The books are nicely produced, though it is irritating that nearly 70 pages of preliminaries and indexes are identical in the two volumes and there is no author index. The editors have, however, done their job well. For a compilation the general standard of the contributions is high. Though much of their content is clearly for specialists, they tackle problems and issues relevant to acoustics, ecology, and evolution as well as ethology, so many biologists will benefit from dipping into them. Though more "long awaited" than they should have been, these books do more than just summarize a field: they identify problems and provide signposts to future developments that will be a positive stimulus to it in the years ahead.

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Neuromorphology

The Central Nervous System of Cartilaginous Fishes. Structure and Functional Correlations. W. J. A. J. SMEETS, R. NIEUWENHUYS, and B. L. ROBERTS, Springer-Verlag, New York, 1983. x, 266 pp., illus. $150.

Although they constitute a relatively small radiation of vertebrates, fewer than 600 species, the cartilaginous fishes exhibit extensive morphological and functional diversity. This diversity and their long evolutionary separation from other vertebrate radiations offer biologists the opportunity to identify examples of certain evolutionary processes: one can recognize primitive features that are shared by cartilaginous fishes and other vertebrate radiations and thus gain considerable insight into the ancestry of jawed vertebrates; moreover, one can identify ways in which cartilaginous fishes have independently "solved" a number of biological problems encountered by other vertebrates. Although they are frequently said to represent a simpler grade of organization than so-called "higher" vertebrates, some cartilaginous fishes have independently evolved endothermy, complex yolk sac placentas or placental analogs, and brains as large relative to body size as those of many birds and mammals. A growing body of data reveals many similarities in addition to relative size among the brains of these vertebrates.

Experimental studies of the brains of cartilaginous fishes have been hampered by the absence of a systematic survey of their neuromorphology, and this problem has now been greatly alleviated by Smeets, Nieuwenhuys, and Roberts. Their contribution will be noted for its thorough and scholarly treatment of a difficult topic. The volume includes chapters that survey major divisions of the central nervous system, and, for a number of species, there are atlases based on line drawings and photomicrographs. The chapters dealing with CNS divisions include information from the primary literature as well as many new observations by the authors. These chapters are clearly and succinctly written, and the literature review is thorough except for the unfortunate omission of many Japanese and Russian studies.

In the second part of the book, the authors focus on the histological variation in brains of cartilaginous fishes and present an excellent series of line drawings and photomicrographs of four genera: *Hydrolagus, Squalus, Raja, and Scyliorhinus*. Although these genera were selected from each of the major taxonomic groups of cartilaginous fishes, they do not represent the diversity seen in the brains of these fishes. For example, both *Raja* and *Scyliorhinus* possess brains that are among the most generalized in their respective groups. Thus the large and complex brains exhibited by most batoids and most galeomorph sharks are not illustrated. Despite these omissions, researchers will find the atlases and summaries of major cell groups and known connections invaluable.

To me, the most disappointing aspect of the book is the absence of a biological context. The authors have scrutinized the literature and have presented a clear summary of what is known about the brains of cartilaginous fishes. As precise and thorough as this summary is, the analysis is not extended beyond this point. The authors do not suggest which features of the brains of cartilaginous fishes are primitive and which derived, let alone the possible origin and advantage of any derived features. In fact, there are few comparisons with the brains of other vertebrates, and there is no speculation regarding the significance of the independently evolved, complex brains of some sharks and rays. By restricting themselves to a summary of what is known, the authors have failed to communicate much of what is exciting about the brains of cartilaginous fishes.

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Evolutionary Theories

The Eclipse of Darwinism. Anti-Darwinian Evolution Theories in the Decades around 1900. PETER J. BOWLER. Johns Hopkins University Press, Baltimore, 1983. xii, 292 pp. $25.

In a letter of 1878 in which he observed that "now there is almost complete unanimity amongst Biologists about Evolution," Charles Darwin did not fail to add: "There is still considerable difference as to the means, such as how far natural selection has acted, and how far external conditions, or whether there exists some mysterious innate tendency to perfectibility." Indeed, the most ardent champions of Darwin in his own day—T. H. Huxley in England and Ernst Haeckel in Germany—differed from Darwin (and each other) in their understanding of how evolution works. By the turn of the century, disagreements regarding the causes of evolutionary change were greater than ever. Though August Weismann was touting the "all-sufficiency of natural selection," a great many of Weismann's contemporaries doubted his claims about natural selection and were furthermore highly skeptical that Weismann's style of theorizing could resolve the problems confronting them. Amidst a luxuriant growth of diverse evolutionary theories, "Darwinism" could claim no clear preeminence. One of Darwinism's least prescient critics went so far as to proclaim that Darwinism was on its "deathbed."

Until now, there has been no broad historical examination of the proliferation of evolutionary theories at the turn of the century (though Vernon Kellogg's *Darwinism To-day*, published in 1907, provides a superb contemporary review of the subject). Peter Bowler's book is thus an extremely welcome contribution to the literature of the history of biology. Generous in scope and containing a wealth of valuable insights, Bowler's book explores the different theoretical alternatives that were available to evolutionary biologists at the end of the 19th and the beginning of the 20th centuries. Though Bowler may not convince the reader that natural selection's popularity *before* the turn of the century was sufficiently widespread to justify speaking of an "eclipse of Darwinism" in the early 1900's (a phrase borrowed from Julian Huxley), Bowler does clearly demonstrate the great diversity and historical interest of the anti-Darwinian evolutionary theories that flourished in the decades around 1900.

