Book Reviews

Historiographic Assumptions

The Emergence of Science in Western Europe. Papers from a conference, Leeds, England, 1974. MAURICE CROSLAND, Ed. Science History Publications (Neale Watson), New York, 1976. vi, 202 pp. $18; prepaid, $15.

A generation ago the natural sciences were on the ascendant in the English-speaking world. The powers of those sciences had been proved in World War II. The promise and the threat inherent in nuclear energy were enough to persuade the lingering doubters, while the trajectory of Sputnik I strikingly underlined the new message. It was against this background that the historical search for the formation of the modern scientific attitude took on resonance and purpose. The quest for the real origin both of the modern world and of the modern mentality found its golden fleece in a "scientific revolution, popularly associated with the sixteenth and seventeenth centuries." The Professor of Modern History at Cambridge University brilliantly argued how that revolution "outshines everything since the rise of Christianity and reduces the Renaissance and Reformation to the rank of mere episodes." Others independently stated, extended, or refined the common thesis.

Influential texts like Butterfield's *The Origins of Modern Science* (1949), Hall's *The Scientific Revolution* (1954), and Gillispie's *The Edge of Objectivity* (1960) made scientists, students, and general readers alike familiar with the proposition that "the most dynamic, distinctive and influential creation of the Western mind is a progressive science of nature." The natural corollary to the proposition was that the most influential roles in creating modern science went to certain distinctive Western minds. The historian's proper focus became the intellectual activity of that pantheon which stretches from Copernicus to Newton, from Boyle to Lavoisier, from Harvey to Linnaeus and, perhaps, to Darwin.

From its title *The Emergence of Science in Western Europe* sounds very much at one with those earlier texts. Indeed it deals with the traditional period (1500–1850) and the traditional countries (Italy, England, Holland, Scotland, France, and Germany, in that order). But certain interesting alterations are apparent. The title itself displays one minor change. Work on the scientific revolution was always work on Europe, but no one used to feel it necessary to make the qualification explicit. The title thus mirrors our present doubts. We are less certain than we used to be about both the power and the virtue of "the modern mentality." We hesitate over whether *science* is anything but a fiction that has outlived its usefulness. Sciences—biological, mental, moral, natural, physical, and social or Eastern, Western, indigenous, imported, exported, ancient, and modern—yes; but "a progressive science of nature" as some one thing identifiable and unique to the Western mind—the proposition fails to persuade.

Crosland is aware of the problems, the doubts, the ambiguities. His thoughtful introduction acknowledges how "what we call science" is not what passed under that title in other days and other countries. Even so he seeks to trace "the development of science." In practice the ten distinguished contributors to the meeting he arranged and the book he has now edited convincingly display the elusiveness of such a goal. As one of them remarks of the apparently much simpler because more limited task of tracing scientific careers in 18th-century France (p. 134), "The answer is complex and difficult because it requires us to think carefully what we mean by science."

The present authors do not mean any one thing by science. Their essays range in subject from a study of three 16th-century Italian mathematicians to the functioning of the 19th-century German university, and in length from 6 to 18 pages. Interestingly, the shortest study deals with the broadest theme ("Science and religion in the seventeenth century") while the longest treats the most specific subject ("Science in the early Royal Society"). The rise and fall of Scottish science, Dutch science in the early 18th century, and German science in the Romantic period are among the other topics treated. As is inevitable in a symposium, quality varies and authors differ in their interpretations. Some provide research essays breaking new ground. Others offer lighthearted surveys of familiar themes. Charles B. Schmitt persuasively draws our attention to the importance of scientific subjects in the Renaissance universities, but Wilfred V. Farrar believes that the connection between science and universities was a casual one before the time of Justus Liebig. Roger Hahn argues that in France the pursuit of science remained a part-time activity well into our own century, while Crosland finds that science became a profession at the time of the French Revolution.

More interesting than such differences of emphasis are certain shared assumptions. The authors agree in viewing science primarily as an institutional mode rather than as an intellectual activity. Their concern with universities, careers, and the *profession* of natural science provides its own oblique commentary on our present world. Commentary of a more subtle sort is provided by the tension in these essays between a view that sees each historical incident as important primarily for its contribution to the "emergence of science" and the view that sees the natural knowledge of any particular period as best understood with reference to the cultural history of the group, institution, or nation under discussion. This tension relates to certain questions with major social, political, and policy implications. To what extent and in what ways is it fruitful to treat intellectual occupations as if they are wholly insulated from the broader culture and to what extent and in what ways should those occupations be viewed rather as manifestations of the culture? Quite obviously, such questions admit of no definitive answer from either politician or historian. The present authors take a variety of stands, but ones perhaps less inclined to the insulated view than would have been common a decade or more ago. Most of the contributors do, however, share with the historians of an earlier generation the assumption that science is synonymous with natural science (if no longer with physical science), that qualitative and literary insights rather than quantitative study provide an adequate basis for historical accounts of science, and that progress, development, and emergence are the terms in which to cast those accounts. All this, one suspects, is about to change.

Whether or not the suspicion is justi-

fied will only be apparent to the readers of *Science* another generation hence. For the present, *The Emergence of Science in Western Europe* expertly encapsulates our historical knowledge even as it also reasonably reflects our societal concerns.

