal lobotomy as a therapeutic procedure.

One could also say that the book, both in its general tone and through the allusions to and quotations from the classics and philosophical works, clearly reveals MacLean to be a scholarly man with great interests in philosophy and the welfare of mankind. Nonetheless, there are some telling shortcomings in his scholarship. For example, in his presentation on the evolution of the R-complex, MacLean makes a comment that should leave Stephen J. Gould, not to mention all other students of evolution, aghast. Claiming that the concept of homology is confused and not clearly defined, he discards it in favor of what he regards as a much less equivocal term, namely correspondence. This is a very critical misjudgment to make in a work on evolution. MacLean also errs in his apparent sweeping acceptance of Haeckel's idea that ontogeny recapitulates phylogeny.

On a final note, although I strongly believe the triune-brain idea to be wrong, it would be myopic to overlook the positive value in what MacLean has ultimately been after. MacLean has been interested in the neural and evolutionary underpinnings of human behavior. He has wanted to see what makes people tick because he wants answers to some of the most basic questions about people. What are we? Where do we come from? How does our animal heritage affect our behavior? Why do we do the things we do? Why can we not live together more harmoniously? Although the questions are diffucult to answer and in many senses religious and philosophical in nature, they are important questions that modern neuroscience research can shed light on, though perhaps not in as global and simple a way as MacLean has sought.

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Some Other Books of Interest

Ecological Concepts. The Contribution of Ecology to an Understanding of the Natural World. J. M. CHERRETT *et al.*, Eds. Blackwell Scientific, Boston, 1989. viii, 385 pp., illus. $92.95; paper, $43.95. British Ecological Society Symposium 29. From a symposium, London, April 1988.

Toward a More Exact Ecology. PETER J. GRUBB and JOHN B. WHITTAKER, Eds. Blackwell Scientific, Boston, 1990. x, 468 pp., illus. $92.95; paper, $43.95. British Ecological Society Symposium 30. From a symposium, Oxford, U.K., Sept. 1988.

When in 1963 the British Ecological Society celebrated its 50th anniversary with a symposium, the organizers identified five "main areas of development" in the field—conservation ecology, quaternary ecology, production ecology, experimental and autecological studies, and the concept of community. For a second, two-symposium jubilee 25 years later, those responsible for the events began with an attempt to identify, through a survey of members, 50 "key concepts." In the opening chapter of the first of the volumes resulting from the symposiums, Cherrett presents the results of the survey. In short, the top five concepts are "the ecosystem," "succession," "energy flow," "conservation of resources," and "competition"; "*r* and *K* selection" comes in no. 33; and "the 3/2 thinning law" and "the guild" bring up the rear.

The remainder of *Ecological Concepts* is given over to invited essays on some of the concepts. In what is described as "a collection of personal views" 13 authors, not all of them British, give some history of the use of the concepts, discuss studies bearing on them, and assess their status. Ecosystems and their energetics are addressed by Waring, food webs by Lawton, the niche by Schoener, diversity and stability by Walker, predator-prey and host-pathogen interactions by Hassell and Anderson, population regulation in animals by Sinclair, competition by Law and Watkinson, life-history strategies by Caswell, optimization by Krebs and Houston, and levels of organization by May.

The choice of theme for the second volume represents a recognition, according to the editors, of the development of ecology from a largely descriptive enterprise to one with theoretical underpinnings supported by experimental evidence. The volume opens with an essay by Grubb expounding the issues of prediction in ecology and "exactness" in various approaches. The remaining papers are arranged according to theme: physiological processes in free-living orga-

nisms (treated in terms of measurement techniques); control of population size (discussed with reference to insects, the grey partridge, and plants); evolutionary and behavioral ecology (the "data base" for comparative studies, experimental study of the costs of reproduction); interrelationships among organisms (forest tree species, insect herbivores and plants, butterflies and ants); ecology of ecosystems (oceans and soils); and applied ecology (topics here being forest decline in Central Europe, water pollution and ecosystem management in Britain, and "resource accounting"). In addition to having author and subject indexes, as does *Ecological Concepts,* the volume has a separate organism index.—**K. L.**

Books Received

The Art of Human-Computer Interface Design. Brenda Laurel, Ed. Addison-Wesley, Reading, MA, 1990. xvi, 523 pp., illus., + plates. Paper, $26.95.

Bluetongue Viruses. P. Roy and B. M. Gorman, Eds. Springer-Verlag, New York, 1990. x, 200 pp., illus. $86. Current Topics in Microbiology and Immunology, vol. 162.

