and methods of solving protein structure clearly distinguish this volume from a biochemistry textbook. The book also provides a good overview and references for graduate courses on structure and function of macromolecules, although it does not contain details of the chemistry or stereochemistry of interactions that might be desirable for such a graduate course. It should be a very important supplementary textbook, strongly recommended for any undergraduate, premedical, or postgraduate biochemistry course.

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Turbulence Theory

The Physics of Fluid Turbulence. W. D. McComb. Clarendon (Oxford University Press), New York, 1990. xxiv, 572 pp., illus. $150. Oxford Engineering Science Series, 25.

The Navier-Stokes equations are not linear, with the consequence that an equation for a given statistical moment contains the next higher moment. This "closure problem" has plagued turbulence theory since its beginning, with many suggestions made but none of them satisfactory. In 1959 Robert Kraichnan suggested borrowing from quantum field theory the renormalized perturbation methods (complete with Feynman diagrams) to close the turbulent moment hierarchy. He was followed by other pioneers (Wyld, Edwards, and Herring) and then by many more. These methods have been followed by simplified techniques (the test field model) and by the distantly related renormalization group method, also borrowed from quantum field theory.

With all these methods lumped together under a single heading, it is fair to say that they offer the only approach to turbulence that can be called a general dynamical theory (as opposed to a phenomenological one), although dynamical systems theory has recently made some progress. (Approaches like multifractals must still be regarded as statistical models.) It was thought for some time that renormalized perturbation methods were approximations that could lead to successive improvements, but it was finally realized that they were more in the nature of very sophisticated dynamical models. The approach has been conceptually very useful in understanding interactions of various wavenumbers and is actually capable of calculating a few things more or less from first principles. It has been useful in plasma physics. Nevertheless, it has not fulfilled its initial promise, primarily because, when it is applied to a shear flow at high Reynolds number, the computations are more costly than would be a direct or large-eddy numerical simulation. People are working on simplifications (such as the test field model) that would make the problem more tractable.

Approximately a third of this book is devoted to these renormalization techniques. The material is quite accessible, thorough, and complete. It is one of the few places to which a student could be referred for instruction in this subject, the others being D. C. Leslie's *Developments in the Theory of Turbulence* (Oxford University Press; paperback edition, 1989), which does not touch on renormalization group methods, and a few pages in M. Lesieur's excellent *Turbulence in Fluids* (Kluwer; 2nd edition, 1991).

McComb's great advantage over Leslie's older and rather monodisperse book is found in the other two-thirds of the volume. Here McComb gives a brief but fairly complete introduction to the semiempirical approach to turbulence and to the classical statistical approach, as well as a bit on measurement techniques, a bit on intermittency, a section on numerical simulation, a section on statistical-mechanical approaches, and a section each on coherent structures, the Lagrangian and Eulerian views of turbulent diffusion, and non-Newtonian fluid turbulence. In the sections on perturbation approaches, McComb is speaking from the heart, but on the other subjects, he is no more than an intelligent and well-informed reporter. Nevertheless, a student who actually reads this book will be moderately well informed also, which is all we can hope for. There is no question that this is a physicists' book that probably will be useful only to those who are not daunted by a great deal of formal manipulation.

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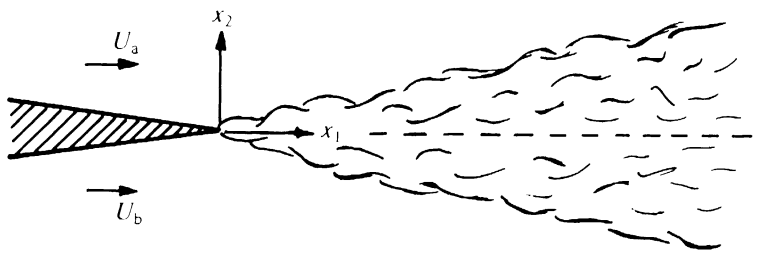

"Definition sketch of a plane mixing layer between two parallel streams with different velocities U_a and U_b." [From *The Physics of Fluid Turbulence*]

Biogeochemical Cycles

Biogeochemistry. An Analysis of Global Change. WILLIAM H. SCHLESINGER. Academic Press, San Diego, CA, 1991. xii, 443 pp., illus. Paper, $39.95.