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

Molecular Virology

Negative Strand Viruses. Papers from a symposium, Cambridge, England, July 1973. B. W. J. MAHY and R. D. BARRY, Eds. Academic Press, New York, 1975. Two volumes. Vol. 1. xx + pp. 1–554 + index, illus. $38.25. Vol. 2. xxviii + pp. 555–928 + index, illus. $27.75.

Evolution keeps trying to produce the perfect virus, and its continuing efforts have generated a startling variety of solutions to the problem of transporting genetic information from cell to cell and getting it to do something useful (or reprehensible, depending on the point of view) when it arrives. One of the more unusual solutions is exemplified in the "negative strand" viruses. Here we have the agents of measles, rabies, and influenza and their close relatives, all with genes encoded in RNA of the single-strand type, but not in the translatable form of messenger RNA. Instead, the genomes of these viruses are the complement of message, "negative" by the convention that messenger RNA molecules are "positive" strands. And because cells have no interest in using RNA as a template for RNA synthesis, these viruses have had to devote a large fraction of the small amount of genetic information they contain to specifying their own transcriptional machinery, which they carry around together with their "negative strand" genomes.

These things and more about the molecular biology of these agents can be learned from *Negative Strand Viruses*, a collection of 65 papers by more than 100 investigators, including most of the leading contributors to the field. Each of the major groups of negative strand viruses is well covered, with about equal space devoted to paramyxoviruses, influenza viruses, and rhabdoviruses. Volume 1 is thicker than volume 2, and it is possibly the better choice for one whose interests lie in the realm of genetic information transfer. It includes sections on virus structure, the architecture of viral genomes, RNA transcription and translation, and RNA replication, with some insights provided by several papers on biochemical genetics. Volume 2 covers additional aspects of viral genetics, virus protein synthesis, and biochemical and biological studies on the outermost part of these viruses, the envelope, a hybrid structure containing virus-specified proteins and cell membrane lipids.

Although almost everything in these volumes has already found its way into print elsewhere, it is convenient to have the information together in this format. Despite some recent developments such as the cell-free translation of influenza virus messenger RNA and the discovery of 5′-terminal modification in rhabdovirus and paramyxovirus messenger RNA molecules, most of the papers in these volumes are still accurate representations of the state of the art. But the prospective reader must be warned that he cannot approach this work unprepared. These are raw scientific papers, unconnected by explanatory text. He who is unfamiliar with the field would do well to consult a recent review on the molecular biology of one of these virus groups before plunging in.

DAVID W. KINGSBURY
Laboratories of Virology, St. Jude Children's Research Hospital, Memphis, Tennessee

Origins of Metabolic Systems

The Evolution of the Bioenergetic Processes. E. BRODA. Pergamon, New York, 1975. x, 212 pp., illus. $20.

Although there are many books at many levels on bioenergetic processes and on their chemical mechanisms this is the first to present such material in an evolutionary framework. Not until very recently has such an effort even been possible, for the original literature is being generated now. The virtue of this book is its value as an organized source of entry to this new literature, which is scattered in geophysical, microbiological, paleontological, and biochemical books and journals. The book is at an introductory level, and instructors concerned with a balanced, lucid, and broad account of the evolution of metabolic systems may find themselves reorienting their courses as a result of this treatment. The bibliography (though unfortunately without titles) is so extensive that the teacher of biochemical evolution can easily upgrade the level by sending the student to the original work.

The orientation is chronological: after a brief introduction to energy in the biosphere and the relation of energetics to evolution one proceeds from the early conditions on the earth and the origins of life through fermentation, photosynthesis, and other prokaryote metabolic virtuosities. The book has an emphasis that is unusual in the evolutionary literature, but probably appropriate to the subject matter, in that 17 of the 25 chapters deal with Precambrian prokaryote evolution. Only four chapters deal directly with eukaryotes, their organelles, their microbial representatives, and bioenergetic processes in multicellular plants, animals, and fungi. Two chapters deal with paleontological and geological evidence for the sequence developed in the book, and the book ends with a discussion of the history of the increase in atmospheric oxygen.

The account is straightforward. Some controversial matters (such as the origin of some eukaryotic organelles by symbiosis, the details of the increase of oxygen to its present value, monophyly of the peroxisome, a detailed phylogeny for the prokaryotes) are labeled as such. In most cases justification for the straightforward statements is given. Other potentially controversial matters are either presented as settled (for example, the time of the first appearance of fossil eukaryotes) or omitted (for example, carbon and sulfur isotope fractionation effects and their use in the interpretation of the past).

The book is clearly an original collection and synthesis of the literature of a new field. It is a fund of easily understood and appreciated information. The details of the author's attempted answer to the question in what organisms at what time under what conditions did such phenomena as fermentation, photosynthesis, carbon dioxide assimilation, and respiration evolve may be disputed by those close to the literature, but I suspect everyone will agree that he has provided us with a fine summary of the literature through 1975. Although much of the factual material will be found in any elementary biochemistry or comprehensive biology textbook, nearly none will be found in books on evolution. Broda's work represents an important step toward the integration of microbiology, biochemistry, and cell physiology into the evolutionary thinking of the neo-Darwinian synthesis.

LYNN MARGULIS
Department of Biology, Boston University, Boston, Massachusetts