include a variety of topics falling under the headings of physiology, behavior, development, life cycles, cytology, and genetics. In these sections, Crowson combines an extensive literature review with his own grasp of variation within the Coleoptera and places the results in an evolutionary framework. The remaining chapters cover special topics of interest to ecologists and systematists alike, such as adaptations to aquatic habitats, beetles in dung and carrion, predation and defense, symbiotic relationships, and herbivorous beetles.

The chapter "An ecological triangle: beetles, fungi and trees" deals with the complex relationships between Coleoptera associated with decaying plant material and the fungi, whose activities make this food source available. Included is a wealth of information on wood borers, cambium feeders, and the inhabitants of leaf litter, as well as those species feeding on fungal spores or fruiting bodies. In this and the previous chapter ("Symbiotic and parasitic relations"), considerable attention is paid to small and often setose cavities on the surface of adult beetles and their possible role in the transport of fungal spores. Although such structures (called mycangia) have been demonstrated in ambrosia beetles (Curculionidae: Platypodinae and some Scolytinae), it is premature to assume that the variety of cavities mentioned and illustrated by Crowson have a similar function.

The chapter on geographical distribution begins with the expected coverage of dispersal powers, global distribution patterns, and faunal characteristics of the major regions. The topic of recent extinctions and changes in distributional limits in northern Europe leads to an interesting discussion of conservation practices and the dangers facing species with limited ecological niches. In the final chapter on evolutionary history, Crowson incorporates his own ideas on the phylogeny of beetles, mostly published elsewhere, with the growing body of fossil evidence coming out of the Soviet Union. At the end of the chapter, he examines certain evolutionary generalizations, such as Dollo's law, in the light of knowledge about the history of beetles. Some cited examples of evolutionary reversal, however, might actually reflect the need for reexamination of the original phylogenetic hypotheses.

Students of Coleoptera may be confused by the classification adopted for the book and included as an appendix. Certain family concepts, such as Empelidae, Hobartiidae, Cryptophilidae, and Megalopodidae, are either entirely novel or have not been used previously by Crowson and his students. The placing of Stylopidae (Strepsiptera) in the superfamily Lymexyloidea is discussed on pp. 71–75, but in this reviewer's opinion the evidence is not convincing.

There are quite a few redundancies and typographical errors, and the book would have been more readable if the chapters had been subdivided. Regardless of minor faults, however, *The Biology of the Coleoptera* is and will remain for years to come the definitive work on the subject.

JOHN F. LAWRENCE
Division of Entomology, Commonwealth Scientific and Industrial Research Organization, Canberra 2601, Australia

Insects and Adaptations

Insect Life History Patterns. Habitat and Geographic Variation. Papers from a symposium, Denver, Colo., Nov. 1979. ROBERT F. DENNO and HUGH DINGLE, Eds. Springer-Verlag, New York, 1981. xii, 226 pp., illus. $29.80. Proceedings in Life Sciences.

Within the last few decades, there has been a shift in the types of organisms most frequently studied by animal ecologists, from vertebrates (especially birds) to insects (especially herbivorous insects). At the same time ecology has increasingly embraced an adaptationist paradigm, in which the life histories of organisms are viewed as strategies deployed to meet differing environmental challenges. This collection of papers is a product of these new emphases; it uses insects to challenge several ecological platitudes (such as the primacy of competition) and exemplifies the promises and limitations of an adaptationist viewpoint. Through an introductory chapter and three synoptic essays, the editors weave together an unlikely blend of life history studies, ranging from demography to diapause to community organization to island biogeography.

