lustrate a fascinating part of past American art and trace the evolution of cartographic techniques and geological methods. Let no one say the geologists considered themselves bigger than nature; when they appear in an outdoor picture, they are dwarfed by magnificent landscapes.

Yet the major theme of Rabbitt's study is revealed in the title of her monograph. In fact, her geologists were engaged in the conquest of nature. They received financial support because their investigations promised to deliver practical results. Abram S. Hewitt made the point during debates over the organization of the western surveys: "Nations become great and independent as they develop a genius for grasping the forces and materials of nature within their reach and converting them into a steady flowing stream of wealth and comfort" (p. 279). Although basic research was undertaken in American geology before 1879, "material comfort" was pursued more vigorously than knowledge for its own sake, and the dollar took precedence over the idea. If the geologists whose work is described in this volume are often lost men in the history of science, they are, more unfortunately for our understanding of modernization, lost men in the history of American economic growth.

MORGAN SHERWOOD
Department of History,
University of California,
Davis 95616

The Stellar Life Cycle

Stars. Their Birth, Life, and Death. IOSIF S. SHKLOVSKII. Translated from the Russian edition (Moscow, 1975) by Richard B. Rodman. Freeman, San Francisco, 1978. xiv, 442 pp., illus. $17.50.

This book, authored by a noted Soviet astrophysicist, charts the life history of stars from cradle to grave. Shklovskii beautifully reviews the triumphs of 20th-century astrophysicists in reaching an understanding of how stars evolve. He also manages to include a number of tightly structured chapters in which he discusses the attempts by modern astrophysicists to confront the most poorly understood phases of the stellar life cycle—conception, birth, and death.

Shklovskii's discussions of the physical behavior of the clouds of gas and dust out of which stars form, the mechanisms that may be responsible for triggering star formation, and the early collapse phases of stellar evolution are lucid, although brief. He provides the reader with a good survey of modern work, including the major recent contributions of millimeter radio astronomy and infrared astronomy. Perhaps the book's most impressive chapters are those describing the final stage of stellar evolution. Shklovskii's discussions of stellar explosions, supernovae, and their by-products, neutron stars and supernova remnants, are exceptional for their clarity. He has also written one of the better available introductions to the world of pulsars, black holes, and x-ray binaries.

The book reflects the author's enthusiasm and imagination. He does not fear to share with the reader some of his most deeply held views and his hopes for the solution of vexing problems. This personal touch adds much to the book's liveliness.

Although aimed at a "serious" popular audience, the book is really best suited for those with a solid grounding in elementary physics. Physical scientists of various breeds who want a sound but rapid introduction to the aspects of modern astrophysics covered by Shklovskii will find the book exceptionally readable. It would also serve well as an ancillary textbook in an upper-level undergraduate or first-year-graduate introductory course in stellar astrophysics. The bibliography provides the reader with immediate references, at a variety of levels, to more comprehensive discussions of specific topics.

The translation, despite a few perplexing non sequiturs, appears to preserve a graceful flow. This reviewer found the book a distinct pleasure to peruse.

STEPHEN E. STROM
Kitt Peak National Observatory,
Tucson, Arizona 85717

Bioluminescence

Bioluminescence in Action. PETER J. HERRING, Ed. Academic Press, New York, 1978. xxvi, 570 pp., illus. $51.75.

In 1952, E. Newton Harvey's *Bioluminescence* was published, and it became the definitive work on the subject. Not only did the book review the entire field, it carefully stated major unsolved problems and put forth speculations. Harvey's book is still unequaled, although an updating is sorely needed. In this collection of review papers Herring has attempted to bring the entire field of bioluminescence up to date. The attempt is commendable, although the field has grown to proportions that preclude a treatment similar to Harvey's.

The book is a good reference for those interested in bioluminescence and a good starting point (after Harvey) for anyone new to the field. It includes chapters on the measurement of light, the chemistry of light-emitting processes, comparative biochemistry of animal systems, and the function and evolution of bioluminescence and many chapters dealing with specific bioluminescent systems. Some of these (chemistry of light-emitting processes, comparative biochemistry of animal systems, bacterial bioluminescence, and the biochemistry of firefly bioluminescence) are essentially repeats of other reviews by the same authors. A proper addition might thus have been a list of "other reviews" relevant to the subject. The chapter on fungal luminescence is disappointing, being primarily a taxonomic treatment of the subject.

The chapters on insects, other invertebrates, dinoflagellates, and fish bioluminescence bring together and synthesize much new information. The chapter by Herring and Morin on the difficult and extensive subject of luminous fishes is particularly good.

Perhaps the most thought-provoking chapter is that of Buck on the functions and evolution of bioluminescence. The evidence in support of many of the existing functional hypotheses (attraction of prey, escape from predators, intraspecies communication, illumination, mimicry, and others) is reviewed and discussed in a comprehensive and excellent treatment of the subject. The stimulating discussion of the origin and possible evolution of luminous systems includes a section on the evolution of symbiotically luminous systems. Much of the discussion in the chapter places other parts of the book in perspective, and this is the chapter that should be read first.

The book suffers from several problems: the styles and goals of the various authors are not united by a common editorial policy; the material is generally poorly indexed (it is often difficult to find specific information such as spectral maxima or kinetics of light emission, and there is no author index); and the all-inclusive bibliography is ponderous and hard to use with the individual papers.

Overall, however, the book achieves its goal, and it should be a part of the personal libraries of all those working in the field.

K. H. NEALSON
Scripps Institution of Oceangraphy,
La Jolla, California 92093