Brain Organization and Memory. Cells, Systems, and Circuits. James L. McGaugh, Norman M. Weinberger, and Gary Lynch, Eds. Oxford University Press, New York, 1990. xviii, 409 pp., illus. $75. From a conference, Irvine, CA, Oct. 1987.

Chaotic Dynamics. An Introduction. Gregory L. Baker and Jerry P. Gollub. Cambridge University Press, New York, 1990. x, 182 pp., illus. $49.50; paper, $17.95.

The Chemical Industry in the USSR. An Economic Geography. Matthew J. Sagers and Theodore Shabad. Westview, Boulder, CO, 1990. xxvi, 590 pp., illus. $89.95. American Chemical Society Professional Reference Book.

Cholinesterase Genes. Multileveled Regulation. Hermona Soreq and Haim Zakut. Karger, New York, 1990. viii, 108 pp., illus. $65.50. Monographs in Human Genetics, vol. 13.

Color Atlas of Veterinary Histology. William J. Bacha, Jr. and Linda M. Wood. Lea and Febiger, Philadelphia, 1990. xii, 269 pp., illus. $37.50.

Common Diagnostic Tests. Use and Interpretation. Harold C. Sox, Jr., Ed. 2nd ed. American College of Physicians, Philadelphia, 1990. xvi, 441 pp., illus. Paper, $32; to ACP members, $29.

Historical Atlas of Crystallography. J. Lima-de-Faria *et al.*, Eds. Published for the International Union of Crystallography by Kluwer, Boston, 1990. x, 158 pp., illus. $36.

Inorganic Chemical Nomenclature. Principles and Practice. B. Peter Block, Warren H. Powell, and W. Conard Fernelius. American Chemical Society, Washington, DC, 1990. xiv, 210 pp., illus. $59.95; paper, $39.95. ACS Professional Reference Book.

Introduction to World Forestry. People and Their Trees. Jack Westoby. Basil Blackwell, Cambridge, MA, 1989. x, 228 pp., illus. Paper, $19.95.

Nutrition and Neurotransmitters. The Nutrient Bases of Behavior. Michael D. Chafetz. Prentice Hall, Englewood Cliffs, NJ, 1990. xxviii, 273 pp., illus. $49.

Oligomorphic Permutation Groups. Peter J. Cameron. Cambridge University Press, New York, 1990. viii, 160 pp., illus. Paper, $22.95. London Mathematical Society Lecture Note Series, 152. From a symposium, 1988.

One-Dimensional and Two-Dimensional NMR Spectra by Modern Pulse Techniques. Koji Nakanishi, Ed. Kodansha, Tokyo, and University Science, Mill Valley, CA, 1990. xii, 234 pp., illus. Paper, $38.50.

Optical Microscopy for Biology. Brian Herman and Ken Jacobson, Eds. Wiley-Liss, New York, 1990. xviii, 658 pp., illus., + plates. $95. From a conference, Chapel Hill, NC, June 1989.

Oxidations in Organic Chemistry. Miloš Hudlický. American Chemical Society, Washington, DC, 1990. xx, 433 pp., illus. Paper, $89.95. ACS Monograph 186.

Peatlands, Economy and Conservation. M. G. C. Schouten and M. J. Nooren, Eds. SPB Academic, The Hague, 1990. xiv, 106 pp., illus. Paper, $22. From a symposium, Baarn, The Netherlands, Oct. 1987.

Physical/Chemical Processes. Harry M. Freeman, Ed. Technomic, Lancaster, PA, 1990. viii, 242 pp., illus. Paper, $49. Innovative Hazardous Waste Treatment Technology Series, vol. 2.

Pocket Atlas of Normal CT Anatomy of the Head and Brain. Anton N. Hasso and Miyuki Shakudo. Raven, New York, 1990. x, 85 pp., illus. Paper, $14.95.

Polar Oceanography. Part A, Physical Science. Walker O. Smith, Jr., Eds. Academic Press, San Diego, CA, 1990. xviii, 406 pp., illus., + plates. $69.50.

Population and Disaster. John I. Clarke *et al.*, Eds. Published by Basil Blackwell in association with International Geographical Union Commission on Population Geography, Cambridge, MA, 1989. x, 292 pp., illus. $49.95. Institute of British Geographers Special Publications Series; 22.

Prospects for Faculty in the Arts and Sciences. A Study of Factors Affecting Demand and Supply, 1987 to 2012. William G. Bowen and Julie Ann Sosa. Princeton University Press, Princeton, NJ, 1989. xvi, 225 pp., illus. $24.

