

book is a nice collection of the latest observations, calculations, and ideas on isolated pulsars.

Fred Seward
Harvard-Smithsonian Center for
Astrophysics,
Cambridge, MA 02138

Homeostatic Conditioning

Learning and Physiological Regulation. BARRY R. DWORKIN. University of Chicago Press, Chicago, 1993. xvi, 215 pp., illus. \$23.95 or £19.25. John D. and Catherine T. MacArthur Foundation Series on Mental Health and Development.

For a rat, a shot of alcohol is a chilling experience, but only at first. One cubic centimeter of ethanol dilates the rat's blood vessels, increasing thermal conductance between core and periphery, so that in a typical 23°C environment the animal rapidly loses body heat. However, after a few of these chilling experiences, anticipatory thermoregulatory mechanisms kick in when the shot of alcohol seems imminent, generating heat to offset the anticipated loss. Thus the animal's thermal response to alcohol shows what a pharmacologist would call tolerance. The drop in body temperature becomes less pronounced with each successive administration of alcohol.

Experiment shows that this tolerance is the result of classical conditioning to stimuli associated with the administration of alcohol. The experimenter first administers alcohol under one set of circumstances and saline solution under different conditions to the same animal and then switches substances. When alcohol is injected under circumstances initially associated with it there is no hypothermic response, indicating tolerance, but when alcohol is injected into the same animal under the circumstances associated with the saline solution, there is a full-blown hypothermic response. Moreover, when the saline solution is injected under circumstances associated with alcohol, there is a strong hyperthermic response. The rat that expects alcohol but gets the saline solution generates heat to offset an anticipated loss that does not materialize.

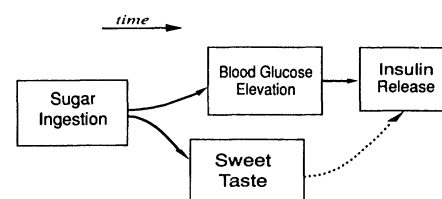
The anticipatory thermoregulatory response illustrates the thesis of Barry Dworkin in *Learning and Physiological Regulation*, in which he brings together two historically disparate experimental and theoretical traditions—the study of learning and the study of regulatory mechanisms. His

goal is to get students of learning to think about classical and instrumental conditioning in a regulatory context and to get students of regulatory mechanisms to appreciate the large role that learning plays in regulation. In the process, he gives a sympathetic review of the often ignored Russian work on the conditioning of interoceptive reflexes.

Dworkin brings into sharp focus a major unsolved problem in regulatory physiology: how the brain achieves accurate long-term regulation of the physiological state in the apparent absence of transducers capable of a prolonged steady-state response. Many physiological variables are held within narrow limits for most of an animal's lifetime. To hold constant such vital internal factors as blood pressure, body temperature, pH, carbon dioxide concentration, salinity, nutrient levels, and so on, the neuroendocrine system receives signals from specialized interoceptive sensors. Many such interoceptors have been identified and studied experimentally. Without fail—as Dworkin goes to some lengths to document—they have one serious shortcoming: they cannot signal drift (slow change). They adapt so rapidly that within a few seconds to, at most, a few minutes after a step change in the value of the sensed variable, the signal from the transducer is essentially zero. Imagine trying to design an effective heating and air-conditioning system when all available thermometers read zero regardless of the actual temperature, provided only that the actual temperature has remained steady for the last few minutes.

Dworkin thinks that instrumental conditioning mechanisms may offer a solution to the problem of how regulatory mechanisms cope with this serious shortcoming in transducer characteristics. The idea is that all the transducers need to do is signal "mistakes" in the patterns of efferent regulatory neural signals. Mistakes are efferent patterns that drive regulated variables outside the bounds of what local buffer-like, non-neural tissue reactions can manage. The mistake signals act the way punishers in instrumental conditioning do; they decrease the frequency of the kinds of outputs that generate them (according to the law of effect, as it applies to punishers). These ideas are developed only in schematic form in the final chapter of the book. It is hard to judge whether they offer serious prospects for resolving the paradox posed by adapting transducers in regulatory pathways.

