on the part of the government, we are still a long way from the total disdain of the 19th and early 20th centuries. The author's suggestion, made in passing, that the focus in England was different owing to the much stronger position of private scientific organizations with a strong influence in government is intriguing, and I would like to have seen that pursued further.

By the author's own word, this is a book of men and ideas. In fact, and of necessity because of the vastness of the terrain it covers, it is rather more a book of events, with brief spotlights on the people that moved and the concepts that moved them. In an introduction of this kind this is probably inevitable, and the book covers a great deal of ground without giving much cause for quibble. The level, I judge, is more that of the educated layman than of the professional oceanographer, but we are all laymen in each other's specialties. Nevertheless, a somewhat more rigorous treatment of concepts would have been both possible and desirable; an example is the very light touch regarding the development of wave theory and experimentation during and after World War II. Somewhat surprisingly, the introduction disclaims any specific intent to discuss the evolution of oceanographic instrumentation. Fortunately, however—and rightly, because our concepts about the sea are so strongly limited by what we can measure—there is in reality a good deal of discussion of instruments, and the slowness of development of our understanding of oceanic circulation in consequence of the inaccuracy of thermometers and salinity determinations is very nicely sketched. One wonders, as a result, to what extent the evolution of oceanography has been so slow because the investigator, bent on testing his ideas, has often found himself charged first with the duty of outfitting his ship and designing his equipment. Even today, we do not always accord due respect or proper reward to those who invent our instruments—no new phenomenon, apparently.

A rather sizable portion of the book is devoted to a discussion of development of new tectonic concepts of the earth. Admittedly, this is an exciting subject and an exciting time, appearing to us geologists a bit like the days in physics when the atom model was developed or the heady times just behind in genetics. The summary is adequate, but basically this is a subject of the sciences of the solid earth, and its future lies there, not in oceanography. I would gladly have seen the space devoted to a more watery subject.

The history of science can be traced along many paths, its evolution seen in terms of concepts, of the contributions of outstanding and powerful minds, of changing social and political conditions, of the lagging or racing ahead of technology, or of the growth and decline of famous institutions. In oceanography, we can also tell sea stories (which somebody ought to preserve). This book includes a bit of all, but mostly it is a classical history in the sense that it describes the temporal sequence of events, although grouped under headings that add a conceptual content. Thus, it leaves me with a taste for a great deal more, for studies of political relationships, so convolutely described recently by Edward Wenk, Jr., in *The Politics of the Ocean* (University of Washington Press, Seattle, 1972), for the history of great institutions (we only have a small one for Scripps—Helen Raitt and Beatrice Moulton's *Scripps Institution of Oceanography, the First Fifty Years*, Ward Ritchie Press, San Diego, 1967—as far as I know), for the tracing of the migration of concepts between the fundamental disciplines, such as physics and chemistry, which generate them, and oceanography, which uses and modifies them, and particularly for more about people. There is more than one side to the role of men in science, who are not only carriers and shapers of ideas but also personalities who, for better or for worse, have often molded the course of events more through their strength and idiosyncrasies than through their science. This is perhaps less clear in this book than it might have been, and it is now certainly time for some good biographies of the major players of the game. Many of those who have put their mark on the marine sciences, or those who have known them well, are still alive. Perhaps this makes the task a little delicate, but it is also a rare advantage, and one longs to see good biographies of many important men like Harold Sverdrup, H. H. Hess, Columbus O'Donnell Iselin, Alfred Redfield, and Maurice Ewing. Maybe the author will take me up on this suggestion; it should fill the rest of her life and be very nice for all of us.

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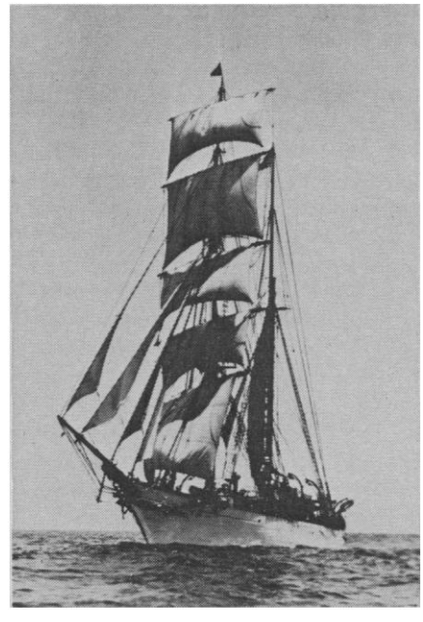

"The nonmagnetic brigantine *Carnegie* under full sail." The *Carnegie* "was framed of white oak, planked with yellow pine, and held together with locust treenails and bolts of copper and bronze. Her auxiliary engine was built almost entirely of bronze, and her anchors were of bronze and manganese. . . . her lines of hemp were rove through wooden blocks and spliced around copper thimbles. (Her crew even wore nonmagnetic belt buckles . . .)." On her maiden voyage in 1909 the *Carnegie* "followed the route taken some 200 years earlier by . . . Edmund Halley in the *Paramour Pink*. Halley had also been collecting data for a magnetic chart. . . . In the 200 years between the two voyages the magnetic declination . . . had changed so much that had the *Carnegie* followed the *Paramour Pink*'s compass courses she would have made landfall, not near Falmouth on the south coast of England as intended, but somewhere along the northwest coast of Scotland." [Reproduced in *The Edge of an Unfamiliar World*, courtesy Department of Terrestrial Magnetism, Carnegie Institution of Washington]

Hale Memorabilia

The Legacy of George Ellery Hale. Evolution of Astronomy and Scientific Institutions, in Pictures and Documents. HELEN WRIGHT, JOAN N. WARNOW, and CHARLES WEINER, Eds. M.I.T. Press, Cambridge, Mass., 1972. viii, 294 pp. $17.50.

