Book Reviews

Lepidopteran Subjects

The Biology of Butterflies. Dedicated to E. B. Ford. R. I. VANE-WRIGHT and P. R. ACKERY, Eds. Published for the Royal Entomological Society by Academic Press, Orlando, Fla., 1984. xxiv, 429 pp., illus. $60. Symposia of the Royal Entomological Society of London, no. 11 (London, Sept. 1981).

In *The Genetic Basis of Evolutionary Change*, Richard Lewontin chided the British school of ecological geneticists for its continued devotion to "the genteel upper-middle-class tradition of fascination with snails and butterflies." However, butterflies offer many advantages for evolutionary studies that are not found in most species of *Drosophila*, the organism of choice for most North American workers. They are easily observed and handled in the field, and the ranges and ecological requirements of most species are reasonably well known. Like *Drosophila*, many can be bred successfully under laboratory conditions. As a consequence, butterflies have played important roles in the development of theories of population structure and regulation, natural and sexual selection, mimicry, genetic polymorphism, and insect-plant coevolution.

All of these topics are covered to some extent in this volume dedicated to E. B. Ford, who is perhaps the most influential member of the British school of ecological genetics. It consists of 33 papers, 31 of which were presented at a symposium held at the British Museum (Natural History). The book has a decidedly international flavor; roughly half of the papers were contributed by scientists from the United Kingdom, a third by Americans, and the rest by workers from Japan, Germany, France, and Australia. By my count, 14 of the papers are reviews of various aspects of butterfly biology, and the remainder are shorter contributions of more limited scope. There are also assorted tributes and dedications, an introduction, four color plates, and a cumulative bibliography containing over 2300 entries.

The editors have organized these contributions into eight sections. The first, on systematics, consists of one paper (Ackery) which provides readers with an overview of butterfly classification through the subfamily level, major references on each subfamily plus the families of their major host plants, and a list of major faunal studies by biogeographic region. Since there are from 10 to 15 thousand species of butterflies worldwide and no comprehensive catalog has appeared in well over half a century, this paper represents a heroic effort and is a major contribution to the field.

The second section contains important reviews on the structure and dynamics of butterfly populations (Ehrlich) and on butterfly communities (Gilbert). This is followed by a section on butterfly-host-plant relationships with reviews on oviposition (Chew and Robbins) and host quality (Singer). Part 4 is concerned with predation, parasitism, and defense, with papers reviewing natural enemies (Dempster), chemical defenses (Brower), and mimicry (Turner). Turner's paper is especially thought-provoking, since, as he points out, whatever explains mimicry also explains much of the evolutionary process. He ends his contribution with a thoroughly neo-Darwinian explanation of race formation in *Heliconius*, a process that looks very much like punctuated equilibrium: long periods of stasis alternating with periods of rapid change.

The next section, on variation and speciation, contains a review of the ecological genetics of *Maniola jurtina*, a topic into which E. B. Ford has contributed considerable insight for many years. The author (Brakefield) points out that the field data now accumulated on this species are the most extensive available on the evolution of quantitative characters in animal populations. Much, however, remains to be done, since the processes underlying the patterns are as yet only dimly perceived.

The section on sex and communication offers some controversy. The late Robert Silberglied reviews the evidence for Darwin's hypothesis that female choice in butterflies is based on male color patterns and decides that Darwin was wrong; he suggests that brilliant butterfly colors may instead serve primarily as agonistic devices between males and in that respect are similar to bird songs. D. A. S. Smith presents data more supportive of Darwin's interpretation and disagrees with Silberglied. Shorter papers by Vane-Wright and Platt *et al.* add additional information and ideas on both sides; finally, the section concludes with a review of chemically mediated interactions by Michael Boppré, who suggests that pheromones may be rather more important in mate selection than visual signals.

Part 7 is entitled Migration and Seasonal Selection. Evidently most lepidopterists fail to distinguish between migration (which involves a return trip) and dispersal (one-way movement, usually from the natal site). Migration is a rare phenomenon in butterflies, but spectacular when it occurs. An example is the autumn migration of the monarch *Danaus plexippus* to overwintering areas in Mexico and California followed by a spring return. The extent to which other species migrate is still essentially unknown and perhaps will remain so until researchers in this field sort out these two phenomena. Baker's otherwise stimulating article on movement patterns is mostly about dispersal: when it occurs, its distance, direction, and economics.

Shapiro and others discuss the phenomenon of seasonal polyphenism, the annually repeating pattern of different phenotypes in successive generations. Since they are under developmental control, seasonal polyphenisms should represent excellent systems for probing epigenetic mechanisms. Shapiro describes his attempt at working out the genetics of an epigenetic system in *Tatochila* as a "noble failure," since the resulting data do not match theory very well. Nevertheless, this whole area of research strikes me as one that is rife with exciting possibilities for future work, including, probably, some revisions of theory.

The final section is on conservation. Because of their host specificity as larvae and their requirements for complex resources as adults, butterfly populations are very sensitive to ecological change. As a result, many species have disappeared from the United Kingdom and much of continental Europe. (Ten butterfly taxa are currently listed as endangered or threatened in the United States, with 60 others under review by the Fish and Wildlife Service). As Thomas points out in his excellent review of

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."

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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.

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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-