In contrast, Dworkin devotes two earlier chapters to a more rigorous, mathematical development of the idea that classical conditioning endows regulatory systems with what amounts to anticipatory



"Conditioned insulin release. The act of eating candy is a common example of this paradigm. Candy contains sucrose, which tastes sweet and when digested and absorbed raises blood glucose, eventually releasing insulin. It goes first into the mouth and from there into the stomach; so the sensory stimulus of a sweet taste automatically precedes the physiological stimulus of elevated blood glucose. After consuming many pieces of candy, a sweet taste alone will release insulin." [From *Learning and Physiological Regulation*]

control. Anticipatory control is a much more sophisticated form of control than that provided by the simple servomechanisms taught in introductory courses in regulatory physiology. Anticipatory regulators extrapolate future challenges and take countermeasures before those challenges materialize. Yet Dworkin's development of this concept is awkward, relying on unconventional discrete time-bin mathematics and equally unconventional diagrams intended to illustrate his arguably more intuitive but certainly less mathematically felicitous approach to the problem of mathematically characterizing the behavior of mechanisms whose outputs and inputs are both continuous functions of time.

Serious students of regulatory physiology will want to read this book. Students of conditioning may also find it thought-provoking, despite what many will think a dated and simplistic treatment of classical and instrumental conditioning.

C. R. Gallistel
Department of Psychology,
University of California,
Los Angeles, CA 90024-1563

Books Received

Advanced Topics in Materials Science and Engineering. J. L. Morán-López and J. M. Sanchez, Eds. Plenum, New York, 1993. x, 356 pp., illus. \$95. From a symposium, Ixtapa, Guerrero, Mexico, Sept. 1991.

Advances in Economic Theory. Vol. 1. Jean-Jacques Laffont, Ed. Cambridge University Press, New York, 1993. x, 327 pp., illus. \$54.95. Econometric Society Monographs, no. 20. From symposia, Barcelona, Aug. 1990.

Aerosol-Cloud-Climate Interactions. Peter V. Hobbs, Ed. Academic, San Diego, CA, 1993. xii, 233 pp., illus. \$65. International Geophysics Series, vol. 54.

Agricultural Research in the Northeastern United States. Critical Review and Future Perspectives. J. T. Sims, Ed. American Society of Agronomy, Madison,

WI, 1993. viii, 139 pp., illus. Paper, \$22; to ASA members, \$18. From a symposium, Storrs, CT, June 1992.

The Best Defense. Policy Alternatives for U.S. Nuclear Security from the 1950s to the 1990s. David Goldfisher. Cornell University Press, Ithaca, NY, 1993. xiv, 283 pp. \$42.95. Cornell Studies in Security Affairs.

Biochemistry. Robert H. Abeles, Perry A. Frey, and William P. Jencks. Jones and Bartlett, Boston, 1992. xxii, 884 pp., illus. \$60. Jones and Bartlett Series in Biology.

Biotechnology in Agriculture. Chongbiao You, Zhangliang Chen, and Yong Ding, Eds. Kluwer, Norwell, MA, 1993. xiv, 519 pp., illus. \$192. Current Plant Science and Biotechnology in Agriculture, vol. 15. From a conference, Beijing, Aug. 1992.

Bioremediation of Industrial and Hazardous Waste. Morris A. Levin and Michael A. Gealt, Eds. McGraw-Hill, New York, 1993. xii, 331 pp., illus. \$60.

Brain Mechanisms of Perception and Memory. From Neuron to Behavior. Taketoshi Ono *et al.*, Eds. Oxford University Press, New York, 1993. xxii, 692 pp., illus. \$95. From a symposium, Toyama, Japan, Oct. 1991.

The Breathing Cathedral. Feeling Our Way into a Living Cosmos. Martha Heyneman. Sierra Club, San Francisco, 1993. xxx, 205 pp., illus. \$25.

Chaotic Dynamics and Transport in Fluids and Plasmas. I. Prigogine, Ed. American Institute of Physics, New York, 1993. xviii, 448 pp., illus. \$120. Research Trends in Physics. From a conference, La Jolla, CA, Feb. 1991.

Colorectal Cancer. A Scientific Perspective. Anne R. Kinsella with Philip F. Schofield. Cambridge University Press, New York, 1993. xiv, 159 pp., illus. \$79.95. Cambridge Monographs on Cancer Research.