Bowler identifies five basic kinds of evolutionary theory: selectionist, theistic, Lamarckian, orthogenetic, and mutationist. He surveys the basic elements of late-19th-century Darwinism, charts the decline in this period of theistic evolution (the idea that the course of evolution was designed by the Creator), and then dwells at length on Lamarckian, orthogenetic, and mutationist alternatives to Darwinian natural selection. Though his emphasis is more on general trends in evolutionary theory than on the particular kinds of evidence that individual theorists cited on their behalf, he does show for at least the American neo-Lamarckians that the different kinds of evidence available to paleontologists on the one hand and field naturalists on the other were reflected in the different ways these groups exploited Lamarckian theory.

Bowler sees the "eclipse of Darwinism" at the turn of the century as the result of two different factors operating simultaneously: a "backward-looking" return to "an earlier, largely teleological view of development in which the evolution of life was modeled on the goal-directed process of individual growth," and a "forward-looking" "more rigorous attempt to reform biology," which involved promoting the laboratory study of heredity and variation. With respect to the first of these factors, he explains that many anti-Darwinian theorists wanted very much to see evolution as an ordered process. Not only the Lamarckians (who preserved a place for purpose in nature by believing that the adaptive responses of organisms to their environments produced heritable organic change) and the orthogenesists (who believed that factors internal to organisms provided direction to the evolutionary process) but also the early mutationists—William Bateson, Hugo de Vries, T. H. Morgan, and others—were uncomfortable with the "randomness" of Darwinian natural selection. In making this point, Bowler is careful to note, however, that the philosophical and social implications of Lamarckism and orthogenesis had their own drawbacks. Lamarckism, though commonly associated with progressive notions regarding the possibilities of human improvement, was in its own day readily enlisted in support of ideas of racial inequality and separate social roles for the sexes. Orthogenesis, with its pessimistic notion of evolutionary lines running predetermined courses to extinction, offered a view of the cosmic process too chilling for many scientists to embrace.

The major weakness in Bowler's treatment of his subject is his failure to relate the various evolutionary theories he examines to the particular institutional contexts in which they were elaborated. He focuses almost exclusively on the internal logic of the theoretical alternatives in question. He writes of evolutionary theory being gradually (and inevitably) purged of its more conservative elements. Representative of his interpretative framework is the statement: "Had the experimental movement not been contaminated by extreme anti-Darwinian sentiments derived from [the] more traditionally oriented philosophy, the emergence of modern genetics might have been accompanied by a far less obvious repudiation of selection" (p. 219). This approach neglects the disciplinary stakes that were involved in the disagreements over the kinds of evidence and methodologies that were most vital to understanding how evolution works. Bowler expresses an inkling that the institutional structure of French science may have had something to do with the peculiar shape of anti-Darwinism in France, but he does not explore the possibility that the course of the evolutionary debates in England, Germany, or the United States may have reflected the organization (and ongoing restructuring) of science in those countries too. Neither what Bowler calls the "overenthusiastic" claims of the experimentalists, nor the competition between the biometricians and the Mendelians in England, nor the way the Lamarckians were forced into the experimental arena despite the fact that the main foundations of their claims lay elsewhere, can be fully understood by looking just at the logic of the theories involved. Future investigators of this subject will have to explore the extent to which being able to pronounce authoritatively on the issue of how evolution works played a role in the competition between disciplines for crucial resources: university positions, research funds, talented students, and so forth. In this regard it is certainly worth remarking that the United States, the home of the most distinctive school of Neo-Lamarckians in the late 19th century, was in the early 20th century the country in which opportunities to pursue academic biology changed most dramatically and at the same time the country where Lamarckism died fastest and genetics developed most quickly.

Bowler's book provides a much-needed overview of a rich and fascinating period in the history of evolutionary theory. The author is to be commended not only for tackling a subject that had been unduly neglected by historians of science but also for providing an account that is bound to attract more scholars to the small but growing number of historians of biology concerned with post-Darwinian issues. Biologists too should find Bowler's well-written account of interest. It is certainly worth knowing that disagreements among evolutionary biologists concerning how evolution works are not just a novelty of the 1970's and 1980's.

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Distributional Patterns

Biogeography. JAMES H. BROWN and ARTHUR C. GIBSON. Mosby, St. Louis, Mo., 1983. xii, 644 pp., illus. $32.95.

Biogeographers study the distributions of organisms. Historical biogeographers try to reconstruct the past positions and movements of plants and animals and decipher their causes. Neo-biogeographers tend to focus on either descriptions of biotic units or the ecological determinants of species boundaries. In its entirety, biogeography thus requires a knowledge of systematics, evolutionary biology, ecology, physiology, geology, and meteorology. Given the diversity of information that must be mastered in order to understand completely the various facets of the subject, it is not surprising that there have been few attempts to produce a modern, integrated biogeography textbook. In fact, since the 1960's there has not been a truly comprehensive book on either plant or animal geography. Brown and Gibson have now corrected this situation by providing a systematically balanced and almost encyclopedic treatment of the elements involved in biogeographical research. They include discussions of topics ranging from continental drift to community ecology and climatology to cladistics. Their discussions are replete with examples drawn from a wide array of terrestrial and aquatic plants and animals. Particular works are cited and the bibliography is extensive. There is, however, a decided bias toward studies centered in the American southwest.

The book is organized into four units dealing with the ecological determinants of plant and animal distributions, the past geological events that shaped species distributions, the modern geographi-