

William Beaumont chair, named after the farmer's son, at the University of Michigan, has written an account of the subject that anyone who is interested in its past—or its future—should read. The story is rooted in the first piece of good Yankee science and is told in a way that conveys the rhythm and the motivation of the work of the next century and a half.

This is not a chatty book. The history here is all science, loaded with information, well referenced, and written with a critical eye on the evolution of methods. The book is nonetheless warm and deeply human in its appreciation of the contributions of individual scientists.

To those acquainted with Davenport's own work it should come as no surprise that the account of the secretion of hydrochloric acid is his first, longest, and perhaps most interesting chapter. He moves quickly through the discovery that hydrochloric acid is the secretory product of the gastric mucosa, reminding us that no less a physiologist than Claude Bernard had concluded that lactic acid was responsible for gastric acidity, and lingers just long enough on studies in which indicator dyes were used to establish that the acid is formed in the canaliculi of parietal cells. He then leads us through the development of concepts and methods that determined the concentration of acid in gastric juice.

In this regard Davenport notes that "by 1975, few gastroenterologists were paying much attention to the concentration of acid in gastric juice." This is certainly the case today; in recent years the majority of patients referred to me by gastroenterologists for management of Zollinger-Ellison syndrome, a condition in which gastrin-secreting tumors cause colossal hypersecretion of hydrochloric acid, have been found to be unable to secrete any acid at all. At the same time the use of medications meant to neutralize or suppress gastric acid secretion has created a business yielding more than \$4 billion in drug profits each year. A bit more of a physiological approach, the measurement of acid secretory rates or just the determination of the pH of gastric juice, would save some patients costly treatments, tests, and even exploratory surgery.

Davenport describes other people's work with care and precision throughout the book, but when he turns to the mechanism of acid secretion the account warms up. In these passages the strong voice of a master sets out issues, methods, and conclusions without either self-importance or false modesty. In his first chapter he writes, for instance, "My demonstration in 1938–1939 that carbonic anhydrase is present in high concentration in parietal cells is important not because it permitted spec-

TABLE,

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*Showing the mean time of digestion of the different Articles of Diet, naturally, in the Stomach, and artificially, in Vials, on a bath.*

The proportion of gastric juice to aliment, in artificial digestion, was generally calculated at one ounce of the former to one drachm of the latter, the bath being kept as near as practicable at the natural temperature, 100° Fahrenheit, with frequent agitation.

Articles of Diet.	Mean time of chymification			
	In Stomach.		In Vials.	
	prep.	h. m.	prep.	h. m.
Rice, -	boiled	1 00		
Sago, -	do.	1 45	boiled	3 15
Tapioca, -	do.	2 00	do.	3 20
Barley, -	do.	2 00		
Milk, -	do.	2 00	do.	4 15
Do. -	raw	2 15	raw	4 45
Gelatine. -	boiled	2 30	boiled	4 45
Pig's feet, soused,	do.	1 00		
Tripe, do.	do.	1 00		
Brains, animal,	do.	1 45	do.	4 30
Venison, steak,	boiled	1 35		
Spinal marrow, animal,	boiled	2 40	do.	5 25
Turkey, domesticated,	roasted	2 30		
Do. do.	boiled	2 25		
Do. wild,	roasted	2 18		
Goose, do.	do.	2 30		
Pig, sucking, -	do.	2 30		
Liver, beef's, fresh,	boiled	2 00	cut fine	6 30
Lamb, fresh,	do.	2 30		
Chicken, full grown,	fricas'd	2 45		
Eggs, fresh,	h'rd bld	3 30	h'rd bld	8 00
Do. do.	soft bld	3 00	soft bld	6 30
Do. do.	fried	3 30		
Do. do.	roasted	2 15		
Do. do.	raw	2 00	raw	4 15
Do. whipped.	do.	1 30	whipped	4 00
Custard, -	baked	2 45	baked	6 30
Codfish, cured dry,	boiled	2 00	boiled	5 00

"Table from William Beaumont's *Experiments and Observations on the Gastric Juice and the Physiology of Digestion* (Plattsburg, NY, 1833). The table continues for two and a half more pages." [From *A History of Gastric Secretion and Digestion*]

ulation that hydration of carbon dioxide is the source of secreted hydrogen ions, but because it was the first fragment of evidence concerning the biochemical constitution of the cells." In tracing the course of his work with inhibitors of carbonic anhydrase activity he points out that some of his assumptions and arguments were "ludicrously wrong," always allowing us to see the line of the field developing. Wisely, he ushers the reader just beyond 1975 in mentioning crucial studies of the H<sup>+</sup> pump published by George Sachs in 1976 and 1978, introducing concepts that have dominated the field to the present.

