Letters on the social aspects of scientific work

Science in America: A Documentary History 1900–1939

N. Reingold, I. Reingold, eds.
489 pp. U. of Chicago Press, 1982. $37.50

Reviewed by Alison Kerr

From a vast quantity of archival documents, Nathan and Ida Reingold have brought together a striking collection to illustrate the growth and development of science in the United States in the first 40 years of this century. The documents—nearly all letters—are not, for the most part, technical. They contain scientists' opinions on a number of central issues, which form the major themes of the work: the location of research in universities or in noninstructional institutes; the relative standing of US scientific disciplines compared to British and European counterparts; the status of US scientists in their own society; the concept of a national scientific community and the development of what we now call networks of influential individuals and their protégés. Another theme, the role of science in national defense, is touched upon in the chapter about World War I, and the final letter in the volume, from Albert Einstein to President Franklin Roosevelt, hints at its far greater role in succeeding years.

Alison Kerr is the archivist at the Los Alamos National Laboratory, New Mexico.

The cast of characters is enormous; perhaps one hundred individuals are represented by their correspondence, with hundreds more mentioned. Strong personalities and better-known scientists stand out, such as George Ellery Hale, Thomas Hunt Morgan, Ernest Lawrence, Jacques Loeb, and the Flexner brothers, Abraham and Simon. Even so, the Reingolds have not overlooked the lesser known. Their carefully researched footnotes provide ample identification of all but a few of the most obscure.

The Reingolds have allowed the scientists to speak for themselves. Almost without exception they have reproduced letters and other writings in their entirety. They have also provided a narrative in their introduction and at the start of each chapter. In it they amplify the themes highlighted in the letters and point out the relevance of earlier ideas to developments in the period after 1939. By itself their narrative offers a valuable commentary on the evolution of science in America.

The list of sources consulted—archival collections that, taken together, must contain millions of separate items—suggests the immensity of the task the Reingolds set themselves. On the whole, they have been successful. The chronological arrangement of documents within each chapter occasionally interrupts a flow of related letters between two correspondents. The documents themselves, understandably, lack the consistency in style and quality that would be found in a volume devoted to the correspondence of a single person. The only notable omission, a regrettable one, is the complete lack of photographs and other pictorial records. By concentrating on written records, the Reingolds have neglected an important form of documentation.

This book should appeal to a wide audience. Aside from its value as a comprehensive reference source, it will be enjoyed not only by scientists and historians, but by all readers interested in the development of US society and the increasingly important role of science and scientists.

Ernest O. Lawrence, some of whose letters appear in *Science in America*, at a control panel of the 184-inch cyclotron being reconverted to peaceful uses after it was used as a mass spectrometer in World War II. He is with Glenn Seaborg (center) and Robert Oppenheimer. (Photo courtesy of Lawrence Radiation Laboratory, University of California, Berkeley, California.)

Volcanoes of the Earth. Revised Edition

F. M. Bullard
579 pp. U. of Texas P., Austin, 1980. $19.95

Volcanic activity, because of its drama and potential threat to human activities, has always been an engaging subject. Its interest is enhanced because of its association with plate tectonics and seismic activity, many types of economic mineral deposits, geothermal energy and global weather variations. Because of the diversity within modern volcanology, no single book can be expected to cover the entire range; however, Fred M. Bullard's *Volcanoes of the Earth* does as well as or better than any of the other available books in the field.

Bullard first witnessed a volcano in 1929 during a trip to Alaska, and over the next 50 years he maintained a passionate interest in volcanoes and volcanic activity. His studies took him to all parts of the globe. Much of what is written is based on his first-hand observations.

The purpose of this book, which is a revision of an earlier volume, is to convey present knowledge about volcanoes to interested readers both inside and outside geology. The book's strong point is in its detailed descriptions of historic eruptions, many of them uncommonly spectacular. Abundant eyewitness accounts bring the reader close to the action. The photographs, some in color and all excellent, enhance the text. When introducing new topics, Bullard generally provides an historical perspective that facilitates the reader's understanding.

For such a broad topic as volcanology, it is not surprising that there are some deficiencies. For instance, Bullard allots very little space to the chemistry and the naming of volcanic rocks. Moreover, his descriptions of sial, sima, and nueé ardente are somewhat outdated; he more or less ignores the occurrence and importance of hyaloclastitic deposits, the extreme events associated with large-scale caldera collapse, and the associated development of widespread welded ash-flow tuffs; he omits the modern uses of trace-element geochemistry in volcanological studies; and he mixes metric and English units in the text and figures.

Overall, however, *Volcanoes of the Earth* is an easily understood storehouse of interesting lore about volcanoes and volcanic activity. It can be enjoyed by volcanologists, other earth scientists and nonscientists with an interest in the subject.

Edwin E. Larson
University of Colorado Boulder

Introduction to the Quark Model of Elementary Particles. Vol. 1. Quantum Numbers, Gauge Theories and Hadron Spectroscopy

D. Flamm, F. Schöberl
372 pp. Gordon & Breach, New York, 1982. $73.50

A little under 30 years ago, Chen-Ning Yang and Robert Mills wrote a paper on gauge field theory that began a revolution in how physicists look at the interactions of elementary particles. The work of Yang and Mills was followed by further rapid advances in quantum field theory and by the invention of the quark model ten years later by Murray Gell-Mann and George Zweig. These developments led to the gauge theory of Sheldon Glashow, Steven Weinberg, and Abdus Salam that unified the electromagnetic and weak interactions, and to quantum chromodynamics, a gauge theory of the strong interactions developed by many physicists beginning with Yoichiro Nambu.

By the mid 1970s, a coherent picture of the strong and electroweak interactions, called the "standard model," had emerged. Since then a number of crucial experiments have spectacularly confirmed many of the predictions of the standard model.

These successes of elementary-particle physics have resulted in a spate of books appearing recently on quarks, leptons, and gauge theories. In particular, 1982 was a banner year, with many books appearing, including *Gauge Theories in Particle Physics* by Ian Aitchison and Anthony Hey, *Quarks, Leptons, and Gauge Fields* by Kerson Huang, *Gauge Theories and the 'New Physics'* by Elliot Leader and Enrico Predazzi, *Introduction to the Physics of the Electroweak Interactions* by S. M. Bilenky and *Leptons and Quarks* by L. B. Okun. While, fortunately, these books emphasize different aspects of the subject, by their very nature they duplicate some material.

Not least among the books appearing in 1982 is the volume under review. This book bills itself as an introduction to the subject, but it is not. Rather, it gives the most detailed treatment of quark masses and hadron spectroscopy of any of the recent books I have seen and contains very many references to the original literature. For these reasons alone, it is a valuable reference tool for serious students and workers in the field.

It has not yet been possible to evaluate the consequences of quantum chromodynamics nonperturbatively (except in versions of the theory in which the fields are defined on a finite number of lattice points rather than on the continuum). Therefore, the authors consider a number of phenomenological models to describe systems—such as bound states of quarks—which must be treated nonperturbatively. The authors are careful to point out both the strong and weak points of these various models as well as their relation to the underlying theory of quantum chromodynamics.

The book would have been improved by a more logical organization. For example, a discussion of so-called "triangle anomalies" in gauge theory in