George Ellery Hale (1868–1938) was one of the giants in the history of science in the United States. He was a leader in establishing the "new" science

of observational astrophysics, the founder of three major observatories, and a statesman of science on both the national and the international level.

Hale's discovery of the magnetic fields of sunspots was a major contribution to knowledge, and his invention of the spectroheliograph provided an important research tool for the study of the sun. In addition to his own research activities, cut short by poor health in 1910, he encouraged and actively supported the work of younger astronomers who wanted to embark on careers in the "new" astronomy.

Founder of the Yerkes Observatory (1897), the Mount Wilson Observatory (1904), and the Mount Palomar Observatory (1928), he created research facilities on a larger scale than anything previously in existence. At the time of its dedication in 1948 the 200-inch telescope was named the Hale Telescope, and more recently the combined Mount Wilson and Palomar Observatories have been renamed the Hale Observatories, fitting tributes to the memory of the man most responsible for their existence.

Hale's activities outside the field of astronomy are perhaps less well known. His organizational genius and ability to persuade wealthy persons and organizations to support scholarly endeavor were devoted to such things as the establishment of the Henry E. Huntington Library and Art Gallery in 1927 (after 21 years of discussion and persuasion) and the transformation of the Throop Polytechnic Institute into the California Institute of Technology. Following his election to the National Academy of Sciences in 1902, he took the lead in enlarging and reorganizing the academy to give it a larger role in American science. He also took the lead during World War I in the organization of the National Research Council under academy auspices, and after the war was responsible for the establishment of the National Research Council Fellowships for postdoctoral study and research. On the international level, in 1904 he pushed for the formation of the International Union for Cooperation in Solar Research, which was replaced after the war by the International Astronomical Union. In 1918 before the war had ended he proposed the creation of an International Research Council, and he took part in the organizational meeting in Paris immediately after the Armistice. This organization was later renamed the International Council of Scientific Unions.

The detailed enumeration and description of Hale's varied activities is to be found in Helen Wright's biography *Explorer of the Universe*. The book under review, *The Legacy of George Ellery Hale*, has a different purpose from a biography, and it does its task very well. The book is divided into three sections: (i) a 110-page broad-brush biography with many illustrations; (ii) 89 pages selected from the papers of George Ellery Hale, including his article in the April 1928 issue of *Harper's Magazine*, "The Possibilities of Large Telescopes"; and (iii) Perspectives, 75 pages devoted to four articles about subjects related to Hale and his work; the authors are C. D. Shane, I. S. Bowen, R. Howard, and D. J. Kevles. For the general reader who is not interested in minute biographical details this is an excellent book. The combination of a large number of thoughtfully chosen illustrations with a well-written text gives the reader a real feeling for what Hale was like and what he did for astronomy, and for America and the world.

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Unexplained Phenomena

UFO's—A Scientific Debate. An AAAS symposium, Boston, Dec. 1969. CARL SAGAN and THORNTON PAGE, Eds. Cornell University Press, Ithaca, N.Y., 1973. xxii, 310 pp., illus. $12.50.

The nature, history, and current status of the issues raised among scientists by reports of unidentified flying objects have been summarized recently by Bruce Murray in his review (*1*) of *The UFO Experience* by J. Allen Hynek (*2*). Since the observational data have a low signal-to-noise ratio, since the most widely publicized hypothesis (that UFO's are of extraterrestrial origin) seems to belong to science fiction, and since some reported sightings appear to contradict tenets of present-day science, one can hardly be surprised that many scientists refuse to take the problem seriously and that the discussion has sometimes proceeded in an irrational and unscientific manner. If we are to make any progress in understanding the UFO problem, the first requirement is that the treatment it receives, from friend and foe alike, should be sanitized.

Scientists generally regard the Condon Report (*3*) on the Colorado Project as being the principal published record, but that report has not settled the issues. Most scientific journals seem unwilling to publish articles on the subject, and the scientific world has therefore been deprived of further presentation, evaluation, and interpretation of the data. In these circumstances it was most commendable of the American Association for the Advancement of Science to arrange a two-day symposium on the UFO question in December 1969, organized by a distinguished panel consisting of Philip Morrison, Thornton Page, Walter Orr Roberts, and Carl Sagan; and it is useful to have now this volume containing the written version of contributions to that symposium.

Since the volume is entitled *UFO's —A Scientific Debate*, a reviewer is immediately faced with two questions: Was it a debate? and Was it scientific? My answer to each question is an unenthusiastic "Yes, to some extent," but this is probably the most that could be achieved at that time, and the organizers and editors deserve our thanks.

A debate is usually conducted between two teams arguing for and against a certain proposition. In this case, the proposition can be taken to be that UFO reports represent a real and significant phenomenon deserving the attention and efforts of the scientific community. The principal protagonists are J. Allen Hynek, astronomer, and the late James E. McDonald, atmospheric physicist. Among their supporters are Robert M. L. Baker, Jr., film analyst, and Robert L. Hall, sociologist. The opposition is spearheaded by Donald H. Menzel, astronomer, who is supported to various degrees by Frank D. Drake, radioastronomer; Lester Grinspoon and Allen D. Persky, psychiatrists; William K. Hartmann, astronomer; Philip Morrison, astrophysicist; and Carl Sagan, astronomer. The remaining contributors, who do not give strong support to either side, are Kenneth R. Harvey, expert on radio propagation; Thornton Page, astronomer; Franklin Roach, astronomer; Douglas R. Price-Williams, psychologist; and Walter Sullivan, science writer.

The principal shortcoming of this