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-