other successful synthetics, also fulfilled these criteria. Synfuels fail on most of them. No process has stood out as uniquely promising. The federal government has been unwilling to push up the price of gasoline, and the cost of synfuels is not likely to fall dramatically. Nor do synfuels display advantages over natural fuels that would justify a higher price. Despite the 1973 shock, disruptions in the supply of petroleum have not been sufficiently frequent or severe, so far, to compel the oil majors to divert R&D heavily to synfuels.

A liquid fuels shortage is indeed likely in the next 40 years, but oil-from-coal technologies are not necessarily the best solution. The scale of the problem is too great for it to be overcome by production of synthetics. Most synthetic products succeed by transforming an abundant raw material into a higher priced commodity, as in the conversion of petroleum into synthetic rubber. The United States produces around 2 million tons of synthetic rubber a year. To replace just 15% of America's petroleum consumption, it would be necessary to produce that amount of synfuels each week. Furthermore, synfuels based on coal are inherently uneconomic. As petroleum reserves run dry, coal will escalate in price, since it will also be in demand as an alternative to oil for power generation, as a domestic fuel, and for chemical manufacture. Moreover, a significant number of synfuel plants would be required to make up the petroleum deficit, and they would be dusty and polluting. In the western United States there would also be problems of water supply. The current political problems surrounding nuclear power station construction indicate the difficulties that could be faced by synfuel producers. And even if all the technological, economic, and political problems were overcome, oil-from-coal technologies would only win America a breathing space of a hundred years or so given the size of economically recoverable U.S. coal reserves.

Effective solutions to the future liquid fuels crisis lie elsewhere. The federal government could do more to encourage the use of economical automobiles (and energy conservation generally) by raising fuel duties to levels found in other Western countries. All levels of government could adopt a long-term strategy of promoting public transportation at the expense of automobiles. There are alternative routes to liquid fuels. Carbon monoxide (from a variety of sources), and even carbon dioxide, can be reduced to methanol and higher-boiling products. Ethanol can be produced from renewable crops by fermentation and is already used for fuel in Brazil. Electricity is clearly the major energy source of the future, however produced, and more research into electric transportation would be a better use of federal funds than coal-based synfuels. DCL and other oil-from-coal technologies will ultimately fail, not because of a lack of commitment by the federal government but because they are a technological and economic dead-end.

PETER J. T. MORRIS
Faculty of the Arts,
Open University,
Milton Reynes MK7 6AA,
United Kingdom

Some Other Books of Interest

Modulation of Defined Vertebrate Neural Circuits. MICHAEL DAVIS, BARRY L. JACOBS, and RONALD I. SCHOENFELD, Eds. New York Academy of Sciences, New York, 1989. viii, 195 pp., illus. $49. Annals of the New York Academy of Sciences, vol. 563. From a conference, Elkridge, MD, Sept. 1988.

This collection of 13 papers is concerned with "defining anatomically, chemically, and physiologically, the neural circuits that directly mediate specific physiological processes and behaviors," a circuit being defined as "a complete neural system in which the afferent and efferent pathways and the nuclei subserving a specific function are characterized." The functions or processes on which experimental work is reported or summarized include motor pattern selection in the turtle (Stein); the escape response in goldfish (Faber *et al.*); spinal cord reflexes in cat and rat (Barnes *et al.*); jaw control in mammals (Jacobs *et al.*) and birds (Zeigler); the blank reflex in rabbits (Evinger *et al.*); auditory space mapping in owls (Takahashi); modulation of breathing in mammals (Feldman and Smith); lordosis in rodents (Pfaff); auditory-motor interactions involved in bird song (Williams); and startle reflex in rats (Davis). The volume also includes a brief general discussion of withdrawal from pain in mammals (Fields and Heinricher) and a discussion of electromechanical analogs of human reflexes (Littman *et al.*).—**K.L.**

Advances in Mutagenesis Research. Vol. 1. G. OBE, Ed. Springer-Verlag, New York, 1990. x, 217 pp., illus. $79.50.