Encyclopaedia of Food Science, Food Technology and Nutrition. R. Macrae, R. K. Robinson, and M. J. Sadler, Eds. Academic, San Diego, CA, 1993. 8 vols. cxx, 5365 pp., illus. \$2100.

Encyclopedia of Cosmology. Historical, Philosophical, and Scientific Foundations of Modern Cosmology. Norriss S. Hetherington, Ed. Garland, New

York, 1993. xvi, 686 pp., illus. \$125. Garland Reference Library of the Humanities, vol. 1250.

Entropy and the Magic Flute. Harold J. Morowitz. Oxford University Press, New York, 1993. xiv, 224 pp. \$22. Articles reprinted from *Hospital Practice*.

Equations of Eternity. Speculations on Consciousness, Meaning, and the Mathematical Rules that Orchestrate the Cosmos. David Darling. Hyperion, New York, 1993. xvi, 190 pp. \$19.95.

The Evening Star. Venus Observed. Henry S. F. Cooper, Jr. Farrar, Straus and Giroux, New York, 1993. xiv, 274 pp. \$22.

Evolution and Reason. Beyond Darwin. Dorothy Kurth Bobeg. Clarion Pacific, North Hollywood, CA, 1993. xviii, 618 pp., illus. \$48.

Friendship and Peer Relations in Children. Phil Erwin. Wiley, New York, 1993. xiv, 302 pp. \$65.

Frontiers in Cerebral Vascular Biology. Transport and Its Regulation. Lester R. Drewes and A. Lorris Betz, Eds. Plenum, New York, 1993. x, 295 pp., illus. \$79.50. Advances in Experimental Medicine and Biology, vol. 331. From a workshop, Duluth, MN, July 1992.

Fullerene C₆₀. History, Physics, Nanobiology, Nanotechnology. Djuro Koruga *et al.* North-Holland, New York, 1993. xvi, 381 pp., illus. \$114.25 or Dfl.200.

Genetic Nutrition. Designing a Diet Based on Your Family Medical History. Artemis P. Simopoulos, Victor Herbert, and Beverly Jacobson. Macmillan, New York, 1993. xvi, 335 pp., illus. \$22.

Geometry in Nature. Vagn Lundsgaard Hansen. Peters, Wellesley, MA, 1993. xiv, 238 pp., illus. \$29.95. Translated from the Danish by Tom Artin.

Gesture and Speech. André Leroi-Gourhan. MIT Press, Cambridge, MA, 1993. xxii, 431 pp., illus. \$39.95. An October Book. Translated from the French edition (Paris, 1964) by Anna Bostock Berger.

Grass Evolution and Domestication. G. P. Chapman, Ed. Cambridge University Press, New York, 1993. xviii, 390 pp., illus. \$99.95.

The Great Bear Almanac. Gary Brown. Lyons and Burford, New York, 1993. x, 325 pp., illus. \$30.

Handbook of Infrared Standards II. With Spectral Coverage of 1.4 μm -4 μm and 6.2 μm -7.7 μm . Guy

Guelachvili and K. Narahari Rao. Academic, San Diego, CA, 1993. x, 715 pp., illus. \$149.

Handbook of the Birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic. Vol. 7. Flycatchers to Shrikes. Stanley Cramp *et al.*, Eds. Oxford University Press, New York, 1993. vi, 577 pp., illus., + plates. \$130.

Handbook of Writing for the Mathematical Sciences. Nicholas J. Higham. Society for Industrial and Applied Mathematics, Philadelphia, 1993. xii, 241 pp., illus. Paper, \$21.50; to SIAM members, \$17.20; to SIAM student members, \$12.

Hannah's Heirs. The Quest for the Genetic Origins of Alzheimer's Disease. Daniel A. Pollen. Oxford University Press, New York, 1993. xvi, 296 pp., illus. \$25.

Health and Management of Free-Ranging Mammals. M. Artois, Coordinator. Office International des Epizooties, Paris, 1992/93. 2 vols. Vol. 1. 230 pp., illus. Paper, \$34 or F185. Vol. 2. 294 pp., illus. Paper, \$40 or F200. From a symposium, Nancy, France, Oct. 1991. Published as *Office International des Epizooties Revue Scientifique et Technique*, vol. 11, no. 4 (1992) and vol. 12, no. 1 (1993).

