Electrophysiological Methods

Ion Channel Reconstitution. CHRISTOPHER MILLER, Ed. Plenum, New York, 1986. xxii, 577 pp., illus. $69.50.

Progress in understanding the biochemistry of channels—those integral membrane proteins that are responsible for the electrical excitability of the brain, heart, and other tissues—has been rather slow, largely because proteins of this type lose their "activity" (ion transport) when they are solubilized for purification. For soluble proteins such as enzymes, one can check at each step in the purification process that what is being sought is still there by assaying for catalytic activity. This strategy cannot be used in purification of integral membrane proteins, however, because these proteins "catalyze" ion flux across membranes, a property that is lost when the membranes are removed. To check that one has what one wants, the purified protein must be reconstituted in a membrane so that the ionic fluxes mediated by the channel can be measured, and the tricks for accomplishing this were not known until relatively recently. *Ion Channel Reconstitution* tells about the tricks: their background, how they are done, and what has been done with them.

The book is divided into four sections. The first presents background information such as the properties of artificial lipid bilayers, the physics of proteins in bilayers, and properties of a well-studied enzyme (superoxide dismutase) as a channel model. This section also gives the tricks needed to make reconstitution studies work: the ways of analyzing the current records that result from channels functioning in artificial lipid bilayers, and methods for actually making bilayers and for inserting purified channels into them so protein functions can be studied by recording electrical signals associated with ion movements through their pores.

The three remaining sections present applications of the reconstitution method. One section deals with the acetylcholine receptor channel, another with the sodium channel, and the last with everything else (several types of potassium and calcium channels, and channels from mitochondria and bacteria).

Although the book represents well what reconstitution of biochemically purified channels has accomplished, it does not treat an alternative "reconstitution" method, namely the currently popular technique of expressing channels in *Xenopus* oocyte membranes by mRNA injections. Perhaps this approach will, in a few years, be a subject for a third volume in the series starting with Sakmann and Neher's *Single-Channel Recording* and continuing with the present book.

The editor of *Ion Channel Reconstitution* did not contribute a chapter himself, but this does not mean he was without profound influence on the product. Miller has been a central figure in the reconstitution business, and a significant fraction of the chapters have as authors close colleagues, former students, or postdoctoral fellows of his. Thus Miller's taste for clear thinking and high-quality science makes itself evident in the product.

Although many of the chapters are models of clarity, this is a book for experts, not for beginners. If you need to know the nuts and bolts of reconstitution and wish to see what has been accomplished by the approach, this is the book for you.

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Lunar Origin

Origin of the Moon. W. K. HARTMANN, R. J. PHILLIPS, and G. J. TAYLOR, Eds. Lunar and Planetary Institute, Houston, TX, 1986. xvi, 781 pp., illus. $25. Based on a conference, Kona, HI, Oct. 1984.

The recent revival of interest in lunar origin is remarkable since it does not arise from an infusion of new data but mainly from an enthusiasm for some relatively new ideas that are still largely untested. Catastrophism is now in fashion: the origin theory currently favored by many involves a giant impact on Earth by a body of about the mass of Mars or more, with the moon forming from the resulting splash of molten and vaporized rock. The whole process may have taken only a hundred years and would have been fun to watch in real time.

This book is the outcome of a conference at which the giant impact idea became prominent. It is more than a conference proceedings, however. It is a thorough presentation of most of the important constraints, alternative theories, and current models by the active workers on lunar origin that will remain a valuable sourcebook even if the current ideas are shot down tomorrow. In structure and intent it is similar to the successful Space Science series of the University of Arizona Press. By this standard it is materially inferior (the paper quality is not as good) but scientifically excellent.

