

Bird Song

Acoustic Communication in Birds. DONALD E. KROODSMA and EDWARD H. MILLER, Eds. HENRI OUELLET, Taxonomic Ed. Academic Press, New York, 1982. In two volumes. Vol. 1, Production, Perception, and Design Features of Sounds. xxxii, 372 pp., illus. \$36. Vol. 2, Song Learning and Its Consequences. xxxii, 390 pp., illus. \$39. Communication and Behavior.

The study of bird vocalizations, and of song in particular, has had an immense impact on our understanding of animal behavior. This has been most notable in the field of behavior development, where, following especially on the pioneering experiments of W. H. Thorpe during the 1950's, work on song has shown better than any other the intricate interplay between genes and environment during ontogeny. But, more recently, song has also contributed handsomely to our understanding of the mechanisms underlying behavior, most impressively through the studies of Nottebohm and his group on the neural pathways involved. Finally, song also poses some fascinating questions to those interested in the currently fashionable areas of function and evolution. Why does song vary so enormously between species, some having but a single short phrase while others have hundreds or even thousands? Why do pairs sometimes duet with each other? Why do some species mimic others? The questions are endless, and there are some ingenious ideas around about the answers to them, though, as so often in these matters, little hard evidence to help one choose among them.

The last book of reviews on this topic was *Bird Vocalizations*, published in 1969 to mark Thorpe's retirement. A new look at the field is therefore timely, and this one is dedicated to Thorpe's student Peter Marler, who shifted the center of gravity of the subject markedly westward when he moved to the United States some 25 years ago. But this is no retirement tribute, for Marler is still young and active, as his recent experiments on the early stages of sound production during development, reviewed here with Susan Peters, have shown. He

has also influenced a succession of excellent students, including Kroodsma, many of whom write in these volumes, so making the volumes very much a product of the Marler school.

Most of the chapters in the first volume are straightforward literature reviews providing useful synthesis but without breaking any particularly new ground. Here Brackenbury deals with sound production, Arnold with neural control, and Dooling with auditory perception. A chapter by Wickstrom on recording methods would have benefited from making more recommendations to the less technically minded and from being extended to cover forms of analysis. The good chapter by Wiley and Richards on transmission and detection is at an easier level than their earlier surveys on these themes. Becker gives a useful review of playback experiments to test for features important in species specificity, which is especially useful because much of the original work appeared in German. Less easy is a review by Miller of character and variance shift in acoustic signals; this is an interesting and neglected topic, but the chapter is heavy going and often obscure. Finally, this volume includes two chapters that attempt to argue more partisan cases. Morton presents what he calls the ranging hypothesis: that characteristics of bird songs and the occurrence of repertoires can be explained if individuals are selected to minimize cues listeners could use for distance assessment. I felt this too speculative: this subject is rife with theories any one of which may appear convincing with the use of selected data from a few species. The other chapter, by Catchpole, takes a broader sweep to present a strong case that the variation in song between species depends on whether inter- or intrasexual selection is predominant. This is a better case because it depends on broad, though informal, correlations among many species.

The second volume concentrates on song learning and its consequences and is the more exciting of the two. Kroodsma reviews song learning and, with Baylis, provides a bibliography of the evidence for its occurrence. The for-

mer chapter is excellent and full of stimulating ideas, as well as tantalizing snippets of unpublished data; the latter is unexceptionable, though Daines Barington would be upset not to appear on the list 210 years after his pioneering experimental study of song learning. A further chapter by Kroodsma wrestles with the problems of defining song repertoires and deals very clearly with the methodological problems of estimating repertoire size and variability, producing an impressive and much-needed discussion. Kroodsma commends the idea that repertoires evolved as a device to avoid habituation, though the evidence here seems weak and the argument based largely on the lack of a convincing alternative. There are a thorough review of individual recognition by Falls and one on geographical variation by Mundinger that usefully introduces some of the methods (and to a lesser extent some of the terminology) used by those studying human dialects. Mundinger appears inconsistent in what he means by "dialects," at one point defining them in terms of sharp boundaries and elsewhere applying the word to much broader categories of geographical variation. Here, as in a number of other places in these books, I felt there to be a need for more rigorous and quantitative data that can be tested against clearly defined null hypotheses.

Four chapters remain. Baker restates his case, largely from correlational evidence, that song dialects have genetic consequences. This is a controversial point that will be settled only by firmer, more quantitative data. Beer provides a typically thoughtful and elegantly worded epilogue on conceptual issues that remain unresolved in studies of communication. Finally, two of the best chapters in the books are by authors new to the field, Baylis on vocal mimicry and Farabaugh on duetting, features of acoustic communication the function of which it is especially hard to understand. Each surveys the occurrence of the feature and attempts to correlate it with other features of species biology. Mimics tend to have large song repertoires and not to be migrants, but there are striking exceptions, and Baylis rightly says the phenomenon is likely to have several functions: he reviews the possibilities and points to many possible experiments. Farabaugh is more successful in her search for correlates of duetting and identifies year-round territoriality and prolonged monogamous pair bonds as most important. From this she suggests that duetting has a role both in territoriality and in pair bonding.

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. NIEUWENHUYNS, 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 pre-eminence. 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.