Book Reviews

The Establishment of a Scientific Community

The Pursuit of Knowledge in the Early American Republic. American Scientific and Learned Societies from Colonial Times to the Civil War. Papers from a workshop, Cape Newagen, Maine, June 1973. ALEXANDRA OLESON and SANBORN C. BROWN, Eds. Johns Hopkins University Press, Baltimore, 1976. xxviii, 372 pp. $16.50.

American scientific and learned societies had their origins in the 18th and 19th centuries, though there were a few earlier efforts, such as Increase Mather's Philosophical Society, which achieved no lasting success. Though many of these first organizations had national pretensions, they were compelled, because of the limitations of communications and transportation, to depend on essentially local membership and support. Not until the establishment of the American Association for the Advancement of Science in 1848 was any truly national constituency a practical objective.

This collection of articles, the first of a projected set of three initiated by the American Academy of Arts and Sciences, traces the development of some of the most important of the organizations down to 1860, with emphasis on the century preceding the Civil War. Attention is focused on organizations in the original 13 states, though there are chapters on the Royal Society and on societies in the southeastern United States, the Ohio Valley, and Canada. Separate chapters deal with the professionalization of science and with particular disciplines, including humanistic studies, medicine, and agriculture. There have been works on science in the colonial era or on the accomplishments of particular organizations, but this is the first attempt at an overview of the accomplishments and influence of the most important of these societies in the nation's formative century. The result is an important contribution to the history of American science and letters.

Marcus McCorison explains in his chapter that the "convivial literary and philosophical debating clubs" of the 18th century provided the basis for library companies, established in a number of the original colonies, which in turn provided the basis for some of the learned societies of the period. The first societies provided a haven for a diversity of interests, but within a short time more specialized groups were created. Historical and other humanistic interests were provided for later. These varied organizations were founded separately from the colonial colleges (some of which had themselves been developed by the library companies), presumably to facilitate the coming together of educators and amateur scientists.

Alexandra Oleson's essay suggests that in the colonial period natural history was an interest common to most learned societies. European scientists were interested in American fauna, flora, fossils, and other natural resources, and the study of such resources provided the best route for Americans who desired international scientific recognition. The research later performed by such men as Agassiz and Gray contributed greatly to progress in systematic zoology and botany in this country and abroad; natural history had practical applications as well in such fields as medicine and agriculture.

Several authors, notably Henry Shapiro, James Cassedy, and Nathan Reingold, address themselves to problems of occupational analysis and to the emergence of professionalism. Reingold thinks that the traditional view of scientists creating a professional community "with elitist, anti-democratic overtones" probably needs reassessment. He divides American men of science in the 19th century into three categories: the cultivators, for whom science was an avocation; the practitioners, who were paid for their scientific work; and the researchers, a small and determined group from which leadership in their disciplines was drawn. The researchers, who desired preeminent status, achieved it by creating societies or honors to sift the outstanding from the merely ordinary and by founding institutions such as Louis Agassiz's museum at Harvard. Wishing to stress to the nation the importance of research, these leaders gave early support to national societies with general scientific interests, as opposed to smaller groups for single disciplines. The process of certifying scientists by awarding them advanced degrees or admitting them to specialized societies did not begin to become important until late in the 19th century.

A. Hunter Dupree stresses that, from their beginnings, learned societies in America consciously functioned as information systems. They realized that before they could participate in the "global information network" their findings must be put into print. The collection and care of specimens also became an important element in the process.

The American Association for the Advancement of Science, writes Sally Gregory Kohlstedt, represented the first successful attempt to create a national forum for American science. Several earlier attempts had been blocked by organizations and individuals who feared the competition and objected to the spirit of amateurism in science. The AAAS absorbed the Association of Geologists and Naturalists, begun in 1840, which had succeeded partly because of the popularity of geology in mid-19th-century America. This smaller group had hit on the novel idea of holding annual meetings in different cities, which then provided funds for publishing its proceedings. The leaders of the AAAS were well educated by the standards of the period, were important members of their local organizations, and were professionally engaged in occupations in which they could make use of their scientific competencies. They were also located in the more populous eastern urban centers. Most important, they demonstrated consistent interest in the fortunes of the new organization.

The editors of this volume have overcome most of the difficulties that beset compilers of papers by different authors. The contributions are generally of a high order, and the authors have ranged widely through the literature. Yet there are several important questions that are not dealt with adequately in any of the papers. We do not, as Barbara Gutmann Rosenkrantz acknowledges in her chapter subtitled "Some conclusions and suggestions for further research," know enough about what the learned societies did to perpetuate themselves, or about their failures to do so. In addition, while several of the essays include a discussion of the role of American colleges in the development of scientific societies, there is no attempt to deal with the influences of higher education on individuals who constituted the membership of these groups. The authors show that many scientists

had no college training and that the caliber of college training in America was frequently primitive in comparison to that available in Europe; thus the American response to science depended on more than the American colleges. It also depended on more than European leadership and publications. On what knowledge base did public reactions to science and the societies rest? What role was played by the common schools and academies? The book sheds little light on the scientific perceptions of the intelligent nonscientist, let alone ordinary citizens, many of whom were caught up by enthusiasm and curiosity about the objects of science. Neither does it deal with the antiscientific undercurrents in American life. These various attitudes toward science were closely involved in its development as well as in the life of learned societies in America.