Imaging in Transport Processes. Samuel Sideman and Kunio Hijikata, Eds. Begell, New York, 1993. xxii, 621 pp., illus., + plates. \$135. From a seminar, Athens, May 1992.

In the Matter of J. Robert Oppenheimer. Politics, Rhetoric, and Self-Defense. Rachel L. Holloway. Praeger, Westport, CT, 1993. x, 123 pp., illus. \$42.95.

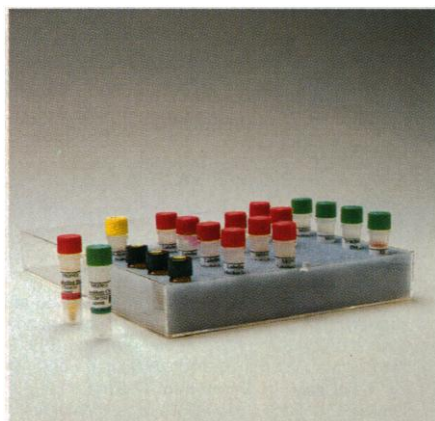
Insect Pollination of Crops. John B. Free. 2nd ed. Academic, San Diego, CA, 1993. xii, 684 pp., illus. \$85.

A Mathematical Introduction to Fluid Mechanics. Alexandre J. Chorin and Jerrold E. Marsden. 3rd ed. Springer-Verlag, New York, 1993. xii, 169 pp., illus. \$34. Texts in Applied Mathematics, 4.

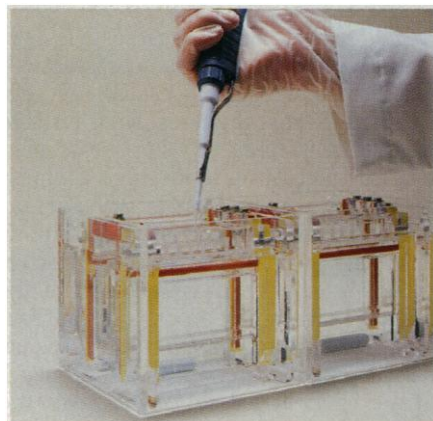
Mathematics for Computer Graphics. S. G. Hoggar. Cambridge University Press, New York, 1993. xviii, 472 pp., illus. \$39.95. Cambridge Tracts in Theoretical Computer Science, 14.

Mechanics of Composite Structures. Valery V. Vasiliev. Robert M. Jones, Ed. Taylor and Francis,

Carbohydrate Analysis



Step 1. Start with your purified glycoprotein or isolated oligosaccharide. Hydrolyze the glycoprotein or oligosaccharide into monosaccharides, or release N-linked oligosaccharides from the glycoprotein. Glycan releasing time is just two hours instead of overnight.



Step 2. Label the mixture of monosaccharides or oligosaccharides with a patented fluorescent tag. Three hours is all you need.



Step 3. Separate the labeled carbohydrates on a high-resolution polyacrylamide gel. Electrophoresis lasts just 60-120 minutes. You can run up to 32 samples at the same time—for high productivity and accurate, side-by-side comparisons. Setup is a snap. No fluid connections or messy wires. It's a gel rig anyone can run.

Philadelphia, 1993. xii, 506 pp., illus. \$99. Translated from the Russian edition (1988) by Lucia I. Man.

Medicare Now and in the Future. Marilyn Moon. Urban Institute Press, Washington, DC, 1993 (distributor, University Press of America, Lanham, MD). xvi, 263 pp., illus. \$57; paper, \$24.

Microevolutionary Patterns in Aboriginal Australia. A Gradient Analysis of Clines. Joseph B. Birdsell. Oxford University Press, New York, 1993. xviii, 469 pp., illus. \$125. Research Monographs on Human Population Biology, 9.

Model Theory. Wilfrid Hodges. Cambridge University Press, New York, 1993. xiv, 772 pp., illus. \$99.95. Encyclopedia of Mathematics and Its Applications, 42.

Modern Methods and Applications in Analysis of Explosives. Jehuda Yinon and Shmuel Zittrn. Wiley, New York, 1993. x, 305 pp., illus. \$125.

