BOOKS: HISTORY OF SCIENCE

Early Neuro Networks

Martha Constantine-Paton

The History of Neuroscience in Autobiography. Vol. I. LARRY R. SQUIRE, Ed. Society for Neuroscience, Washington, DC (distributor, Academic Press, San Diego). xii, 607 pp., illus. $49. ISBN 0-12-660301-4.

Anyone interested in the history of science in this century will find the 17 autobiographical essays collected in volume one of *The History of Neuroscience in Autobiography* rich both in facts and in the sociology of science. The book, edited by Larry Squire, a former president of the Society for Neuroscience, was conceived to inform and inspire students and working scientists alike. It represents an unusual addition to the autobiographical genre for several reasons. First, the writers were selected by a panel of active neuroscientists because of the impact of their careers on the nascent field of brain biology. The essays represent a range of interests and activities as diverse as the field their authors helped build. Nevertheless, by frequent references to one another or to the same third parties, the authors document the complex networking and mentoring that remains a large component of success in science. Finally, because the careers of these individuals began between the world wars and span a period of incredible advances in the computing and engineering technologies, the reader glimpses the impact of worldwide political and technological shifts on the science these practitioners tenaciously pursued.

Some of these essays are engaging for their insights into the personalities of the individuals themselves. For example we learn that as a young medical student, David Hubel borrowed his family car and rushed to keep an appointment with Wilder Penfield and Herbert Jasper—an appointment that initiated his work in brain science. On returning to the car, he "found it running, with keys locked inside. …It was a stressful afternoon." This is the same David Hubel who fabricated the rugged tungsten microelectrode, which greatly facilitated the functional study of individual nerve cells. He, Torston Weisel, and Roger Sperry were awarded the 1981 Nobel Prize in Physiology and Medicine for their pioneering studies of neocortical signal processing.

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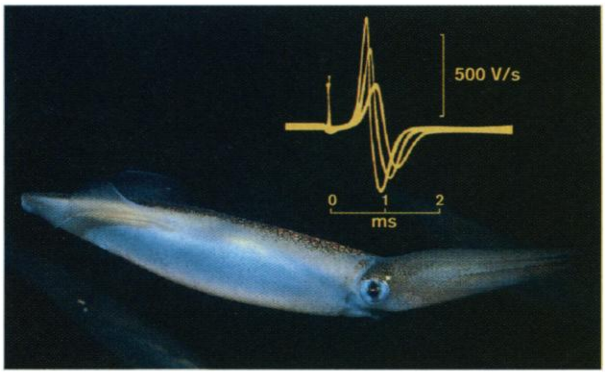
The volume also documents the serendipitous and frequently prolonged series of events that lead to the development of powerful new technologies. Louis Sokoloff recounts the long incubation period of the ^{14}C 2-deoxyglucose technique for localization and measurement of glucose utilization in minute regions of brain tissue. In the mid-1950s, Sokoloff learned of the existence of the glucose derivative that could be trapped in brain cells. Another decade passed before he developed an enzyme kinetic model for the method, and not until 1971 were the first experiments on awake, active animals carried out with the technique.



Classic experiments on the giant axon of the squid *Loligo*. These established the ionic basis of the action potential. The tracings show the effect of sodium concentration on the rate of change of membrane voltage. [A. L. Hodgkin and B. Katz, *J. Physiol.* (*London*) **108**, 37 (1949)]

ANIMALS ANIMALS © DOUG WECHSLER

John Young rediscovered the giant nerve axon of the squid while looking for its epistellar body, an organ he had discovered in the octopus during a 1928 visit to the Zoology Station in Naples, Italy. The function of these huge transparent strands, which seemed more like veins, was proved by the contraction of the mantle muscle when the nerve was pinched close to the ganglion. He and his colleagues at the Marine Biology Laboratory at Woods Hole, Massachusetts, demonstrated action potential activity in these fibers and introduced Alan Hodgkin and Andrew Huxley to the giant axon preparation. As Hodgkin points out in another essay, the exceptionally large diameter of this fiber allowed him to pursue the first internal electrode studies. In 1939 Hodgkin demonstrated that the "action potential might exceed the resting potential by some 40 mV," thereby destroying the classical theory that action potential currents were simply a temporary breakdown of the cell membrane polarization. Following the disruptions of World War II, Hodgkin and Huxley established the ionic hypothesis of nerve conduction. Bernard Katz joined in their research at Plymouth before taking up his pioneering work on the mechanism of communication between neurons at synaptic contacts.

