A Dynamic Structure

The Cell Surface in Development. Papers from a symposium, Montreal, Aug. 1973. A. A. MOSCONA, Ed. Wiley, New York, 1974. xiv, 334 pp., illus. $24.

In many cases rapid developments make a symposium proceedings out of date before it is published. Not so in this case. Certainly cell surface membrane research is a very active area, and new findings, books, and reviews emerge with distressing frequency. This book, however, cuts across the mainstream of membrane research, focusing on the broad biological implications and roles of the cell surface. This breadth gives one a sense of order in the midst of rapid change.

Moscona points out in the preface to this volume that developmental biologists have long viewed the cell surface as a dynamic structure. This undoubtedly reflects an intuitive understanding of the necessity for a dynamic, changing cell surface to account for the plasticity of development. It is only fitting that those interested in the plasma membrane in development should assist in redirecting attention to the cell surface as a dynamic structure.

Clearly, not all areas of developmental biology in which the cell surface plays a critical role could be included in a single volume. Sperm-egg interactions, invertebrate development, induction, and topoinhibition of cell growth and movement are but a few of the major areas that have not been discussed. The organizers have made an outstanding selection, however. The 16 papers that are included highlight representative areas of plasma membrane and developmental biology research.

The papers range from one on the biophysics and structural asymmetry of artificial lipid vesicles (T. E. Thompson *et al.*) to one that presents a theory relating development and cancer (N. G. Anderson and J. H. Coggin). In between, the spectrum of topics covered can be broadly categorized, from a membrane viewpoint, as methodological (physical, chemical, genetic, immunological, descriptive, or biological). A different categorization is possible if one has a developmental perspective. The foci here are differentiation (differential gene expression), morphogenesis (tissue formation), intercellular communication, and the causes of and changes resulting from malignancy. Most of the authors have presented their subjects with a broad, multidisciplinary readership in mind. This is not a volume for those interested in details of methodology, but it is highly recommended to workers in search of functional significance for cell surface membrane research.

One flaw of the volume is its failure to assess adequately the state of cell surface membrane isolation and analysis. The paper on membrane structure by M. Bretscher evaluates structures deduced from the red cell membrane and extrapolates to other membranes. Alas, not all cell surface membranes are so easily isolated and analyzed. It might have been judicious to include a paper dealing with the many problems encountered by workers wrestling with the surface of more obstinate cell types. (For reviews, see D. F. H. Wallach and P. S. Lin, *Biochim. Biophys. Acta* **300**, 211 [1974], and J. W. De Pierre and M. L. Karnovsky, *J. Cell Biol.* **56**, 275 [1973].)

This volume is printed on high-quality glossy paper, and the illustrations, print, and electron micrographic reproductions are exceptional.

EDWARD J. MCGUIRE
Department of Research, National Jewish Hospital and Research Center, Denver, Colorado

Bernard's Real Methods

Claude Bernard and Animal Chemistry. The Emergence of a Scientist. FREDERIC LAWRENCE HOLMES. Harvard University Press, Cambridge, Mass., 1974. xxii, 542 pp., illus. $18. A Commonwealth Fund Book.

The lasting fame of Claude Bernard (1813–1878) derives only partly from his monumental contributions to physiology. At least as important to his later reputation was his *Introduction to the Study of Experimental Medicine* (1865), long regarded as a classic expression of the "scientific method" by one of its leading practitioners. The *Introduction*, written in spare, lucid prose, attracted an audience extending far beyond the scientific community and won its author a place in the Académie Française. It promoted Bernard's vision of a medicine based increasingly on experimental physiology; offered his nuanced concept of "determinism" as a *via media* between vitalism and mechanism; and enlisted "case histories" from his own research in support of his methodological precepts. In general, Bernard insisted, scientists should allow their imagination "free scope" in the construction of hypotheses, but should then submit them to rigorous criticism and counterproof, ready always to abandon any hypothesis that fails to conform to the evidence.

Happily for historians of science, who have long distrusted such idealized prescriptions for scientific research, Bernard left behind an extensive set of laboratory notebooks. Recently, part of this material was put to admirable use in M. D. Grmek's impressive *Raisonnement expérimental et recherches toxicologiques chez Claude Bernard* (Droz, Geneva, 1973). Grmek's general admiration for Bernard's *Introduction* does not extend to its personal "case histories," perhaps because Grmek's own careful research shows that Bernard's work on poisons (notably curare and carbon monoxide) followed a developmental pattern infinitely more complex than the tidy, logical pattern imposed upon it in the *Introduction*. Now Frederic Holmes, in an important book already going to press when Grmek's appeared, reaches a similar conclusion vis-à-vis Bernard's early work in digestive physiology. Also using the laboratory notebooks as his point of departure, Holmes provides a remarkably detailed, persuasive, and revealing reconstruction of Bernard's research on digestion between 1842 and 1848. During the last two of these years Bernard made his two most important discoveries in the field—the fat-digestive properties of pancreatic juice and the glycogenic function of the liver. In demonstrating that neither discovery will fit the route assigned it in Bernard's *Introduction*, Holmes joins Grmek in suggesting that the didactic-cum-methodological aims of this work led Bernard unconsciously to telescope and simplify the process of discovery.

More generally, Holmes reveals a Bernard who sometimes followed his own methodological precepts but at other times did not—who sometimes pursued hypotheses in the face of powerful evidence against them, and whose published papers sometimes transformed equivocal experimental results into decisive ones or reversed the order in which experiments had actually been performed. From Holmes's account, historians of science will perceive anew the frailty of interpretations based solely on the published record.