PCR. Clinical Diagnostics and Research. A. Rolfs et al. Springer-Verlag, New York, 1992. Variously pagged, illus. \$59. Springer Laboratory.

Phytochemical Potential of Tropical Plants. Kelsey R. Downum, John T. Romeo, and Helen A. Stafford, Eds. Plenum, New York, 1993. viii, 299 pp., illus. \$79.50. Recent Advances in Phytochemistry, vol. 27.

Poliovirus Attenuation. Molecular Mechanisms and Practical Aspects. F. Brown and B. P. Lewis, Eds. Karger, New York, 1993. viii, 187 pp., illus. Paper, \$144, DM216, or SwF180. Developments in Biological Standardization, vol. 78. From a workshop, Bethesda, MD, Dec. 1991.

Putting Health Care on the National Agenda. Arnold Birenbaum. Praeger, Westport, CT, 1993. xvi, 208 pp. \$49.95.

Reputation, Image and Impression Management. D. B. Bromley. Wiley, New York, 1993. xii, 300 pp., illus. \$69.95.

The Research Foundations of Graduate Education. Germany, Britain, France, United States, Japan. Burton R. Clark, Ed. University of California Press, Berkeley, 1993. xxii, 390 pp. \$45.

The Retroviridae. Vol. 2. Jay A. Levy, Ed. Plenum, New York, 1993. xiv, 443 pp., illus. \$89.50. Viruses.

Review of Progress in Quantitative Nondestructive Evaluation. Vols. 12A-B. Donald O. Thompson and Dale E. Chimenti, Eds. Plenum, New York, 1993. 2 vols. xxxvi, 2431 pp., illus. \$345. From a symposium, La Jolla, CA, July 1992.

Science Policy and Politics. Alexander J. Morin. Prentice Hall, Englewood Cliffs, NJ, 1993. xii, 195 pp., illus. Paper, \$23.60.

Scientific Discovery. Logic and Tinkering. Aharon Kantorovich. State University of New York Press, Albany, 1993. xii, 281 pp., illus. \$17.95. SUNY Series in Philosophy and Biology.

The Secret Forest. Charles Bowden. Jack W. Dykinga, photographer. University of New Mexico Press, Albuquerque, 1993. xii, 141 pp., illus. Paper, \$19.95.

The Skin Microflora and Microbial Skin Disease. W. C. Noble, Ed. Cambridge University Press, New York, 1993. xii, 390 pp., illus. \$100.

Tales of the Earth. Paroxysms and Perturbations of the Blue Planet. Charles Officer and Jake Page. Oxford University Press, New York, 1993. xiv, 226 pp., illus. \$24.

Things Maps Don't Tell Us. An Adventure into Map Interpretation. Armin K. Lobeck. University of Chicago Press, Chicago, 1993. xiv, 159 pp., illus. Paper, \$17.95. Reprint, 1956 ed.

Time Machines. Time Travel in Physics, Metaphysics, and Science Fiction. Paul J. Nahin. American Institute of Physics, New York, 1993. xviii, 408 pp., illus. \$45.

Tobacco Smoking and Nutrition. Influence of Nutrition on Tobacco-Associated Health Risks. John N. Diana and William A. Pryor, Eds. New York Academy of Sciences, New York, 1993. x, 366 pp., illus. Paper, \$90. Annals of the New York Academy of Sciences, vol. 686. From a conference, Lexington, KY, Sept. 1992.

Topics in Fluid Mechanics. Rene Chevray and Jean Mathieu. Cambridge University Press, New York, 1993. xvi, 320 pp., illus. \$125; paper, \$49.95.

Topology of Gauge Fields and Condensed Matter. Michael Monastyrsky. MIR, Moscow, and Plenum, New York, 1993. 372 pp., illus. \$95. Translated from

the Russian by Oleg Efimov.

Toxic Phytoplankton Blooms in the Sea. Theodore J. Smayda and Yuzuru Shimizu, Eds. Elsevier, New York, 1993. xxiv, 952 pp., illus. \$214.25 or Dfl.375. Developments in Marine Biology, 3. From a conference, Newport, RI, Oct. 1991.