Reality Isn't What It Used to Be. Theatrical Politics, Ready-to-Wear Religion, Global Myths, Primitive Chic, and Other Wonders of the Postmodern World. Walter Truett Anderson. Harper and Row, San Francisco, CA, 1990. xvi, 288 pp. $18.95.

Recent Advances in Superconductivity. S. L. Kakani and C. Hemrajani. Today and Tomorrow, New Delhi, India, 1990. vi, 171 pp., illus. $50.

Reflection Groups and Coxeter Groups. James E. Humphreys. Cambridge University Press, New York, 1990. xii, 204 pp., illus. $39.50. Cambridge Studies in Advanced Mathematics 29.

Rehabilitating Criminal Sexual Psychopaths. Legislative Mandates, Clinical Quandaries. Nathaniel J. Pallone. Transaction, New Brunswick, NJ, 1990. vi, 162 pp. $24.95.

Relativity, Supersymmetry, and Strings. Arnold Rosenblum, Ed. Plenum, New York, 1990. viii, 128 pp., illus. $55. From a conference, Logan, Utah, Feb. 1986.

Rickettsiology. Current Issues and Perspectives. Karim E. Hechemy *et al.*, Eds. New York Academy of Sciences, New York, 1990. xiv, 586 pp., illus. Cloth or paper, $137. Annals of the New York Academy of Sciences, vol. 590. From a meeting, Diamond Point, NY Sept. 1989.

The Robert A. Welch Foundation Conference on Chemical Research. 33, Membrane Proteins: Targeting and Transductions (Houston, Oct. 1989). Welch Foundation, Houston, 1990. x, 317 pp., illus.

Safety, Environmental Impact, and Economic Prospects of Nuclear Fusion. Bruno Brunelli and Heinz Knoepfel, Eds. Plenum, New York, 1990. viii, 352 pp., illus. $79.50. Ettore Majorana International Science Series, vol. 48. From a seminar, Erice, Italy, Aug. 1989.

Sandstone Petroleum Reservoirs. John H. Barwis, John G. McPherson, and Joseph R. J. Studlick, Eds. Springer-Verlag, New York, 1990. xvi, 583 pp., illus. $89. Casebooks in Earth Sciences.

Secrets of the Soil. New Age Solutions for Restoring Our Planet. Peter Tompkins and Christopher Bird. Harper and Row, New York, 1990. xxvi, 444 pp., illus. Paper, $12.95. Reprint, 1989 edition.

Selected Lectures of Dr. M. R. Srinivasan. Published for Nuclear Power Corporation of India by the Department of Atomic Energy, Bombay, 1990. x, 342 pp., illus.

Selected Papers. S. Chandrasekhar. Vol. 5, Relativistic Astrophysics. University of Chicago Press, Chicago, 1990. xx, 588 pp., illus. $79.95; paper, $29.95.

Sensor in Bioprocess Control. John V. Twork and Alexander M. Yacynych, Eds. Dekker, New York, 1990. xii, 326 pp., illus. $115. Bioprocess Technology, vol. 6.

Sleep and Respiration. Faiq G. Issa, Paul M. Suratt, and John E. Remmers, Eds. Wiley-Liss, New York, 1990. xxii, 435 pp., illus. $99.95. Progress in Clinical and Biological Research, vol. 345. From a symposium, Banff, Canada, April 1989.

Soil Erosion in the Tropics. Principles and Management. Rattan Lal. McGraw-Hill, New York, 1990. x, 581 pp., illus. $89.95.

Space Places. Roger Ressmeyer. Collins, San Francisco, 1990. 207 pp., illus. $45.

Structure and Function of Nucleic Acids and Proteins. Felicia Y.-H. Wu and Cheng-Wen Wu, Eds. Raven, New York, 1990. xvi, 336 pp., illus. $85. From a symposium, Taipei, Taiwan, May 1989.

Sulfur Nutrition and Sulfur Assimilation in Higher Plants. Fundamental Environmental and Agricultural Aspects. H. Rennenberg *et al.*, Eds. SPB Academic, The Hague, 1990. xii, 276 pp., illus. $66. From a workshop, Bern, Switzerland, March 1989.

Synthetic Zeolites. S. P. Zhdanov, S. S. Khvoshchev, and N. N. Feoktistova. 2 vols. Vol. 1, Crystallization. xiv, 296 pp., illus. $195. Vol. 2, Adsorption Properties. xiv, 428 pp., illus. $260. $364 set. Gordon and Breach, New York, 1990. Translated from the Russian edition (Moscow, 1981) by N. F. Standen.