Subsequent chapters cover in a similar style studies of pepsins and pepsinogens, mucus and cell renewal, reflex control of gastric secretion, histamine, chemical control of gastric secretion, the gastric mucosal barrier, blood flow and secretion, and digestion and absorption, beginning the account of each subject with the 19th century or earlier and ending with a summary of its status as of 1975.

Special attention is given in the book to the work of Charles Code of the Mayo Clinic and Foundation, to whom the book

is dedicated and whose retirement provides the cutoff date for the coverage. In a typical aside Davenport cites one of the many maxims Code was given to quoting from his teacher Frank Mann: "Dr. Mann used to say that no experiment is any good unless the dog is smiling and wagging its tail while you are doing it." The essence that distills is Davenport's own love of science.

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## Spectra at a Distance

**Spectroscopy of the Earth's Atmosphere and Interstellar Medium.** K. NARAHARI RAO and ALFONS WEBER, Eds. Academic Press, San Diego, CA, 1992. xii, 526 pp., illus. \$129.50.

The use of spectroscopy in remote sensing has a long history that reaches back to the discovery of the Fraunhofer lines in the solar spectrum. In the last few decades, however, there has been a great increase in interest in such uses, deriving in part from the onset of planetary exploration and the perceived need to understand our changing environment on a global basis. Instrumentation for this purpose has matured rapidly and has sometimes led laboratory spectroscopy, which provides baseline data against which to interpret those from the atmosphere. This book is a collection of six disparate chapters that deal with various elements of the remote sensing applications. The wavelengths used range from microwave to near-infrared, and the instrumental techniques differ greatly. This provides a natural division of the subject and hence of the book.

In the opening chapter Carli and Carlotti explain how microwave and millimeter-wave observations are made. In this frequency regime the measurements are made by observation of the thermal emission from the atmosphere. The authors go into some detail about the peculiarities of the spectroscopy of the atmosphere in this regime, the species observed, the technologies of observation, and the method of retrieval of the atmospheric physical and chemical parameters from the radiometrically calibrated observations. Since many of the analytical tools derived for the retrieval of atmospheric parameters from observations made in this spectral regime pertain to the mid-infrared as well, this is an excellent introduction to the technology of remote sensing more generally.

Brown *et al.* provide a brief historical overview and describe the methods and re-

sults of infrared absorption spectroscopy of the atmosphere. These kinds of observations are made most advantageously and sensitively by observing the sun tangentially through the atmosphere; in this way an absorption path of a few hundred kilometers can be achieved from a high-altitude platform such as a balloon or high-flying aircraft or spacecraft. This permits a most sensitive measurement of trace species. The measurements made by the high-resolution Fourier transform spectrometer ATMOS are taken to be exemplary of this type of observation. The authors present a well-thought-out discussion of a variety of methods used to determine the gas concentrations.

Smith *et al.* deal with the status of the molecular absorption database, which is almost universally required for any serious work in this field. For the serious atmospheric spectroscopist these tabulations provide indispensable knowledge of the state of the list and permit an estimate of the reliability of the simulations or whatever calculations are necessary for the design or analysis of experiments.

The next two chapters deal with esoteric aspects of atmospheric spectroscopy. Collisional line mixing affects the line-shape in narrow regions of the carbon dioxide spectrum and must be considered in the analysis of observations made there. The theory of this phenomenon is developed by Lévy *et al.*, and some laboratory and atmospheric applications are developed. Champion *et al.* discuss the spectra of spherical top molecules, of which is the greenhouse gas methane is an example. Being a spherical top molecule methane might be expected to have a vibration-rotation spectrum similar to that of a linear rotator, but with highly degenerate lines. The actuality is that the degeneracies are broken for spherical molecules and the resultant spectrum exhibits extreme complexity. Some of this complexity is revealed and explained in this chapter for both tetrahedral and octahedral molecules.

The final chapter makes fascinating reading but has little in common with the first ones. In it Winnewisser *et al.* describe the origins of the spectroscopy of interstellar molecules and the complexities of the observations and analyses, give an inventory of the molecules observed and some of the interesting places to look for them, and discuss the technologies for doing all that. Specific examples of 11 interstellar molecules are considered.