Several papers in this volume examine environmental variability, highlighting its consequences for the success and evolution of insect life histories. Among the most provocative of these is a contribution by Whitham, in which he suggests that within-plant somatic variation is an antiherbivore adaptation. Casual observation of almost any plant-insect association will reveal that herbivorous insects concentrate their feeding on a small subset of any particular plant's tissue. Whitham takes a fresh look at this ordinary observation and shows that insects often suffer from increased competition or predation as a result of aggregating at restricted feeding sites. He does not, however, provide evidence indicating that variability by itself is an adaptation; to do so would require data on the fitnesses of plants that differ only in their degrees of somatic variability. Edmunds and Alstad also consider the challenge that plant variability presents to specialized herbivores, focusing on between-plant (as opposed to within-plant) variation in ponderosa pines. This chapter is a rehash of a paper (*Science* **199**, 941 [1978]) that is widely cited as providing an example of a herbivorous insect (the black pineleaf scale) with low mobility that has evolved counteradaptations to the defenses of individual plants. This interpretation may be premature since evidence of genetic differentiation among demes of scale insects is lacking. Furthermore, the transplant experiments performed by Edmunds and Alstad do not rule out an alternative hypothesis that involves neither differentiation nor adaptation on the part of scale insects. In particular, scales transferred from infested trees to uninfested trees may fail not because the scales are uniquely adapted to particular infested trees but because all uninfested trees are unsuited to all scale insects. Such unsuitability could well be a result of historical or environmental factors acting on the trees. Before it is concluded that genetic differentiation and adaptation are responsible scales should at least be transferred among different infested trees. By sampling insect populations from geographically distant areas, other authors are able to document striking examples of heritable differentiation in life history traits. Istock offers an especially tempting sketch of his extensive studies of life history variation in pitcher-plant mosquitoes. Combining quantitative genetics, field observations, and a simple model, Istock first demonstrates the genetic basis of inter- and intrapopulation variation in diapause strategies and then explains this variation as a bet-hedging tactic in response to a fluctuating environment. In some instances, the insights that make sense of life history patterns derive from careful natural history and not from expectations of theory. For example, after finding classical *r*- and *K*-selection theory to be unhelpful, Blau argues that adjustments in body size for thermoregulatory purposes underlie the life history differences between temperate and tropical swallowtail butterflies. One theme

running throughout this volume is that variation in the length of favorable seasons is a critical factor determining patterns of insect life history variation.

Studies of insects have generated new ideas and approaches in community ecology as well as in the narrower area of life history patterns. Comparing hispine beetle co-occurrences on rolled leaves with frequencies of co-occurrences expected randomly, Strong concludes that interspecific competition has no apparent influence on hispine distributions. Simberloff also reports data that are consistent with a null hypothesis of randomly assembled arthropod communities. On the nonrandom side, Simberloff shows that good colonizers of mangrove islands tend to be both good dispersers and good persisters. Tallamy and Denno connect species-specific overwintering strategies to the organization of a guild of sap-feeders in *Spartina* marshes, suggesting that coexistence is maintained in part because severe winters keep the community "in a state of nonequilibrium."

I cannot think of a book that better illustrates current fads in ecology, touching on topical issues such as nonequilibrium communities, plant-herbivore coevolution, null hypotheses of community organization, island biogeography, and, of course, life history theory. But this is much more than a trendy symposium publication; it is a well-edited and revealing portrayal of evolutionary approaches to understanding life history patterns in general.

PETER KAREIVA

Biology Division,
Brown University,
Providence, Rhode Island 02912

Centennial Contributions

The Evolving Earth. L. R. M. COCKS, Ed. British Museum (Natural History), London, and Cambridge University Press, New York, 1981. viii, 264 pp., illus. Cloth, $72.50; paper, $22.50. Chance, Change and Challenge.

The Evolving Biosphere. P. L. FOREY, Ed. British Museum (Natural History), London, and Cambridge University Press, New York, 1981. viii, 312 pp., illus. Cloth, $79.50; paper, $24.95. Chance, Change and Challenge.