The Thermodynamics of Life and Experimental Physiology 1770–1880. Richard L. Kremer. Garland, New York, 1990. xii, 512 pp. $50. Harvard Dissertations in the History of Science.

Thoughtful Foragers. A Study of Prehistoric Decision Making. Steven G. Mithen. Cambridge University Press, New York, 1990. xii, 289 pp., illus. $59.50. New Studies in Archaeology.

Time Journeys. A Search for Cosmic Destiny and Meaning. Paul Halpern. McGraw-Hill, New York, 1990. xx, 153 pp. $19.95; paper, $11.95.

To Govern a Changing Society. Constitutionalism and the Challenge of New Technology. Robert S. Peck, Ed. Smithsonian Institution Press, Washington, DC 1990. x, 187 pp. Paper, $9.95.

Toward a Scientific Practice of Science Education. Marjorie Gardner *et al.*, Eds. Erlbaum, Hillsdale, NJ, 1990. xii, 357 pp., illus. $49.95. From a conference, 1988.

Transduction in Biological Systems. Cecilia Hidalgo *et al.*, Eds. Plenum, New York, 1990. xviii, 513 pp., illus. $110. Series of the Centro de Estudios Cientificos de Santiago. From a workshop, Montemar, Chile, May 1988.

Traumatic Brain Injury and Neuropsychological Impairment. Sensorimotor, Cognitive, Emotional, and Adaptive Problems of Children and Adults. Rolland S. Parker. Springer-Verlag, New York, 1990. xii, 452 pp., illus. $59.

The 21st Century in Space. George V. Butler, Ed. Published for the American Astronautical Society by Univelt, San Diego, CA, 1990. xii, 433 pp., illus. $90; paper, $75. Advances in the Astronautical Sciences, vol. 70. From a conference, St. Louis, MO, Oct. 1988.

Under the Microscope. A Hidden World Revealed. Jeremy Burgess, Michael Marten, and Rosemary Taylor. Cambridge University Press, New York, 1990. 208 pp., illus. Paper, $19.95.

Unified Physical Theory. R. R. Sharma. Cosmo, New Delhi, 1990. xii, 161 pp. Rs 165 (India). A Falcon Book.

Urban Ecology. Plants and Plant Communities in Urban Environments. H. Sukopp, S. Hejný, and I. Kowarik, Eds. SPB Academic, The Hague, 1990. viii, 281 pp., illus. Paper, $47. From a congress, July 1987.

The User's Directory of Computer Networks. Tracy L. LaQuey, Ed. Digital, Bedford, MA, 1990. xvi, 630 pp., illus. Paper, $34.95.

Vegetation and Flora of Temperate Zones. European Natural and Semi-Natural Vegetation and Spontaneous Flora. U. Bohn and R. Neuhäusl, Eds. SPB Academic, The Hague, 1990. viii, 83 pp., illus. Paper, $16. From a symposium, Berlin, F.R.G., July 1987.

The Water Encyclopedia. Frits van der Leeden, Fred L. Troise, and David Keith Todd. 2nd ed. Lewis, Chelsea, MI, 1990. xiv, 808 pp., illus. $125. Geraghty and Miller Ground-Water Series.

Where the Truth Lies. Franz Moewus and the Origins of Molecular Biology. Jan Sapp. Cambridge University Press, New York, 1990. x, 340 pp., illus. $59.50; paper, $18.95.

Wilderness Preservation and the Sagebrush Rebellions. William L. Graf. Rowman and Littlefield, Savage, MD, 1990. xviii, 329 pp., illus. $38.50.

Wittgenstein's Lectures on the Foundations of Mathematics, Cambridge, 1939. From the Notes of R. G. Bosanquet *et al.*, Cora Diamond, Ed. University of Chicago Press, Chicago, 1990. 300 pp., illus. Paper, $12.95. Reprint, 1976 ed.

World Directory of Research Projects. UNESCO, Paris, 1989 (U.S. distributor, Unipub, Lanham, MD). xxvi, 480 pp. Paper, $23.

A World in Crisis? Geographical Perspectives. R. J. Johnston and P. J. Taylor, Eds. 2nd ed. Basil Blackwell, Cambridge, MA, 1989. x, 371 pp., illus. Paper, $17.95.

Writing Scientific Programs Under the OS/2 Presentation Manager. James W. Cooper. Wiley, New York, 1990. xxiv, 403 pp., illus. Paper, $39.95.

The Year in Immunology 1989–1990. Molecules and Cells of Immunity. Julius M. Cruse *et al.*, Eds. Karger, New York, 1990. vi, 284 pp., illus. $198. The Year in Immunology, vol. 6.