out childhood, youth, or education, having been mysteriously incarnated at the age of 19; in contrast one is almost reassured to learn that Isaac Newton "was born prematurely and was a frail child. His father had died before his birth; within three years his mother remarried, leaving her son in the care of his maternal grandmother."

These variations in format no doubt spring from the interesting, indeed disturbing, fact that the *Concise DSB* has no editor: instead, it was somewhat mechanically derived from the parent volumes. It possesses neither the systematic, uniform treatment of its subjects apparent in the smaller *Biographical Dictionary of Scientists*, edited by Trevor I. Williams, nor the massive range of entries apparent in the *World Who's Who in Science: A Biographical Dictionary of Notable Scientists from Antiquity to the Present*, edited by Allen G. Debus (both reviewed in *Science* **167**, 363 [1970]). What it does provide is an interesting supplement to those works and a well-produced if expensive guide to the riches available in Charles Gillispie's 16 volumes. What it does not offer (despite its publisher's claim) is a useful entrée to the extant knowledge of the history of science. For that, one must turn to the work that Bynum, Browne, and Porter have edited.

The *Dictionary of the History of Science* deserves admiration for its boldness. Its aim is to cover all the (Western) sciences, in all their tangled evolution and present complexity, inside one volume. This is a daunting task, and to accomplish it the editors have opted for an active stance, and *edited*. They eschew biography, saying, "We have judged it more useful to have articles on the Atom, the Unconscious, or Mendelism, than on Dalton, Freud or Mendel." Even the foundation ideas of science (light, evolution) are given only a highly compressed treatment in articles of 1000 to 2000 words, while most central topics receive a mere 500 to 700 words (galaxy, Galenism, generation-reproduction, geometry, gravity) and some are relegated to 250 to 400 words (genetics, God's relation to nature, geophysics, groups). Some items are barely even defined (gamete, germ, geology). What is lacking in substance is made up for by the verve of the entries, and by an exhaustive series of cross-references (golden numbers, *see* calendars; Golgi bodies, *see* protoplasm; goniometer, *see* crystals; gonorrhoea, *see* syphilis; Goodman's paradox, *see* new riddle of induction).

Reflecting its editors' interests, the *Dictionary* is strong on biological and medical matters, on geology, on certain classic areas of the history of science (Copernican revolution, corpuscular philosophy, and Kepler's laws all receive major entries), and on the philosophy of science (classification, conjecture/refutation, consilience, conventionalism, correspondence rules, counterfactuals, counter-induction). Almost entirely ignored are technologies of all kinds, scientific societies and institutions, and most areas of social science. Just as the *DSB*, while claiming universal coverage, is a recognizably American work, so too the *Dictionary of the History of Science* is obviously British in its quirks (Macmillans of London were its original publishers, and two-thirds of its 95 contributors are from the United Kingdom). Thus the "grid-group analysis" of Mary Douglas receives extended attention, while the long articles on "sociology" and "sociology of (scientific) knowledge" manage to avoid all mention of Robert K. Merton. No simple national chauvinism is at work here, as may be seen from the fact that the fashionable "ethnomethodology" of the American Harold Garfinkel is treated at length.

It is a pity that the English publisher chose to economize on production costs. The minute print and the absence of any illustrations give a cheap effect, which is reinforced by poor typography and clumsy layout. Under this malign influence, Princeton University Press also seems to have abandoned its usual standards, settling on shoddy covers and narrow margins for the American edition. However, if one looks beyond these dispiriting circumstances, and also makes allowance for the editors' particular angle of vision, then the real achievement comes alive: in the hackneyed cliché, "The *Dictionary of the History of Science* will prove an invaluable work of reference, that deserves a place on every scientist's bookshelf."

ARNOLD THACKRAY
*Department of History and Sociology of Science, University of Pennsylvania, Philadelphia 19104*

# Science Establishing Itself

**Science in America.** A Documentary History, 1900–1939. NATHAN REINGOLD and IDA H. REINGOLD, Eds. University of Chicago Press, Chicago, 1982. xii, 490 pp. $37.50. The Chicago History of Science and Medicine.

"In a democracy today," wrote Jacques Loeb to a colleague in 1915, "there is as yet no room in a state university for pure research. It may be done on the sly, but public pressure is against it." The German-born, American biologist added that "a research man is really safe only at present in a privately endowed institution, while he can not feel safe in a teaching institution." As detailed by Nathan and Ida H. Reingold in *Science in America*, Loeb's remarks touch on a problem and response that animated the scientific community in the United States during the opening four decades of the 20th century.

