papers he has written several books that are fascinating in their accounts of how it really happened. He became a Fellow of the Royal Society and a Nobel laureate at an early age, though he was not quite so meteoric as the book cover suggests, which starts his career ten years after he did himself.

First and Last Experiments in Muscle Mechanics follows Hill's recent book *Trails and Trials in Physiology*. Once again the old master takes us behind the scenes and makes clear how the simple joys of discovery are intertwined with the perplexities of results that didn't fit, of theories that "took, like Charles II, an unconscionable time dying."

The book starts with part of the famous paper of Gasser and Hill on "The Dynamics of Muscle Contraction" (*Proc. Roy. Soc. B* **96**, 398–437 [1924]), which described many of the more intriguing properties of isolated muscle, such as the relation between force and velocity, and the remarkable effects of quick releases and quick stretches. Much of this is still not completely understood. The book finishes with Hill's inaugural address to the Congress of the International Union of Physiological Sciences in Tokyo in 1965 and explains why the book is dedicated to "Ryotaro Azuma—physiologist, oarsman, public servant and friend."

In between Hill presents his last experiments on these problems, which show, for example, that his famous Hill equation does *not* predict the maximum velocity at which an unloaded sartorius muscle can develop tension. He imposed a velocity on the muscle and found that some fibers had very high intrinsic speeds. Some, however, were much slower. He first presented this work at an informal discussion at Churchill College, Cambridge, in December 1967, and it is good to see it finally in print.

In the past, Hill has issued "A Challenge to Biochemists" and "A Further Challenge to Biochemists." After paraphrasing a statement from Horace (*Satires* I, i, 24), "There is nothing to stop you from announcing your results with a laugh," he now asks physiologists to clear up several problems. These include "Will anyone undertake the laborious task of measuring v_0/l_0 and/or ATPase activity in a number of single fibres in a frog sartorius?" and "Will someone please make the experiment in this way?" A section called "The effect of a stretch on a collapsing structure" is followed by, "This seems rather an obscure title: its purpose is to induce someone to try to make the nature of the effect less obscure."

Without doubt, this book should be read carefully by everyone interested in muscle. Parts of it should be of interest to almost everyone else who cares about disinterested research.

ROBERT E. DAVIES
Department of Animal Biology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia

Cellular Relations

Organization and Control in Prokaryotic and Eukaryotic Cells. A symposium, London, April 1970. Published for the Society for General Microbiology by Cambridge University Press, New York, 1970. xii, 460 pp. + plates. $16. SGM Symposium 20.

This is an excellent symposium volume, consisting of 16 original articles, a reprint of E. C. Dougherty's abstract (1957) introducing the terms "prokaryon" and "eukaryon," and a useful glossary of cytological terms. The organizers are to be commended for bringing together a group of outstanding scientists of diverse interests and at the same time maintaining focus on a common theme. Each contributor "does his thing," but with specific regard to the relations between eukaryotes and prokaryotes. R. Y. Stanier's article "Aspects of the biology of cells" provides the framework for the book. Stanier exhibits his breadth of knowledge and unique ability to sense and communicate important problems in biology. After defining the "least common denominators" of eukaryotic and prokaryotic cells in modern terms, Stanier goes on to speculate on the evolution of eukaryons from prokaryons. Stanier's arguments rely heavily on ultrastructure as a source of evidence and inspiration and, in this reviewer's opinion, slight the more fundamental underlying biochemical processes.

The genetic codes of eukaryotic and prokaryotic cells are compared by C. R. Woese. Although the codon catalog is universal, there are interesting differences in the translation machinery of the two cell types. These subtle differences are utilized to derive some thought-provoking, admittedly speculative ideas on the evolution of the genetic code. H. G. Whittman and U. E. Loening present critical reviews on similarities and differences in the structure, function, and biosynthesis of ribosomes. There are five excellent articles dealing with the structural, functional, and possible evolutionary relationship between eukaryotic mitochondria and chloroplasts and bacteria. One fine example is the paper by Hughes, Lloyd, and Brightwell on the distribution of organelles in prokaryotic and eukaryotic microorganisms. In addition, there are some papers on selected aspects of comparative molecular genetics—the quantity, organization, and replication of DNA in prokaryons (Richmond) and eukaryons (Holliday) and the role of mutation (Holliday), diploidization (Raper and Flexer), and bacterial plasmids (Richmond) in evolution. Geneticists will find W. F. Bodmer's article "The evolutionary significance of recombination in prokaryotes" particularly interesting.

This volume is recommended highly to all serious students of cell biology. It is up-to-date, informative, and critical. The challenge, intellectual stimulation, and excitement of current cell biology are all here. At a time when certain molecular biologists claim that the era of discovery is finished, this book points clearly to some fundamental unresolved problems.

EUGENE ROSENBERG
Department of Microbiology, Tel-Aviv University, Tel-Aviv, Israel

Intellectual History

Eclosion and Synthesis. Perspectives on the History of Knowledge. SALOMON BOCHNER. Benjamin, New York, 1969. xiv, 274 pp. Cloth, $10; paper, $3.95.

This essay "offers an overall characterization of twentieth-century knowledge," on the basis of which Bochner proposes a sharp distinction between present knowledge and "knowledge in preceding centuries." A comparison and contrast are made between the half century 1776–1825, designated as the "Age of Eclosion," when "most of our present-day knowledge evolved into its main organizational divisions," and the 20th century, an "Age of Synthesis."

The main part of this essay deals with science and mathematics (and notably various "aspects of the conception of space"). But there are some "excursions into the social sciences and humanities," so that a test may be made of the thesis "that Eclosion and Synthesis, especially Eclosion, apply to all intellectual pursuits."