The book contains over 30 papers by about 50 contributors. A few of these are labeled review papers, but many authors write in review style even when describing their own work. The review by John Wood is particularly good and should be read by those who have a passing interest in lunar origin but lack the time or patience to assimilate the large amounts of detail that follow. The papers on geochemical and geophysical constraints on origin (about 350 pages) do not contain much new material, but they help to focus the issues, and it is useful to have all this material in one place. The latter part of the book, almost 300 pages on theories and processes of origin heavily weighted toward the giant impact hypothesis, will probably be of greatest interest to most readers. The material presented here is a substantial improvement on the models discussed during the conference and even includes some recent preliminary supercomputer simulations performed at Los Alamos and Sandia. Although likely to become out of date rapidly, this material will serve as a benchmark in the development of the field. One complaint I have about the book is that there is too much duplication of review material. Stronger editorial control could have led to a slimmer, more digestible book—but I would not wish this editorial task on anyone.

Does this volume allow one to reach a well-informed opinion about lunar origin and the current bandwagon of giant impacts? Despite my generally positive reaction, I have to equivocate on this. There are too few quantitative calculations on either the giant impact scenario or its most plausible alternative, coaccretion (formation of the moon from a long-lived circumterrestrial particulate disk). The crucial issues confronting the giant impact story are these: How do we get the right lunar composition (not much iron)? How do we get the right initial thermal structure? (A completely molten initial state is difficult to reconcile with the absence of contraction tectonics.) How many impacts contributed to the lunar-forming material? (Some people, especially A. G. W. Cameron of Harvard, favor the overwhelming domination of a singular event, but I suspect this hypothesis violates simple scaling arguments; smaller impacts should not be *much* less efficient in providing material. But how, then, does one guarantee the right amount of angular momentum?) What is the efficiency of orbital injection following impact? Some of these questions may be answered soon, but others are likely to resist easy resolution.

The book is about as good as it could be, but it is as much a testament of our ignorance as a statement of our knowledge. It is sobering to reflect that this state of affairs may persist indefinitely, in view of the currently slow (imperceptible?) pace of plane-

tary exploration. My suspicion is that although the moon is an oddball in some respects, we will eventually gain better insight by looking more carefully at other planets and their satellites. Meanwhile, I strongly recommend this book because it provides plenty of intellectual sustenance—but don't expect to find the answers in the back.

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Strings

Workshop on Unified String Theories. (Santa Barbara, CA, July 1985.) M. GREEN and D. GROSS, Eds. World Scientific, Singapore, 1986 (U.S. distributor, Taylor and Francis, Philadelphia). x, 745 pp., illus. $79; paper, $37.

In the wake of the 1984 renaissance of string theories numerous workshops, symposia, and conferences have been devoted to this exciting subject. This book contains the proceedings of a three-week workshop that took place in Santa Barbara in the summer of 1985. To judge by the table of contents the organizers, M. Green and D. Gross, set themselves the task of obtaining an overview of the full range of string theory both as practiced in the '70's and in the year preceding the workshop. To judge by the contents proper, they have succeeded handsomely.

At the outset important ideas and techniques from the '70's are described along with novel uses to which they can be put (C. Thorn, S. Mandelstam, L. Brink). These presentations should be useful to younger readers, who will thus be spared the effort of retrieving this material from the necessarily less focused original papers.

String theory has had a major impact in certain branches of mathematics, most notably on the theory of Kac-Moody algebras and the theory of sporadic groups. Conversely, major modern developments in topology, differential geometry, and Riemann surfaces find natural applications in string theory. Much of this remarkable physics–mathematics interplay is lucidly covered here (P. Goddard, D. Olive, I. Frenkel, J. Lepowsky, A. Meurman, O. Alvarez, E. Witten). These are presentations not readily paralleled elsewhere in the literature. Their inclusion gives this collection its most distinct flavor and may ensure its interest for a long time to come. Superstrings, the star attraction, are rendered excitingly by Green and Gross.

String theories are two-dimensional conformally invariant field theories. Recently developed general techniques for dealing with such theories are elegantly presented (D. Friedan, S. Shenker).