Treatise on Analysis. Vol. 8. J. Dieudonné. Academic, San Diego, CA, 1993. xii, 356 pp. \$110. Pure and Applied Mathematics, vol. 10. Translated from the French edition (Paris, 1978) by Laura Fainsilber.

Tropical Deforestation. Small Farmers and Land Clearing in the Ecuadorian Amazon. Thomas K. Rudel with Bruce Horowitz. Columbia University Press, New York, 1993. xviii, 234 pp., illus. \$50; paper, \$24. Methods and Cases in Conservation Science.

Unbounding the Future. The Nanotechnology Revolution. K. Eric Drexler and Chris Peterson with Gayle Pergamit. Quill (William Morrow), New York, 1993. 304 pp., illus. Paper, \$12. Reprint, 1991 ed.

Understanding Biotechnology Law. Protection, Licensing, and Intellectual Property Policies. Gale R. Peterson, Ed. Dekker, New York, 1993. x, 482 pp. \$135.

Understanding Language Acquisition. The Framework of Learning. Christina E. Erneling. State University of New York Press, Albany, 1993. xiv, 256 pp. \$14.95.

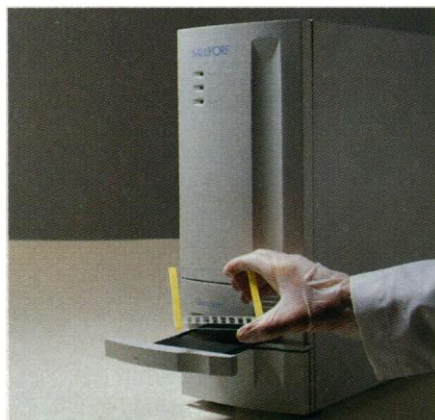
Who Is Who at the Earth Summit. (Rio de Janeiro, 1992.) Terra Christa Communications, Tucson, AZ, and VisionLink Education Foundation, South Burlington, VT, 1992. 481 pp., illus. Paper, \$30.

Who Is Who in Service to the Earth. People, Projects, Organizations, Key Words. Hans J. Keller, Ed. 2nd ed. VisionLink Education Foundation, South Burlington, VT, 1993. iv, 361 pp., illus. Paper, \$30.

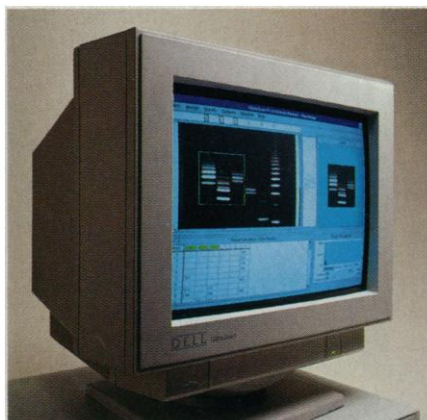
Wind Power for Home and Business. Renewable Energy for the 1990s and Beyond. Paul Gipe. Real Goods Trading, Ukiah, CA, and Chelsea Green, Post Mills, VT, 1993. xviii, 413 pp., illus. Paper, \$35.

Wound Healing. Biochemical and Clinical Aspects. I. Kelman Cohen, Robert F. Diegelmann, and William J. Lindblad. Saunders, Philadelphia, 1992. xxvi, 630 pp., illus. \$125.

For The Do-It-Yourselfer.



Step 4. Take a picture of the band pattern. Simply slide the gel cassette into the imager.



Step 5. In less than one minute, a high-resolution image is displayed on the screen. Easy-to-use, Windows® driven software lets you quickly determine the number of bands and perform quantitative as well as qualitative analysis of your data.

Picture-perfect carbohydrate analysis—in five easy steps. That's Millipore's Glycoscan™ system. It's based on mini-gel electrophoresis and FACE™ chemistry, so procedures and data interpretation are conveniently familiar. Already have an electrophoresis setup? Get a quick idea of Glycoscan advantages with our startup kit which includes all chemistries, 5 gels, 5 buffers, and a free gel box. For the kit or details on the complete Glycoscan system, call 1-800-225-1380 in the U.S. In Europe, call (33) 1.30.12.70.00. And in Japan, call (81) (3) 3471-8191.

Circle No. 27 on Readers' Service Card

MILLIPORE