gene frequency for the "Z" allele associated with serious problems in the homozygous state appears to be about 1 to 2% among Caucasian populations versus less than 0.1% among Oriental and African black populations), slow hydroxylation of mephenytoin (4% among Caucasians and Chinese versus 18 to 23% among Japanese), and the well-known associations of appreciable frequencies of abnormal hemoglobin and X-linked glucose-6-phosphate dehydrogenase deficiency genes with regions of the world that historically had a high incidence of malaria. There are also quite a few cases where the researchers report no difference or differences of twofold or less, including the clearance of paracetamol, primaquine, phenytoin, antipyrine, caffeine, and diphenhydramine, the frequency of genes for slow hydrolysis of paroxon, and levels of catechol-*O*-methyltransferase.

Two of the strongest papers in the book provide an important counterweight to the emphasis on interethnic differences. Masatoshi Nei reviews earlier work analyzing overall human genetic variation based on differences in proteins, blood groups, and mitochondrial DNA using data from the three major human racial groups. When the overall heterozygosity is subdivided into within- and among-population components, it is found that differences among the major racial groups account for only 6 to 11% of the total variation. Presumably genetic differences that could be associated with smaller "ethnic" differences would be less. Elliot Vesell, in a section emphasizing methodological difficulties in determining interethnic differences, provides a critical review of past claims of interpopulation differences in antipyrine metabolism. Among other things, he contrasts the ease with which four- to sixfold interindividual variability in antipyrine clearance can be demonstrated in small groups of subjects within populations with the difficulty of documenting average differences of twofold or less between groups distinguished by diet, geography, or ethnic origin.

Prudently, the papers in the final section of the book, Implications and Consequences, essentially ignore the "ethnic" component of variability. Drug regulatory authorities in different countries may well find the possibility of cross-national differences in response worrisome enough to require some local clinical testing and adaptation of clinical criteria and recommended dosages. However, there are in the book no proposals to use the "color coding" or ethnic origins of people as an important input for selecting either drug therapy or occupational or environmental health protection measures. The final discussion by Gilbert Omenn of implications of differential susceptibility to occupational and environmental exposures is a helpful review and guide to much other material.

Despite the distraction of the "ethnic" theme, this book is a good starting source of quantitative information on human interindividual variability as currently measured by clinical and experimental researchers. What is perhaps lacking in the book is what is lacking in the field itself—a more statistical/mathematical modeling perspective and analysis of the quantitative implications of all this variability for human health risk assessment. Current procedures for carcinogenic risk assessment essentially assume uniform susceptibility in populations, and procedures for setting tolerances for non-carcinogens use an arbitrary tenfold "safety" or "uncertainty" factor that has relatively little basis in empirical observations such as those which can be found in this book.

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Fish Behavior

The Behavior of Teleost Fishes. TONY J. PITCHER, Ed. Johns Hopkins University Press, Baltimore, 1986. xvi, 553 pp., illus. $57.50.

Birds and fishes are often compared because they are the dominant, obvious vertebrate animals in their respective media. Bird behavior, for which there is a vast literature, has been central to the conceptual development of ethology and behavioral ecology despite the fact that birds are a relatively conservative and, in some ways, atypical group. Because fishes occur in a hostile and inaccessible environment, comparatively little is known about their behavior. Aquarium observations of fish behavior, particularly aggression, contributed to the progress of ethology, however, and with the advent of scuba diving studies of fishes are becoming increasingly important to sociobiology and behavioral ecology.

The editor of this compendium has chosen a wide variety of topics that provide a good background on the subject. But I missed accounts of recent studies of territoriality and mating systems among coral-reef fishes and experiments on combat, through which the study of fish behavior has made exciting contributions. Overall, the book has a didactic tone, though some essays are written at a more advanced level. It will be useful to people getting started in the field and might serve well as a supplementary textbook for an ichthyology course or as the basis of a course in fish behavior. For a course, however, the emphasis is uneven: over half the chapters in the section on behavioral ecology treat feeding and predator-prey relationships, introducing an element of redundancy.

The book starts with a section on the bases of behavior, covering genetics (D. L. G. Noakes), motivation (P. Colgan), and development (F. A. Huntingford). Then comes a group of chapters on sensation. Written by physiologists, they form an impressive set giving the basics for vision (D. M. Guthrie), hearing (A. D. Hawkins), olfaction (T. J. Hara), and the lateral line (H. Bleckmann).

The largest section is entitled Behavioral Ecology. The chapters by P. J. B. Hart on foraging theory and A. E. Magurran on individual differences take a general perspective whereas the others address problems that are more distinctly piscine. Thus G. Turner describes mating systems. And R. C. Sargent and M. R. Gross theorize on the generality of male parental care, arguing that it can be explained by the cost to the female, in growth, of being the caretaker. Pitcher presents a masterful and lengthy essay on shoaling, shifting the emphasis away from the traditional concern for synchronization and polarization to the functional aspects of feeding and predation. He also uses "shoaling" as an inclusive term for aggregations and restricts "schooling" to the narrower set of polarized and synchronized groups. The remaining chapters here deal with the day-night turnover in fish communities (G. S. Helfman), intertidal fishes (R. N. Gibson), cave fishes (J. Parzefall), and sticklebacks (G. J. FitzGerald and R. J. Wootton). Much of the literature on cave fishes has been in German, so Parzefall's chapter, making it available to the English-speaking audience, is welcome.

Fisheries biologists have been reluctant to accept the study of behavior as important to their tasks. Yet many fisheries questions have behavioral answers. Fisheries biologists, for example, want to know when and where to find fish and how they get there. How can they be caught with nets, traps, baits, or lures? In the last section, C. S. Wardle presents an impressive demonstration of how, by incorporating information about behavior and physiology, one can design a superior trawl, even one that sorts the catch and permits the escape of undesired species. In fresh waters, managers need to know how to improve habitat, to guide fishes, and so on (K. O'Hara).

The authors were charged with establishing principles, giving the evidence, creating

an awareness of controversies, and ending on the frontiers of the topic. The looking-forward component is present in only a few chapters. Sargent and Gross enumerate a number of important questions to be answered about the adaptiveness of caretaking. Hawkins points to unresolved issues regarding the directionality of hearing, and Hara draws attention to unanswered questions in the evolution of alarm substances. Pitcher's conclusions on shoaling are clearly forward-looking. FitzGerald and Wootton had an advantage in that sticklebacks are the only fishes for which the literature begins to rival that of birds; thus there are now several contradictory findings to spur future research, as evidenced by their claim that reports of paternal male sticklebacks cannibalizing their own eggs may be incorrect.

The editor obviously spent considerable time pulling the chapters together and refining the presentations. But in such a large volume errors are unavoidable. Some authors regularly confuse "fish" with "fishes," and I found the number of typographic errors disconcerting at times, including the printing of one line twice in succession and omission of part of another on p. 192. But these are minor complaints. This is a marvelous and long overdue book.

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