Biogeochemistry deals with the interaction between life and its chemical environment. Biogeochemical cycles, with which this book is principally concerned, describe the processes that control the composition of the environment, atmosphere, and natural waters and the processes by which the composition can change. The term "cycles" refers to the fact that much of the movement of matter is cyclical; photosynthesis, for example, transfers carbon from the atmosphere to the biota while decay transfers the carbon from the biota back to the atmosphere at an essentially equal rate. Carbon therefore cycles between atmosphere and biota. The methodology for the study of the biogeochemical aspects of global change is based largely on considerations of conservation of matter. The global environment is divided into a number of reservoirs appropriate to the problem at hand. These reservoirs might be ocean, atmosphere, and global biota, for example. The amounts of the element of interest in each of the reservoirs are established by observation, along with the rates at which material is transferred between reservoirs. Then, at least in principle, the evolution of the system can be calculated by saying that the amount of material in each reservoir changes with time at a rate equal to the difference between the rates at which material is added to the reservoir (the sources) and the rates at which material is removed from the reservoir (the sinks). This approach to the study of biogeochemical cycles is well developed in this book, with chapters devoted to the global cycles of water, carbon, nitrogen and phosphorus, and sulfur. In addition, the book sets the stage for the consideration of these global cycles with chapters on the atmosphere, lithosphere, terrestrial biosphere, biogeochemical cycling on land, in freshwater wetlands and lakes, in rivers and estuaries, and in the sea. The treatment is comprehensive and detailed. The book contains a wealth of useful information in the form of tables, diagrams, and text. There are approx-

imately 2000 references, including work published in 1990. The index is complete and the language is easy to read and to understand.

There is, however, an important element of biogeochemical cycles that receives no mention. In order to understand global change, to interpret change that has already been observed, or to predict change that may occur in the future, we need to know not only how much matter is in the reservoirs and how fast matter is transferred between reservoirs at present but also how the rates of transfer of matter between reservoirs depend on the state of the system. We need to know, for example, how the global rate of photosynthesis varies with the partial pressure of carbon dioxide in the atmosphere and how the global rate of decay of biomass depends on temperature and other climatic and biotic variables. Such information is not easy to come by, of course. In principle, the size of a global reservoir can be established to any degree of precision by enough measurements of concentration or amount at enough locations around the globe. Somewhat more difficult to measure are rates of exchange of material between reservoirs, but in principle, again with enough observations, global rates of exchange could be established to any necessary degree of precision. But we cannot establish global rate laws simply by making measurements on the global system. We cannot, for example, vary the concentration of carbon dioxide in the atmosphere and see how the global rate of photosynthesis varies while all other parameters of the system are held constant. Controlled global experiments simply are not possible. Rate laws must be guessed, or deduced from observations of global change, or extrapolated from local measurements. So global rate laws are poorly known and hard to know. But without knowledge of the global rate laws we cannot claim to understand how the Earth system works or to predict reliably future global change.

Because this book fails even to mention the problem of rate laws, let alone to explore their possible forms, it cannot, in my opinion, really claim to be "an analysis of global change." Nevertheless it is a very useful compendium of much of the information we will need as we strive toward an understanding of the workings of the biogeochemical system. Do not take a spin on a biogeochemical cycle without first reading Schlesinger's description of the components of that cycle.

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Some Other Books of Interest

Global Catastrophes in Earth History. An Interdisciplinary Conference on Impacts, Volcanism, and Mass Mortality [Snowbird, UT, Oct. 1988]. VIRGIL L. SHARPTON and PETER D. WARD, Eds. Geological Society of America, Boulder, CO, 1991. x, 631 pp., illus. Paper, $72.50. GSA Special Paper 247.

The 1988 conference known as "Snowbird II" was a sequel to a conference held in 1981 at the same Utah ski resort devoted to the attention-getting subject of mass extinctions. Snowbird II was reported on in some detail in *Science* (**242**, 1380–82 [1988]) shortly after it was held. Now formal proceedings are available in this Geological Society of America Special Paper. The volume consists of 58 peer-reviewed papers chosen, the editors report, from 75 submissions. The papers are grouped under six headings: Patterns of Mass Mortality: Models, Overviews, and Hypotheses (11 papers, beginning with "The 'facts' of mass extinctions" by K. W. Flessa); Catastrophic Effects of Volcanism: Observations and Hypotheses (5 papers); Observations and Effects of Large-Scale Meteorite Impact (13 papers); The K/T Boundary: The Geologic Record (12 papers); The K/T Boundary: The Biological Record (13 papers); and Other Phanerozoic Extinctions (4 papers). A 15-page subject index has been added. The volume is dedicated to the late Luis Alvarez.—**K.L.**

Genetic and Physical Mapping. KAY E. DAVIES and SHIRLEY M. TILGHMAN, Eds. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1990. viii, 189 pp., illus. $35. Genome Analysis, vol. 1.