The book contains extensive references and is a good starting place for someone already somewhat familiar with molecular spectroscopy to learn about its use in remote sensing. With only the first three chapters dealing directly with general considerations regarding atmospheric spectra observations and analysis, and the remain-

ing three being specialized, the book does not, however, offer a rounded treatment of a common theme.

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## Books Received

**All About Arthritis.** Past, Present, Future. Derrick Brewerton. Harvard University Press, Cambridge, MA, 1992. x, 317 pp., illus. \$24.95.

**Anatomy of Love.** The Natural History of Monogamy, Adultery, and Divorce. Helen E. Fisher. Norton, New York, 1992. 431 pp. \$22.95.

**Animal Models of Drug Addiction.** Alan A. Boulton, Glen B. Baker, and Peter H. Wu, Eds. Humana, Totowa, NJ, 1992. xxii, 436 pp., illus. \$99.50. Neuromethods, 24.

**Anti-Evolution.** A Reader's Guide to Writings Before and After Darwin. Tom McIver. Johns Hopkins University Press, Baltimore, MD, 1992. xvi, 385 pp. Paper, \$15.95. Reprint, 1988 ed.

**Cholera.** Dhiman Barua and William B. Greenough III, Eds. Plenum Medical, New York, 1992. xx, 372 pp., illus. \$59.50. Current Topics in Infectious Disease.

**Coastal Bottom Boundary Layers and Sediment Transport.** Peter Nielsen. World Scientific, River Edge, NJ, 1992. xvi, 324 pp., illus. \$56; paper, \$28. Advanced Series on Ocean Engineering, vol. 4.

**Codes of Evolution.** The Synaptic Language Revealing the Secrets of Matter, Life, and Thought. Rush W. Dozier, Jr. Crown, New York, 1992. x, 294 pp., illus. \$20.

**Diffraction Effects in Semiclassical Scattering.** H. M. Nussenzweig. Cambridge University Press, New York, 1992. xiv, 238 pp., illus. \$59.95. Montroll Memorial Lecture Series in Mathematical Physics, 1.

**Drug Abuse Treatment.** Ronald R. Watson, Ed. Humana, Totowa, NJ, 1992. x, 206 pp., illus. \$59.50. Drug and Alcohol Abuse Reviews, vol. 4.

**Dynamic Biological Networks.** The Stomatogastric Nervous System. Ronald M. Harris-Warrick, Ed. MIT Press, Cambridge, MA, 1992. xx, 328 pp., illus. \$65. Computational Neuroscience.

**Encyclopedia of Microbiology.** Joshua Lederberg, Ed. Academic Press, San Diego, CA, 1992. 4 vols. Vol. 1, xiv, 648 pp., illus. Vol. 2, xvi, 646 pp., illus. Vol. 3, xvi, 642 pp., illus. Vol. 4, xiv, 582 pp., illus. The four, \$595.

**Energy and Environment.** The Policy Challenge. John Byrne and Daniel Rich, Eds. Transaction Publishers, New Brunswick, NJ, 1992. xvi, 306 pp., illus. Paper, \$21.95. Energy Policy Studies, vol. 6.

**Ethel Browning's Toxicity and Metabolism of Industrial Solvents.** Vol. 3, Alcohols and Esters. Ronald G. Thurman and Frederick C. Kauffman, Eds. 2nd ed. Elsevier, New York, 1992. xxxviii, 394 pp., illus. \$228.50.

**Freud's Dream.** A Complete Interdisciplinary Science of Mind. Patricia Kitcher. MIT Press, Cambridge, MA, 1992. x, 245 pp., illus. \$24.95.

**From Neuron to Brain.** A Cellular and Molecular Approach to the Function of the Nervous System. John G. Nicholls, A. Robert Martin, and Bruce G. Wallace. 3rd ed. Sinauer, Sunderland, MA, 1992. xxii, 807 pp., illus. \$47.50.

**From Personal Ads to Cloning Labs.** More Science Cartoons. Sidney Harris. Freeman, New York, 1992. Unpagged. Paper, \$10.95.

**In Search of a Better World.** Lectures and Essays from Thirty Years. Karl Popper. Routledge, Chapman and Hall, New York, 1992. x, 245 pp. \$27.50. Translated from the German edition (1984) by Laura J. Bennett.

**Incineration of Hazardous Waste.** Toxic Combustion By-Products. Wm. Randall Seeker and Catherine P. Koshland, Eds. Gordon and Breach, Philadelphia, 1992. viii, 459 pp., illus., + plate. \$60; to institu-

tions, \$120. From a congress, Los Angeles, Aug. 1989.

