butterfly conservation in temperate regions, the local extinction of a butterfly population may be considered only a trivial loss in many conservation circles; however, such an event should be treated very seriously as an indicator of long-term habitat deterioration. I was quite impressed by the amount of information on population structure, habitat requirements, extinction rates, and recolonization events that has been amassed on rare butterflies in the United Kingdom, and Thomas's chapter should be read by all conservation biologists, irrespective of their particular taxon of interest.

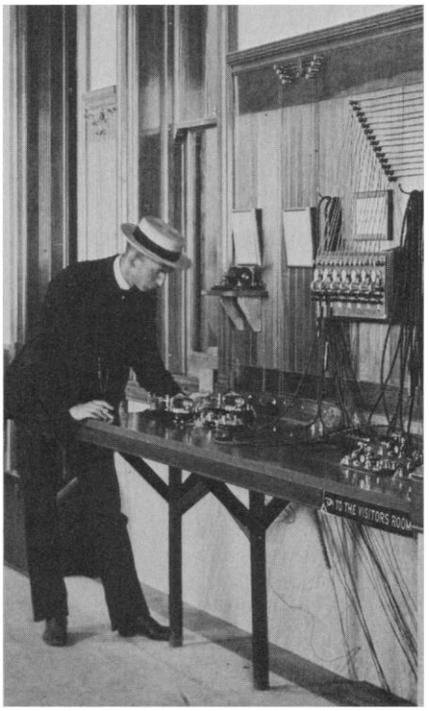
In summary, the editors have given us a book on butterfly biology that is exciting, informative, useful, and attractive. It clearly belongs on the bookshelf of anyone who uses butterflies as experimental organisms, and parts of it can be read with benefit by anyone interested in the general topics covered. This volume is a fitting tribute to Ford, and it amply justifies Henry Walter Bates's observation made in 1864 in *The Naturalist on the River Amazon*: "As the laws of Nature must be the same for all beings, the conclusions furnished by this group of insects must be applicable to the whole organic world; therefore, the study of butterflies—creatures selected as the types of airiness and frivolity—instead of being despised, will some day be valued as one of the most important branches of biological science."

PETER F. BRUSSARD
Section of Ecology and Systematics,
Cornell University,
Ithaca, New York 14853

A 19th-Century Astronomer

James E. Keeler. Pioneer American Astrophysicist and the Early Development of American Astrophysics. DONALD E. OSTERBROCK. Cambridge University Press, New York, 1984. xii, 411 pp., illus. $39.50.

James Keeler (1857–1900) was widely regarded as the leading American astronomical spectroscopist of his generation. Born to a family of modest circumstances and growing up in communities devoid of scientific or cultural resources, Keeler might have become a mechanic or an instrument maker had he been a few years older. Luckily for him, and for science, he came of age at a time when America was ready to educate and employ scientists. In 1877, through a series of coincidences, Keeler was able to matriculate at Johns Hopkins, newly established as America's first advanced research university. Following graduation he went to work with Samuel Pierpont Langley at the Allegheny Observatory, where he acquired practical experience manipulating telescopes, spectroscopes, cameras, and bolometers. In 1883 he went to Germany for further study of physics and mathematics.



James E. Keeler at the time service switchboard at Lick Observatory, 1886. [From *James E. Keeler*; reproduced by permission of the Mary Lea Shane Archives, Lick Observatory]

Keeler's professional career, which lasted but 16 years, was spent alternating between the Allegheny and Lick observatories. Dedicated in 1862, the Allegheny Observatory had been founded by a group of Pittsburgh businessmen largely as a cultural adornment for their city. They sought the largest telescope their money could buy (a 13-inch refractor) and the most handsome building, but provided few resources for salaries, publications, and all the other necessary expenses of a scientific institution. To fund his researches Langley adopted the expedient of selling observatory time to local railroads concerned with establishing standard time signals. By the 1880's much of the equipment at Allegheny was antiquated, and the expansion of heavy industry in the area was proving a hindrance to good seeing. The Lick Observatory, by contrast, was new, well situated, well endowed, and designed for research. Keeler, who was chosen director of the Allegheny Observatory in 1891, became director of the Lick Observatory in 1898. He did excellent work in both places, both as a scientist and as an administrator. Together with George Ellery Hale, he was a founder of the *Astrophysical Journal*. Crowning his scientific achievements were his spectroscopic proof that the rings of Saturn are composed of particles and his photographic discovery of the abundance of spiral nebulae.

An astronomer by profession and himself a former director of the Lick Observatory, the author of this biography displays remarkable sympathy for his subject and tells his story with charm and grace. Keeler's strength was as an observer. He had a good sense of what projects might yield good results, and he knew how to squeeze the most from his instruments. In Osterbrock's words, he "tended to distrust far-ranging conceptual schemes, and to emphasize the complexities shown by the observations themselves" (p. 138). The same observation might be made of this biography. Osterbrock's interpretation of Keeler's work in terms of the science of his time and larger issues in the politics or sociology of science is weak. He has, however, scoured some 25 archives, unearthed just about every piece of paper to, from, and about Keeler, and organized the material systematically. This is narrative history in the grand tradition, leaving us to draw our own conclusions.

DEBORAH JEAN WARNER
National Museum of American History,
Smithsonian Institution,
Washington, D.C. 20560

The Dynamics of Climate

Climate Processes and Climate Sensitivity. JAMES E. HANSEN and TARO TAKAHASHI, Eds. American Geophysical Union, Washington, D.C., 1984. viii, 368 pp., illus. $28. Geophysical Monograph 29. Maurice Ewing Volume 5. From a symposium, Palisades, N.Y., Oct. 1982.

In an attempt to add to our understanding of the internal climate feedback mechanisms this book of proceedings presents 30 papers describing climate interactions in all parts of the climate system. Organized into six sections—Atmosphere and Ocean Dynamics, Hydrologic Cycle and Clouds, Albedo and Radiation Processes, Cryospheric Processes, Ice Cores and Glacial History, and Ocean Chemistry—the papers provide a sampling of current work on the subject. That the book is not completely comprehensive is testimony to the explo-