The new monograph series Genome Analysis, under the general editorship of Davies and Tilghman, is to consist of "short, single-theme books that review the data, methods, and ideas emerging from the study of genetic information in humans and other species" and that will serve as "an information source for junior and senior investigators." This first volume, *Genetic and Physical Mapping*, contains five papers: "A fluorescence in situ hybridization approach for gene mapping and the study of nuclear organization" by J. B. Lawrence; "Hybridization fingerprinting in genome mapping and sequencing" by H. Lehrach *et al.*; "Yeast artificial chromosomes: promises kept and pending" by P. Hieter *et al.*; "Germ line deletion mutations in the mouse: tools for intensive functional and physical mapping of regions of the mammalian genome" by E. M. Rinchik and L. B. Russell; and "Human DNA polymorphisms based on length variations in simple-sequence tandem repeats" by J. L. Webster. Most of the chapters open with, in lieu of abstracts in the ordinary sense, introductions that include sections with headings such as "This chapter discusses:" or "The main elements of our approach are:," and most make some reference to the Human Genome Project and its overall goals. Each has its own reference list, but a general subject index has been added. It is expected that a new volume in the series will appear "every four to six months." Projected future volumes will have as their themes chromosome structure and function, gene expression and its control, and genes and phenotypes.—**K.L.**

Books Received

Applicant of Conjugate Gradient Method of Electromagnetics and Signal Analysis. Tapan K. Sarkar, Ed. Elsevier, New York, 1991. xviii, 634 pp., illus. $82. Progress in Electromagnetic Research, 5.

Applied Child Study. A Developmental Approach. Anthony D. Pellegrini. 2nd ed. Erlbaum, Hillsdale, NJ, 1991. xiv, 242 pp., illus. $49.95; paper, $22.50.

Applied Isotope Hydrogeology. A Case Study in Northern Switzerland. F. J. Pearson *et al.* Elsevier, New York, 1991. xxiv, 437 pp., illus., + index, + plates. $177. Studies in Environmental Science, 43. Technical Report 88–01.

Applied Laser Spectroscopy. Wolfgang Demtröder and Massimo Inguscio, Eds. Plenum, New York, 1990. xii, 499 pp., illus. $115. NATO Advanced Science Institutes Series, vol. 241. From an advanced study institute, San Miniato, Italy, Sept. 1989.

Artificial Intelligence and Human Cognition. A Theoretical Intercomparison of Two Realms of Intellect. Morton Wagman, Praeger, New York, 1991. xiv, 153 pp., illus. $45.

Artificial Intelligence and International Politics. Valerie M. Hudson, Ed. Westview, Boulder, CO, 1991. viii, 422 pp., illus. $55.

Basic Issues of the History of Nutrition. K. Y. Guggenheim. Akademia University Press, Jerusalem, 1990. 130 pp. + plates. $22.

Behavior Disorders of Adolescence. Research, Intervention, and Policy in Clinical and School Settings. Robert J. McMahon and Ray DeV. Peters, Eds. Plenum, New York, 1990. xiv, 227 pp., illus. $65. From a conference, Banff, Canada, March 1988.

The Behaviour of Pinnipeds. Deane Renouf, Ed. Chapman and Hall, New York, 1991. xviii, 410 pp., illus. $175.

Beyond 40 Percent. Record-Setting Recycling and Composting Programs. Brenda Platt *et al.* Island Press, Washington, DC, 1991. xvi, 264 pp., illus. Paper, $25.

Coherent Detection at Millimeter Wavelengths and Their Applications. P. Encrenaz *et al.*, Ed. Nova Science, New York, 1991. xvi, 465 pp., illus. $85. Centre de Physique les Houches Series. From a workshop, Les Houches, France, March 1990.

Comprehensive Neurology. Roger N. Rosenberg, Ed. Raven, New York, 1991. xvi, 920 pp., illus. $220.

Computers in Endocrinology. Recent Advances. Vincenzo Guardabasso, David Rodbard, and G. Forti, Eds. Raven, New York, 1991. xvi, 207 pp., illus. $62.50. Serono Symposia Publications, vol. 72. From a course, Milan, Italy, May 1990.

Conceptual Basis for Calculations of Absorbed-Dose Distributions. Recommendations of the National Council on Radiation Protection and Measurements. National Council on Radiation Protection and Measurements, Bethesda, MD, 1991. viii, 234 pp., illus. Paper, $22. NCRP Report no. 108.

Conquering Mathematics. From Arithmetic to Calculus. Lloyd Motz and Jefferson Hane Weaver. Plenum, New York, 1991. xiv, 305 pp. $23.50.

The Epigenesis of Mind. Essays on Biology and Cognition. Susan Carey and Rochel Gelman, Eds. Erlbaum, Hillsdale, NJ, 1991. xii, 338 pp., illus. $49.95. Jean Piaget Symposium Series. From a symposium, 1988.