Perhaps the most deep-seated of Bernard's methodological precepts was

his insistence that the physiological approach in general, and vivisection experiments in particular, offered a more reliable guide to the investigation of vital phenomena than did the chemical approach. Unlike most students of Bernard, Holmes examines this position critically and concludes that Bernard simply assumed that what worked best for him would work best for others. In fact, Bernard's two major discoveries in digestive physiology depended primarily on his operative skill and ingenuity, and both came only after he had devoted almost five years of frustratingly inconclusive work to the problem of gastric digestion, where his modest chemical talents proved unequal to the challenge. To establish this point, Holmes describes the years of Bernard's travail with gastric digestion at least as fully as he does the two subsequent, triumphant years. Holmes also stresses the achievements as well as the shortcomings of Bernard's chemical rivals, and his scrupulously balanced handling of controversies sets his book apart from any previous study of Bernard. So does his richly detailed account of the scientific context, which illuminates the ways in which Bernard sometimes surpassed, sometimes lagged behind, and sometimes depended upon his scientific contemporaries.

Even the most sympathetic reader may wonder, however, whether Holmes could not have accomplished his aims in much less space with greater economy and force of expression. Indeed, Bernard appears so rarely in the first half of the narrative (after the introduction he disappears until chapter 6, and then again until chapter 10) that inattentive readers may sometimes forget that he is the central figure in the story. Perhaps no general intellectual historian, very few philosophers of science, and too few historians of science will have the patience (or technical competence) to wade through this part of the book in order to reach those chapters (especially 17 through 20) where the pace accelerates and where the subtlety and importance of the long prelude suddenly becomes manifest.

Holmes obviously recognizes the difficulty, warning that his "exposition of details . . . may sometimes grow tedious." But he insists that "tedium is itself an essential side of scientific research . . . and it is difficult to sense the quickening pace at climactic moments if one has not felt the slowness of movement during the interludes between them" (p. xvii). In the end, Holmes refuses to compromise either technical rigor or wealth of contextual detail for the sake of a wider readership. That is a defensible, perhaps even brave, response to a problem faced by any historian of science whose material is inherently technical. Unfortunately, it will severely restrict communication with those who perhaps most need to know why Holmes clearly and responsibly doubts the influence on Bernard of general philosophical currents, and why he rejects the view that Bernard's research suddenly hit stride when he discovered, or adopted, some quasimagical "scientific method." To spread that message widely, another vehicle will almost certainly be required. But those who are patient, technically prepared, and fascinated by Claude Bernard or the science of his time should find a prominent place on their shelves for Holmes's distinguished book. It will remain there for a long time to come.

GERALD L. GEISON
Program in History and Philosophy of Science, Princeton University, Princeton, New Jersey

Amphibian Genetics

The Control of Gene Expression in Animal Development. J. B. GURDON. Harvard University Press, Cambridge, Mass., 1974. x, 160 pp., illus. $6.50.

The major part of this book consists of a detailed summary of the elegant and important work from the author's own laboratory on the early development of amphibians. It is an outgrowth of a popular three-lecture series Gurdon presented at Harvard last year, and the book follows the lectures rather closely. The first chapter deals with transplantation of nuclei from somatic cells into enucleated eggs and the evidence that stable, qualitative changes in the genome do not take place during the course of amphibian cell differentiation. The second deals with translational control of protein synthesis and the microinjection of messenger RNA (mRNA) into living oocytes and eggs. It reviews the evidence that shows that oocytes will not only translate faithfully and at very high efficiency any added eukaryotic mRNA but also can modify or process properly the protein product. The third chapter deals with the control exerted by the cytoplasm of eggs and oocytes over RNA and DNA synthesis by injected nuclei. Among the important results summarized here is that the cytoplasm of eggs contains some component that can "turn off" ribosomal RNA synthesis in a normally active nucleus. A good many experimental data are given in figures and tables, and in a welcome appendix there is a detailed description of the microinjection technique. The discussion and interpretation of the author's own work are unusually complete and articulate.

Perhaps inevitably, because of its small size, this book is much less successful in its treatment of other areas of developmental biology. Much of the background sections is written in a rather terse style, and many crucial experiments are described in little detail. Although there is a detailed glossary, defining such terms as "actinomycin," "activation of an egg," "adenocarcinoma," and "allele," the author assumes a good background on the part of the reader. Some of the discussion of the genetic analysis of adult nuclear-transplant frogs in chapter 1 makes intricate reading for the nonspecialist. Many important topics—for instance, RNA-DNA hybridization and the function of the various types of DNA sequences within the chromosomes—are discussed very briefly.

This book is warmly recommended for advanced students in cell biology or developmental biology. It would make an excellent supplementary text for an undergraduate course in developmental biology.

HARVEY F. LODISH
Department of Biology, Massachusetts Institute of Technology, Cambridge

Organic Semiconductors

Energy and Charge Transfer in Organic Semiconductors. Proceedings of a seminar, Osaka, Japan, Aug. 1973. KOHZOH MASUDA and MARVIN SILVER, Eds. Plenum, New York, 1974. x, 200 pp., illus. $18.50.

The papers collected in this volume are of interest to the physics and chemistry community as indicators of the status of a potentially important field of research. For the reader who is willing to dig and sift through a series of terse articles by specialists, the book provides a sampling of the understanding of organic semiconductors (as of August 1973) upon which further