One of the crucial open questions of string theory asks for the underlying geometry. A lot of work has been devoted to this problem over the last year and a half; some of the earlier work is covered here (W. Siegel, B. Zwiebach, T. Banks, M. Peskin). Another subject on which much remains to be done is spontaneous space-compactification in superstring theory. This along with the related, and up to now notoriously unyielding, phenomenological problems is the subject of many contributions (G. Horowitz, A. Strominger, and others). Numerous interesting contributions on special topics are also included.

The book ends on a nine-page pun/which properly trimmed would be more fun.

This book is certainly not the last word on strings, nor was it intended to be. Much of the recent material is susceptible to fast obsolescence; this is a fast-moving field after all. Still, some of the presentations may be useful to string theorists for some time to come.

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Books Received

Ape Language. From Conditioned Response to Symbol. E. Sue Savage-Rumbaugh. Columbia University Press, New York, 1986. xxx, 433 pp., illus. $40. Animal Inteligence Series.

Applied Geochemistry in the 1980's. Iain Thornton and Richard J. Howarth, Eds. Halsted (Wiley), New York, 1986. xiv, 347 pp., illus. $54.95. From a meeting, London, April 1983.

The Art of Creative Thinking. Robert W. Olson. Perennial Library (Harper & Row), New York, 1986. xiv, 265 pp., illus. Paper, $5.95. Reprint, 1980 ed.

Artificial Intelligence. Principles and Applications. Masoud Yazdani, Ed. Chapman and Hall (Methuen), New York, 1986. xiv, 348 pp., illus. $49.95; paper, $22.

Astrometric Techniques. Heinrich K. Eichhorn, Robert J. Leacock, and Jeanne M. Kerrick, Eds. Published on behalf of the International Astronomical Union by Reidel, Dordrecht, 1986 (U.S. distributor, Kluwer, Norwell, MA). xxii, 838 pp., illus. $144; paper, $61.50. From a symposium, Gainesville, FL, Jan. 1984.

Biotechnology. Strategies for Life. Elizabeth Antebi and David Fishlock. MIT Press, Cambridge, MA, 1986. 239 pp., illus. $39.95. Translated from the French edition (Neuilly-sur-Seine, France, 1985).

Central Actions of Acth and Related Peptides. David de Wied and William Ferrari, Eds. Liviana Press, Padua, Italy, and Springer-Verlag, New York, 1986. viii, 240 pp., illus. $69. Fidia Research Series. Symposia in Neuroscience, vol. 4. From a conference, Villasimius, Italy, June 1985.

Evolutionary Processes and Theory. Samuel Karlin and Eviatar Nevo, Eds. Academic Press, Orlando, FL, 1986. x, 786 pp., illus. $62.50; paper, $34.50. Based on a workshop, Israel, March 1985.

The Experimental Manipulation of Ovule Tissue. G. P. Chapman, S. H. Mantell, and R. W. Daniels, Eds. Longman, New York, and Wiley, New York, 1986. xvi, 256 pp., illus. + plates. $84.95. Monographs and Surveys in the Biosciences.

Fast and Slow Chemical Signalling in the Nervous System. L. L. Iverson and E. C. Goodman, Eds. Oxford University Press, New York, 1986. xiv, 316 pp., illus. $47.50. Oxford Medical Publications. Based on a symposium, Harlow, England, May 1985.

Hormone Binding Sites in Plants. Michael Venis. Longman, New York, and Wiley, 1986. viii, 19 pp., illus. $39.95. Research Notes in Plant Science.

How Far Are We from the Gauge Forces. Antonio Zichichi. Plenum, New York, 1985. x, 741 pp., illus. $95. The Subnuclear Series, 21. From a course, Erice, Italy, Aug. 1983.

Immunology and Cancer. Margaret L. Kripke and Philip Frost, Eds. Published for the University of Texas System Cancer Center, M. D. Anderson Hospital and Tumor Institute, Houston, by the University of Texas Press, Austin, 1986. xii, 304 pp., illus. $47.50. University of Texas M. D. Anderson Symposium on Fundamental Cancer Research, vol. 38. From a symposium, Houston, Feb. 1985.