The series *Advances in Mutagenesis Research* is intended to treat both basic and applied aspects of the subject—the molecular mechanisms leading to mutation and effects of mutagens introduced into the environment. In this first volume the opening paper, by H. Hayatsu, deals with "blue cotton," a form, discovered in 1983, bearing phthalocyanine pigment and useful in assaying mutagenicity in food. R. M. Speed next surveys the history of research on "meiosis in mammals and man." H. Nöthel, noting that mutations "are most often detrimental to their carriers [but] also represent the ultimate source of genetic variability," discusses mutagen-mutation equilibria in evolution with reference to *Drosophila*. R. Huber and M. Bauchinger discuss the occurrence of micronuclei (accessory nuclear bodies in the cytoplasm) in human lymphocytes in response to exposure to chemicals or ionizing radiation, and C. Kessler expounds the use of non-radioactively labeled probes (such as ELISA) for detecting DNA sequences. In the last two papers, C. A. Smith and I. Mellon review research on the organization of DNA repair systems in rodents and humans, and F. K. Ennever considers the use of genotoxicity tests in risk assessment, noting that the issue "appeared simpler 15 years ago, when carcinogenicity appeared to be a rare property of chemicals, and the paradigm that 'carcinogens are mutagens' . . . had few counterexamples." That English is not the native language of all the contributors is evident in some chapters. The volume includes a subject index.—**K.L.**

Books Received

The Analysis of Directional Time Series. Applications to Wind Speed and Direction. Jens Breckling. Springer-Verlag, New York, 1989. viii, 238 pp., illus. Paper, $23. Lecture Notes in Statistics, vol. 61.

Archäobotanik am Zürichsee. Ackerbau, Sammelwirtschaft und Umwelt von Neolithischen und Bronzezeitlichen Seeufersiedlungen im Raum Zürich. Stefanie Jacomet, Christoph Brombacher, and Martin Dick. Fussli, Zürich, 1989. 348 pp., illus. SwF 129. Berichte der Zürcher Denkmalpflege, vol. 7.

The Conquest of Water. The Advent of Health in the Industrial Age. Jean-Pierre Goubert. Princeton University Press, Princeton, NJ, 1989. vi, 300 pp., illus. $29.95. Translated from the French edition (Paris, 1986) by Andrew Wilson.

Deterrence and Juvenile Crime. Results from a National Policy Experiment. Anne L. Schneider. Springer-Verlag, New York, 1990. x, 127 pp., illus. $49. Research in Criminology.

Group Beliefs. A Conception for Analyzing Group Structure, Processes, and Behavior. Daniel Bar-Tal. Springer-Verlag, New York, 1990. x, 140 pp. $49.50. Springer Series in Social Psychology.

Handbook of Physiology. Section 6, The Gastrointestinal System. Vol. 3, Salivary, Gastric, Pancreatic, and Hepatobiliary Secretion. John G. Forte, Ed. 2nd ed. American Physiological Society, Bethesda, MD, 1989 (distributor, Oxford University Press, New York), x, 779 pp., illus. $195.

Inverse Schrödinger Scattering in Three Dimensions. R. G. Newton. Springer-Verlag, New York, 1989. x, 170 pp. $39.50. Texts and Monographs in Physics.

Maximum-Likelihood Deconvolution. A Journey into Model-Based Signal Processing. Jerry M. Mendel. Springer-Verlag, New York, 1990. xiv, 227 pp., illus. $45.

El Niño, La Niña, and the Southern Oscillation. S. George Philander, Academic Press, San Diego, CA, 1989. x, 293 pp., illus. $59.50. International Geophysics Series, vol. 46.

Noyaux et Particules. Modèles et Symétries. Luc Valentin. Hermann, Paris, 1989. x, 375 pp., illus. Paper, 196 F.

Principles of Magnetic Resonance. C. P. Slichter. 3rd ed. Springer-Verlag, New York, 1990. xii, 655 pp., illus. $49.50. Springer Series in Solid-State Sciences, vol. 1.