Above all this book is a treasure of the history, ideas, innovations, and politics that coalesced to produce, and still color, current neuroscience. Anyone entering this field should find the volume valuable for this reason alone. For example, the present tremendous push to work on the neurobiology of mammals and preferably on the neocortex will be placed in perspective by Theodore Bulloch's eloquent discussion of the scientific lessons to be learned from diversity. Young scientists, used to performing virtually any analytical operation at the touch of a button, will better understand the physics and engineering bent of much of classical physiology after reading Denise Albe-Fessard's account. In the late 1930s, working with one of the first cathode ray oscilloscopes required that the vacuum be "re-established in the tube before each measurement. German tubes without this inconvenience had just appeared on the market, but it was still necessary to build the time base and amplifier."

The quality of these essays is not uniform. Many are dry in places and packed with details of experiments, trips, or administrative undertakings. A few simply tell stories that I found boring. All applaud former teachers and mentors (a good thing, but good things can get tedious). Historians may find the endless citing of names useful; those seeking inspiration may find it dull.

One disturbing aspect of this book is not due to an editor's oversight or a singular problem with any of the contributions. The essays accurately reflect the sociology of the science as it was and, sadly, as it largely remains. Brain science, as painted in this text, is a science of men. Women figure prominently in many of these contributions as inspiring mothers, devoted wives, as scientific collaborators, as the helpmates that moved their own professional careers around to allow their brilliant husbands to succeed, as fellow students, and as the powers that maintained animal facilities or lab order. But the women are seldom portrayed as the innovative investigators that surely some of them must have been.

The sole woman contributor to this volume, Denise Able-Fessard, who is widely acclaimed and honored for her dissection of central nervous system nociception, certainly understood the problem. She writes: "It was difficult for women in physics to find work in industry. The leading firms did not employ them in their shops but offered them positions researching the literature." Victor Hamburger, the acknowledged scion of developmental neurobiology in the United States, counts among his notable achievements being chair of "the first department [Zoology at Washington University, St. Louis] in which two women, Florence Moog and Rita Levi-Montalcini became full professors." Several students and postdoctoral associates mentioned by Professor Hamburger were young women who went on to independent research careers of their own. Perhaps it is not coincidental that so many of today's active and independent women neuroscientists have gravitated toward developmental neurobiology.

Neuroscience is the interdisciplinary study of nervous system development, structure, and function. It now occupies the working lives of more than 35,000 scientists and clinicians worldwide and, as a field, is still growing rapidly. Seymour Kety—a pioneer in studies of cerebral blood flow, oxygen consumption in the human brain, and the genetic contribution to schizophrenia—aptly muses in this volume about his preclinical studies: "Neuroscience was not a course or even a discipline in 1935; was it even a word?" Indeed, neuroscience was not a word then; electrophysiology, neuroanatomy, physiology, experimental embryology, psychiatry, neurology, behavioral genetics, and psychology existed as separate fields.

The reader will learn from various essays in this book—most notably those of Robert Galambos, Jasper, and Kety—how the concerted activities of leading scientists and clinicians in many countries founded the International Brain Research Organization (IBRO) in 1960, how F.O. Schmidtt's Neuroscience Research Program (1962) gave the neonatal field its first four truly interdisciplinary texts, and how the U.S. Committee on Brain Science, initially organized as the U.S. corporate member of IBRO, gave rise to the present day Society for Neuroscience. The latter, the publisher of this series, has been a guiding light for interdisciplinary brain research. The society and its affiliated programs, through their ecumenical example, have minimized the philosophical and practical differences among subdisciplines, promoted training programs, and furthered basic and applied research on brain development and function.