The critical reader of this essay cannot help having two distinct reactions. First, it is extremely difficult to define exactly what characterizes the pseudo-biological "eclosion," much less the "synthesis" of a later age. Indeed, the author all but says as much when he declares that "the Age of Eclosion was so sweeping and potent in its achievements that it even produced our eventual notion of Synthesis." And, as might be expected, this "notion of Synthesis has an affinity to the renowned triad, thesis, antithesis, and synthesis, of the philosopher of history Friedrich Hegel." Second, on every topic he takes up Bochner presents a variety of new insights that will inform and challenge all philosophers and historians of science. I found particularly brilliant chapter 14, "The problem of the size of the universe," the three chapters on space (". . . in knowledge and the arts"; ". . . before the Age of Eclosion"; ". . . and geometry since eclosion"), and chapter 5, "Psychology and pedagogy."

Much attention is given to Newton, who appears prominently in a number of chapters. As one would expect from a distinguished mathematician such as Bochner, who has shown us his talents for historical-philosophical studies, the discussions of the Newtonian and post-Newtonian traditions in mathematics and mathematical physics are extremely valuable. For instance, comparing the intense activities in developing fluid mechanics in the post-Newtonian century with a lack of major advances in optics in the same period, Bochner wisely castigates those who explain the latter by reference to Newton's influence and his failures without being aware that the situation in fluid mechanics would show the unsoundness of an argument of this sort. With regard to Newton, however, I believe Bochner would not so have insisted on Newton's "syllogistic mathematization of his mechanics" had he studied Newton's treatment of the general problems of motion, "supposing a centripetal force of any kind, and granting the quadrature [= integration] of curvilinear figures . . ." (*Principia*, Book I, Props. XXXIX–LXI). Here, especially, the geometric mask does not really hide the essentially analytic character of Newton's presentation.

The personal charm of the author's style matches the incisiveness of the comments. My favorite remark occurs on page 31, in relation to the new electronic digital computers, which cause the author to "admit (reluctantly perhaps) that the nascent theories of communication, information, control, coding, and so forth, inject into our intellectuality a certain factuality whose range of effectiveness cannot yet be circumscribed." He concludes that, "although the machine of the Age of Eclosion only wanted to supplement and outdo man's brawn, the novel machine of the Age of Synthesis wants to supplement and outdo man's brain. I regret that I will not be alive in the twenty-first century to know the ultimate outcome of this match between newfangled factuality and old-fashioned intellectuality."

I. BERNARD COHEN
Department of the History of Science, Harvard University, Cambridge, Massachusetts

Instruments and Their Use

Optical Methods in Biology. ELIZABETH M. SLAYTER. Wiley-Interscience, New York, 1970. x, 758 pp., illus. $29.95.

The aim of the author is to present a single and unified account, suitable for a graduate course in optical instrumentation or as a reference for the working scientist, of optical principles that are important for biological research. The book is not written to be a treatise on design, an account of the state of the art, or a handbook of technics or of what has been discovered by the application of the optical methods.

The amount of material covered is impressive. Light, lenses, x-rays, and electron microscopes are allotted over half of the book. Other microscopes, monochromators, spectrophotometry, luminescence, and other aspects of the subject are treated less adequately. The mathematics has been kept as simple as possible, but equations occur throughout the book, and the reader is assumed to be able to use them. The book is compiled from standard textbooks and many of the references at the ends of the chapters are to these textbooks or the *Scientific American*. Few papers from the literature are cited, nor is the reader referred to primary source books for particular instruments. The treatment is that of physics; the biologist must make his own interpretations.

For microscopy, Abbe's theory is used with no reference to recent work on problems of resolution. Bereck is listed in the index and referred to via Martin's book. Köhler's name is misspelled. Depth of focus and field are treated solely as physics with no mention of the role of accommodation of the observer's eye. Phase microscopy is explained by the vector method rather than by the general equations. Two of the four types of diffraction plates are described. The older types of interference microscopy are briefly considered, but the small shearing differential method and its special form of contrast are omitted. The addition of references to the basic books could have brought the chapter on interference microscopy more nearly up to date.

Electron microscopy receives more detailed coverage, likewise the polarizing microscope. A reference to Shurcliff's *Polarized Light* would have been appropriate and useful.

It is unfortunate that the S.I. units are not used. The lumen is defined, with an error of 10, in terms of the candela, which the author calls candle. On page 506, brightness is a property denied for a surface. The concept of luminance would help the author's problem that units of illumination tend to be confusing. She should use the U.S.A. Standard Z7.1-1967.

Slayter's book should be a useful review for the graduate student of optical instrumentation. Such a student may be annoyed when the descriptions get complicated and he is referred back to Jenkins and White, Strong, or other classic texts. For the scientist looking for an equation or a brief explanation of a principle the book should be useful. The biologist who likes his physics straight should enjoy it. As a biologist, I prefer more detailed books on the special instruments which have some relation to their biological use.

OSCAR W. RICHARDS
College of Optometry, Pacific University, Forest Grove, Oregon

Books Received

Automation and Data Processing in the Clinical Laboratory. Proceedings of a symposium, San Francisco, February 1969. Geoffrey M. Brittin and Mario Werner, Eds. Thomas, Springfield, Ill., 1970. x, 174 pp., illus. $13.50.

Biology of Plants. Peter H. Raven and Helena Curtis. Worth, New York, 1970. xii, 708 pp., illus. $11.95.

Biology Teachers' Handbook. Evelyn Klinckmann, Supervisor. Wiley, New York, ed. 2, 1970. xviii, 698 pp., illus. $8.95. Biological Sciences Curriculum Study.

(*Continued on page 1113*)