The Lewin Legacy. Field Theory in Current Practice. Eugene Stivers and Susan Wheelan, Eds. Springer-Verlag, New York, 1986. xx, 281 pp., illus. Paper, $28. Recent Research in Psychology. From a conference, Philadelphia, May 1984.

Little Science, Big Science ... and Beyond. Derek J. De Solla Price. Columbia University Press, New York, 1986. xxvi, 301 pp., illus. $35; paper, $14.95. A collection of 13 reprinted essays including those in Price's 1963 work, with added material by Robert K. Merton and Eugene Garfield.

Local and Global Methods of Nonlinear Dynamics. A. W. Sáenz, W. W. Zachary, and R. Cawley, Eds. Springer-Verlag, New York, 1986. viii, 263 pp., illus. $26.40. Lecture Notes in Physics, 252. From a workshop, Silver Spring, MD, July 1984.

Mathematical Ecology. An Introduction. Thomas G. Hallam and Simon A. Levin, Eds. Springer-Verlag, New York, 1986. xii, 457 pp., illus. $80. Biomathematics, vol. 17. Based on a course, Trieste, Italy, 1982.

Mathematics and Optimal Form. Stefan Hildebrandt and Anthony Tromba. Scientific American Library, New York, 1986 (distributor, Freeman, New York). xvi, 215 pp., illus. $29.95.

Meaning and Context. An Introduction to the Psychology of Language. Hans Hörmann. Robert E. Innis, Ed. Plenum, New York, 1986. xiv, 294 pp., illus. $35; paper, $18.95. Cognition and Language. Translated, with revisions, from the German edition (Darmstadt, 1981).

Numerical Methods in the Theory of Neutron Transport. G. I. Marchuk and V. I. Lebedev. 2nd ed. Harwood Academic, New York, 1986. xx, 601 pp., illus. $125. Translated and edited from the Russian edition (Moscow, 1981) by O. Germagenova.

Ocean Seismo-Acoustics. Low-Frequency Underwater Acoustics. Tuncay Akal and Jonathan M. Berkson, Eds. Plenum, New York, 1986. xvi, 915 pp., illus. $135. NATO Conference Series 4, vol. 16. From a symposium, San Terenzo di Lerici, La Spezia, Italy, June 1985.

An Ontology of Consciousness. Ralph Ellis. Nijhoff, Dordrecht, 1986 (U.S. distributor, Kluwer, Norwell, MA). viii, 205 pp., illus. $42. Martinus Nijhoff Philosophy Library, vol. 18.

Ore Fields and Continental Weathering. Jean-Claude Samama. Van Nostrand Reinhold, New York, 1986. x, 326 pp., illus. $44.95. Evolution of Ore Fields Series. A Hutchinson Ross Publication.

Research Methods in Applied Behavior Analysis. Issues and Advances. Alan Poling and R. Wayne Fuqua, Eds. Plenum, New York, 1986. xiv, 337 pp., illus. $39.50. Applied Clinical Psychology.

Residue Number System Arithmetic. Modern Applications in Digital Signal Processing. Michael A. Soderstrand *et al.*, Eds. The Institute of Electrical and Electronics Engineers Press, New York, 1986. viii, 418 pp., illus. $50.95; to members, $30.20. IEEE Press Reprint Series.

Supersymmetry and Its Applications. Superstrings, Anomalies and Supergravity. G. W. Gibbons, S. W. Hawkins, and P. K. Townsend, Eds. Cambridge University Press, New York, 1986. xiv, 481 pp., illus. $49.50. From a workshop, Cambridge, UK, June 1985.

Sweet Track to Glastonbury. The Somerset Levels in Prehistory. Bryony and John Coles. Thames and Hudson, New York, 1986 (distributor, Norton, New York). 200 pp., illus. $29.95. New Aspects of Antiquity.