**Indian Rock Art of the Columbia Plateau.** James D. Keyser. Douglas and McIntyre, Toronto, and University of Washington Press, Seattle, 1992. 139 pp., illus. \$35; paper, \$17.50.

**The Mechanical Properties of Semiconductors.** Katherine T. Faber and Kevin J. Malloy, Eds. Academic Press, San Diego, CA, 1992. x, 375 pp., illus. \$99.50. Semiconductors and Semimetals, vol. 37.

**Medical and Nutritional Complications of Alcoholism.** Mechanisms and Management. Charles S. Lieber. Plenum, New York, 1992. xvi, 579 pp., illus. \$89.50.

**Mental Machinery.** The Origins and Consequences of Psychological Ideas. Part 1, 1600–1850. Graham Richards. Johns Hopkins University Press, Baltimore, MD, 1992. xii, 490 pp. \$49.95.

**Mycorrhizae in Sustainable Agriculture.** G. J. Bethlenfalvay and R. G. Linderman, Eds. Crop Science Society of America, Soil Science Society of America, and American Society of Agronomy, Madison, WI, 1992. xx, 124 pp., illus. Paper, \$18; to members, \$15. ASA Special Publication, no. 54. From a symposium, Denver, Oct. 1991.

**New Worlds, New Technologies, New Issues.** Stephen H. Cutcliffe *et al.*, Eds. Associated University Presses, London, and Lehigh University Press, Bethlehem, PA, 1992 (distributor, Associated University Presses, Cranbury, NJ). 233 pp., illus. \$36.50. Research in Technology Studies, vol. 6.

**Organic Matter.** Productivity, Accumulation, and Preservation in Recent and Ancient Sediments. Jean K. Whelan and John W. Farrington, Eds. Columbia University Press, New York, 1992. xvi, 533 pp., illus. \$75. From a symposium, Nov. 1988.

**The Ostrich Communal Nesting System.** Brian C. R. Bertram. Princeton University Press, Princeton, NJ, 1992. viii, 197 pp., illus. \$35. Monographs in Behavior and Ecology.

**Photochemical Vapor Deposition.** J. G. Eden. Wiley, New York, 1992. xiv, 193 pp., illus. \$54.95. Chemical Analysis, vol. 122.

**Physics at the Highest Energy and Luminosity.** To Understand the Origin of Mass. Antonino Zichichi, Ed. Plenum, New York, 1992. viii, 421 pp., illus. \$125. The Subnuclear Series, vol. 29. From a course, Erice, Italy, July 1991.

**Phytochemical Resources for Medicine and Agriculture.** Herbert N. Nigg and David Seigler, Eds. Plenum, New York, 1992. viii, 445 pp., illus. \$195. From a symposium, Miami Beach, Sept. 1989.

**Recognition and Alleviation of Pain and Distress in Laboratory Animals.** Institute of Laboratory Animal Resources. National Academy Press, Washington, DC, 1992. xviii, 137 pp., illus. \$29.95.

**Recombination of Atomic Ions.** W. G. Graham, Ed. Plenum, New York, 1992. x, 345 pp., illus. \$95. NATO Advanced Science Institutes Series B, vol. 296. From a workshop, Newcastle, Northern Ireland, Oct. 1991.

**The Release of Genetically Modified Microorganisms - REGEM 2.** Duncan E. S. Stewart-Tull and Max Sussman, Eds. Plenum, New York, 1992. xiv, 271 pp., illus. \$75. Federation of European Microbiological Societies Symposium, no. 63. From a symposium, Nottingham, U.K., Aug. 1991.

**Science with a Smile.** An Anthology. Robert L. Weber. Institute of Physics, Philadelphia, 1992 (distributor, American Institute of Physics, New York). xii, 439 pp., illus. \$39.

**Science with a Vengeance.** How the Military Created the US Space Sciences After World War II. David H. DeVorkin. Springer-Verlag, New York, 1992. xxii, 404 pp., illus. \$69.

**The Search for Bioactive Compounds from Microorganisms.** Satoshi Omura, Ed. Springer-Verlag, New York, 1992. xvi, 352 pp., illus. \$69. Brock/Springer Series in Contemporary Bioscience.

**Theories of Everything.** The Quest for Ultimate Explanation. John D. Barrow. Fawcett Columbine (Ballantine), New York, 1992. xvi, 302 pp., illus. Paper, \$12. Reprint, 1991 ed.

**Thrombin.** Structure and Function. Lawrence J. Berliner, Ed. Plenum, New York, 1992. xvi, 438 pp., illus. \$95.