The problem was the inadequate recognition and support in American society for researchers and their work. As Loeb implied, this lack of deference to science was particularly acute in state universities where public pressure to provide mass education was keenly felt. The solution for Loeb and many others lay in privately funded institutions for basic research. These "sheltered enclaves," as the Reingolds label them, would provide talented researchers with recognition and support in an environment free from outside distraction and governmental interference. Loeb himself in 1910 had abandoned a university career in favor of a research position in the recently organized Rockefeller Institute; other American scientists had affiliated with the equally new Carnegie Institution. This trend culminated in the early 1930's with the founding of the prestigious Institute for Advanced Study.

The Reingolds see an ironic outcome to this strategy of establishing enclaves. Contrary to scientists' expectations, private institutions did not in later years come to dominate the pattern of research in the United States. Indeed, during and after World War II the emergence of federally funded, large-scale, project-oriented research reversed the previous trend. A further irony is that with the federal science of mid-century came the national deference that scientists had previously sought through private institutes. And, to the scientists' dismay, increased public involvement soon led to increased public skepticism toward science.

Clearly, the Reingolds have an eventful story to tell and stimulating conclusions to draw. Unlike other historians of American science, however, they have done so using few of their own words. In an effort to recapture the "glorious jungle of ideas, men, and events" that made up the reality of American science in the period from 1900 to 1939, they have prepared a "documentary history." Unpublished letters constitute the bulk of the individual elements in this "mosaic of bits of the past," and editorial commentaries by the Reingolds provide the cement that loosely binds the elements together.

The Reingolds have grouped the letters and other documents into 13 chapters that emphasize the institutional as well as the disciplinary and personal concerns of scientists. Their opening chapter on the Carnegie Institution highlights basic institutional issues. They immediately complement this with detailed chapters on physical and biological science prior to 1915. Next, in the "central core" of the book, they deal with the National Academy of Sciences, the American Association for the Advancement of Science, and the mobilization of scientists during World War I through the National Research Council. The Reingolds then return to the biological and physical sciences during the postwar years. The book concludes with documents relating to the Institute for Advanced Study, the final item being Einstein's 1939 letter to President Roosevelt warning of the possible development of nuclear weapons. Represented in the volume is a diversity of scientists, educators, administrators, philanthropists, and statesmen. Three scientists who particularly come to life through their letters and the editorial asides are the astronomer George Ellery Hale ("one of the great promoters and mythmakers of science"), the physiologist Jacques Loeb ("not a typical biologist . . . he was far too polemical and too philosophical"), and the mathematician Norbert Wiener ("the ebullient former prodigy").

The emphasis in this book on actual documents entails costs as well as benefits for readers. In contrast to conventional, analytic monographs on American science, the Reingolds' documentary history contains sections that will seem fragmented or unintelligible to some readers. An example of the former is the early chapter on physics with its wide-ranging collection of letters; examples of the latter are the technical passages that occasionally contain specialized or antiquated scientific concepts. Also, despite the Reingolds' interpretative comments, the documentary approach will inhibit some readers from fully grasping the broad historical themes implicit in the letters and other items. Details are simply so abundant that it requires constant effort to bear in mind general themes.

On the other hand, the documentary style of *Science in America* offers benefits sometimes difficult to realize in conventional histories. For the general reader, there is an intimate and entertaining glimpse into the complex web of individuals, institutions, and ideas that constituted the everyday reality of early 20th-century science. For the more serious student of American science, there are not only general insights into institutional development within the national context but also subsidiary insights into a remarkable range of particular persons, events, issues, and ideas. Finally, for the professional historian of science, the Reingolds do the service of exposing a myriad of rich archival veins that can be profitably mined for years to come.

ALBERT E. MOYER
*Department of History, Virginia Polytechnic Institute and State University, Blacksburg 24061*

## Millikan and His Era

**The Rise of Robert Millikan**. Portrait of a Life in American Science. ROBERT H. KARGON. Cornell University Press, Ithaca, N.Y. 1982. 204 pp., illus. $22.50.

Robert Millikan's career spanned more than half a century, during which American physics rose to a position of world leadership. Millikan came to physics at a time when it was being enriched by the discoveries of x-rays, radioactivity, and the electron and by the elaboration of the new quantum theories. His experimental contributions to these fields won him a Nobel Prize in physics in 1923, the first awarded to a native-born American. His organizational and entrepreneurial skills as executive head of the National Research Council in World War I and of the California Insti-

Robert Millikan sending cosmic ray instruments aloft, 1938. [From *The Rise of Robert Millikan*; courtesy of the Archives, California Institute of Technology]