Despite these gaps, many valuable insights into the motivations and objectives of American scientists before 1860 are contained in these essays. We now have a clearer and more detailed picture of the roots and structure of learned societies in the United States and Canada. Historians of science will find this volume essential to their understanding of the sociology of the scientific community.

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The Ocean Bottom

The Benthic Boundary Layer. Proceedings of a conference, Les Arcs, France, Nov. 1974. I. N. McCAVE, Ed. Plenum, New York, 1976. x, 324 pp., illus. $27.50.

Processes at the planetary boundaries control the properties of atmosphere and hydrosphere. Almost all of life is concentrated here—the terrestrial ground cover and its dependents, the marine plankton of the mixed layer, the benthos of the ocean floor.

The benthic boundary is the least well known of the three. There is no comprehensive introduction to this environment. This book makes an effort to provide one. The various disciplines that are relevant—marine physics, chemistry, biology, engineering, geology—take their turns in the nine main chapters. The final third of the book consists of "working group reports," that is, outlines of concepts and open questions in various lines of investigation.

A product of a conference (which was supported by the NATO Science Committee), the book has some problems. There is, in places, too much technical detail—for example, the 14-page discussion of laboratory microtechniques in the chapter on metabolic activities of benthic organisms appears out of place. Conversely, there are passages in certain of the working group reports that are too general and contain little information (taking the line that everything needs more study). Notwithstanding such (and other) defects, the volume has a great deal to offer.

I found the chapters having to do with chemistry especially thought-provoking. R. A. Berner (geochemical processes) emphasizes the supply of organic matter as the driving force for the reactions near the sediment-water interface. (I would add calcium carbonate dissolution to the "biogenically controlled" reactions because of the worldwide evidence for strong dissolution on the continental slopes, that is, in areas of high fertility.) Profiles of interstitial water properties are widely used in reconstructing the geochemical reactions. Stratigraphers might wish to caution the geochemists: A large change in sedimentary conditions, the deglaciation event some 11,000 years ago, is only 10 centimeters or so down within the deep-sea record. A similar event, albeit less drastic, is represented by the end of the Little Ice Age 150 years ago, and affects profiles from sediments near continents (such as those from Santa Barbara basin).

From Berner's discussion of biologically driven reactions one gains the impression that much of the chemical imprint of the ocean is produced in surface sediments on the continental margins. This impression is reenforced by the paper by E. Suess, who combines a review of nutrient geochemistry at the interface with specific research examples. The continental slope and its overlying waters are revealed to be a giant nutrient trap. Oxygen uptake is considerable, with marked effects on the chemistry of the bottom water. One might conclude that it is time to retire the venerable Wyrtki model of the oxygen minimum, a model still widely used in various modifications, and to replace it with one giving due recognition to oxgyen consumption by slope sediments combined with horizontal diffusion.

As to physics, M. Wimbush briefly recapitulates the mathematical tools used to describe idealized flow patterns near the interface and A. D. Heathershaw presents evidence for the patchiness of flow energy in the Irish Sea. Typically, brief bursts of Reynolds stress (which governs erosion) exceed the average by a factor of 10, even 30 to 50 in the extreme, a fact of great significance to the interface environment.

The biology chapters (by P. A. W. J. De Wilde and by P. Laserre) suffer from a lack of focus on central problems. Perhaps this reflects a deficiency of the state of the science, rather than of the authors. De Wilde concentrates on the tidal flat environment, and Laserre summarizes laboratory studies on metabolic activities. Direct measurements in situ, the most relevant information in the present context, get short shrift, although the references are there.

R. B. Krone (engineering interests) reports on experiments concerning aggregation and erosion. A. F. Richards and J. M. Parks introduce aspects of marine "geotechnology." They summarize information on physical properties of deep-sea sediments, with emphasis on depth-related changes. We learn little beyond the fact of the trends, however, since there is no discussion of what causes them. As represented in the two engineering chapters, the state of the field as an environmental science is unimpressive, perhaps even ominously so in view of one of the authors' reference to its practitioners' involvement in the testing of a proposed site for a floating nuclear power plant (R. B. Krone, referring to laboratory tests on erodibility of the seabed).

The last chapter, by C. D. Hollister, J. B. Southard, R. D. Flood, and P. F. Lonsdale, summarizes earlier work on the mapping of echogram character in the northwest Atlantic and offers new interpretations based on a deep-towed instrument package which includes side-looking sonar. The authors present evidence for an abyssal mixed layer, about 100 meters thick, whose origin is connected with the existence of abyssal furrows of compatible wavelengths.

The committee reports review the scope of the field and list the areas of research where work is most urgently needed. A greater effort at setting priorities would have been helpful. For obvious reasons, this is a difficult task in a democratic setting. The key references are given, a very useful feature indeed.

Virtually all workers in any way concerned with processes on and near the sea floor will want to have access to this book.

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