Although the essayists in this book are frequently referred to as pioneers of their field, that label is somewhat misleading. The actual initial practitioners of modern brain science were in the generation that came before them: Ross G. Harrison in neuroembryology; Ramon y Cajal, Wilhelm His, and C. Judson Herrick in anatomy; Charles Sherrington, Kenneth Cole, and Herbert Gasser in physiology; and Wilder Penfield in neurology, to name a few. What the 17 scientists in this book pioneered was a vision of a single brain science—a science that has in the last 30 years successfully incorporated multiple explosions in molecular biology and genetics, in imaging, and in recordings from the synapses of single cells. Neuroscience is biology at its most complex. *The History of Neuroscience in Autobiography* is a good book. It teaches and inspires without preaching. I expect that young scientists who read it will be motivated to respond to its obvious but unspoken challenges. Maybe, in the 21st century, neuroscience will finally reveal how molecules make the mind.

Vignette

Advancement in Science

As an Academician, Lavoisier was *expected* to advance science. As an Academician elected at a young age with no major scientific advances to his credit, he was probably more eager than many of his colleagues to prove that he belonged to this class of scientists. Some of his behavior during the spring of 1773 can be attributed to the eagerness of this ambitious young Academician to live up to such expectations. After occupying himself for several years with projects at which he did well, but that led to nothing extraordinary, he made, in the fall of 1772, a discovery that he saw at once as his best opportunity to become one of those who truly did advance the sciences. That he seized on that opportunity before he knew how hard it would become to exploit it fully, can thus be explained in part by the culture of the Academy to which he belonged. But his experience is more universal. It is shared by men and women of talent, in many times and places, who aspire to creative achievement, and who set for themselves challenging goals long before they can see how they will reach their destinations.

—*Frederic Lawrence Holmes*, in *Antoine Lavoisier—The Critical Next Year. Or, The Sources of His Quantitative Method in Chemistry* (Princeton University Press)

Browsings

Applied Dimensional Analysis and Modeling. Thomas Szirtes. McGraw-Hill, New York, 1998. 815 pp., illus. $99.95. ISBN 0-07-062811-4.

This thorough and wide-ranging treatment of the theory and practice of dimensional analysis incorporates over 250 applications to problems in engineering, physics, astronomy, geometry, biomechanics and economics.

Biological Treatment of Hazardous Wastes. Gordon A. Lewandowski and Louis J. DeFilippi, Eds. Wiley, New York, 1998. 413 pp., illus. $79.95. ISBN 0-471-04861-5.

The 25 authors describe basic principles and engineering practices for the transformation of organic pollutants into innocuous products. Chapters detail in situ and ex situ approaches, consider anaerobic and aerobic systems, and include numerous case studies.

Buzzed. The Straight Facts About the Most Used and Abused Drugs From Alcohol To Ecstasy. Cynthia Kuhn, Scott Swartzwelder, and Wilkie Wilson. Norton, New York, 1998. 317 pp., illus. Paper, $14.95. ISBN 0-393-31732-3.

Current pharmacological and psychological research on the effects of drugs on the brain and behavior is summarized in this educational handbook for the public.

Downsizing Science. Will the United States Pay a Price? Kenneth M. Brown. AEI Press, Washington, DC, 1998. 165 pp., illus. $29.95. ISBN 0-8447-4026-8. Paper, $14.95. ISBN 0-8447-4027-6.

Agreeing that reduced federal funding for science threatens basic research, the education of new scientists, and economic expansion, Brown offers policy guidelines for continued excellence in science while living within tighter budgets.

Rediscovering Geography. New Relevance for Science and Society. Rediscovering Geography Committee, National Research Council. National Academy Press, Washington, DC, 1997. 248 pp., illus. $34.95. ISBN 0-309-05199-1.

Geography's current and potential connections with a broad range of scientific and social challenges are considered here. The NRC committee argues that geography can inform discussions of environmental change, international trade, human health, education, and the condition of cities.

Satiation: From Gut to Brain. Gerard P. Smith, Ed. Oxford University Press, New York, 1998. 302 pp., illus. $65. ISBN 0-19-510515-X.

The authors consider molecular, cellular, endocrine, neural, and behavioral approaches to understanding how ingested food stops one from eating.