The British Museum (Natural History) has been celebrating the 100th anniversary of its move to South Kensington in 1881, and one of the events marking the occasion was the publication of these two volumes. Written largely by staff scientists at the museum, both books are collections of essays that "do not set out to review the research output of the last century, neither are they intended to serve as text-books," in the words of R. H. Hedley, the museum's director, in the foreword that appears in both volumes. After reading the books I was left wondering precisely what purpose each might be expected to serve.

Though the books are unified by the overtitle Chance, Change and Challenge and have a single overall editor (P. H. Greenwood) and identical formats (the artwork is generally good and reminiscent of the style of, say, *Scientific American*), there is little other reason to consider them together. *The Evolving Earth* is a tome useful to a broad spectrum of readers, from interested laypersons through professional scientists. *The Evolving Biosphere*, on the other hand, hardly contains a single contribution of truly general interest. The reason for such uneven success in such a highly coordinated publishing effort seems to be what the authors and editors made of the word "evolving." "The evolving earth" seems to have inspired something of a fresh approach to the salient features of earth history, whereas "the evolving biosphere" evoked merely another potpourri of articles (some of them, to be sure, quite good) on specific aspects of the evolutionary process.

The Evolving Earth consists of 15 chapters organized into five sections. Each section is separately introduced, and it is in these introductions (as in those in the other volume) that we find some of the better and more informative writing. For example, Jefferies and Cocks, in their introduction to part 2—The Evolution of Continents—draw an amusing, but telling, parallel between their section, which "starts with the largely molten world of the Pre-Archaean, more than 3800 million years ago, and finishes with the soils round Hemel Hempstead in Hertfordshire," and the Book of Genesis: as one gets closer to the present, the story told becomes more recognizable and prosaic—and hence more believable. And M. K. Howarth's introduction to part 4—Continental Drift and Plate Tectonics—forcefully reminds us just how much our views of the earth and its history have been altered in very recent times: he quotes a 1959 statement by the secretary of the Mohole Committee predicting that oceanic sediments "could contain an uninterrupted record of the earth's development for two thousand million years . . . if palaeontologists can obtain cores of fossil-bearing strata considerably older than Cambrian sediments, one of their fondest dreams will be realized." As recently as 1959 no one had the faintest idea that no part of the present-day ocean basins is older than 200 million years.

The Evolving Earth is successful because chapter after chapter takes some major aspect of the physical earth—its ocean basins, its atmosphere, its climate, its sediments, and so on—and traces what we think we know about how they have changed through the past 3.8 billion years (the age of the oldest rocks so far discovered) to become as we find them today. There is, throughout, a spirit of open inquiry: rather than the usual litany of linear historical "events," one reads constantly of the dilemmas and uncertainties that beset the student of the earth's remote past. The chapters are rich in details, but usually the general points emerge clearly. To take but one example, I approached chapter 4, "The evolution of sedimentary environments" (by Cocks and Parker), warily: after all, how can sedimentary environments be said to "evolve" in any meaningful sense? But, thinking of "evolution" simply as "change through time," the authors told me that the relative proportions of the several major sediment types have changed rather drastically over the eons. Virtually all the chapters of *The Evolving Earth* have much food for thought as we share the authors' struggles while they grapple with various changes through geologic time.

The latter part of *The Evolving Earth* looks at process—plate tectonics—before reverting to history: the differential movement of plates through time, and the changing positions of lands and seas. Here I was entranced by the handling of the views of H. G. Owen, a staff member of the museum and one of the few voices crying out in the wilderness in favor of the notion of an expanding earth. Owen thinks that 200 million years ago the earth's diameter was only 80 percent of what it is today. He bases his claim on the better fit of the continents he obtains using his model of a reduced diameter for remote times. Owen sets his views out nicely in his own chapter, but it is his colleagues' treatment of them that proved to me to be one of the more appealing features of the book. In his frank introduction to part 4 Howarth tells us of the relative unpopularity of Owen's ideas, remaining tantalizingly neutral himself. But Howarth's own chapter on the palaeogeography of the Mesozoic, in which he prefers a model of a constant-diameter earth, nevertheless