

Bird Coloration. Volume I: Mechanisms and Measurements.—Geoffrey E. Hill and Kevin J. McGraw [editors]. 2006. Harvard University Press, Cambridge, MA. 624 pp., 32 color illustrations. ISBN 0-674-01893-1. \$95.00 (cloth).

What is a bird without its colors, and how much richer are our lives because of them? In the opening statements of this book's preface, the role of avian coloration in our lives is put into context: "Interest in the bold and brilliant colors of birds comes naturally. Like birds, but unlike most other mammals, humans are visual animals... we are struck by the vivid scarlet wings of a Ross's Lourie (*Musophaga rossae*) or the iridescent blue chest of a Fork-tailed Woodnymph (*Thalurania furcata*). To wonder how and why birds should display such pleasing coloration is inescapable" (pg. vii). Certainly, my childhood fascination with and attraction to bird coloration has matured into my intrigue and research into the physiological

mechanisms behind avian pigmentation. I found this book extremely valuable for a number of reasons and for anyone interested in the "how" of avian coloration, this book is an essential reference.

This impressive compilation of 12 chapters from ten contributing authors includes four chapters from its editors, G. E. Hill (Auburn University) and K. J. McGraw (Arizona State University), two of the most prolific contributors to the primary literature on the evolutionary significance and proximate bases for avian coloration. There are three main divisions to this volume. Part I includes four chapters on color perception and measurement. The chapters on color quantification (S. Andersson and M. Prager, Göteborg University, Sweden) and on color analysis (R. Montgomerie, Queen's University, Canada) provide comprehensive backgrounds on colorimetrics and how to implement and interpret colorimetric data using the most objective methods for assessing plumage coloration. I. C. Cuthill's (University of Bristol, UK) contribution on color perception includes a thorough treatment of vertebrate color vision, with a comparative approach to human and avian visual systems, and the most up-to-date review on the perception of color in birds. This chapter is well integrated with that of M. Théry (Muséum National d'Histoire Naturelle, France) on the influence of environmental light on color perception and its influence on the evolution of visual signals in birds.

Parts II and III focus on the mechanisms of avian coloration. Part II includes five chapters on the occurrence, properties, and physiological processes involved with avian pigments. Three of these chapters by K. J. McGraw are among the best written and informative of the book, dealing with the major types of pigments found in avian tissues, namely carotenoids, melanins, and the "uncommon" pterins, porphyrins, and psittacofulvins. R. O. Prum (Yale University) provides background on structural coloration, a topic that necessitates a more technical, physical description of color production. R. Montgomerie contributes a chapter on "cosmetic and adventitious" colors, i.e., those that are strictly exogenously obtained (other than through diet) for sexual displays or crypsis, for example the colorful decorations used to adorn the bowers of bowerbirds, changes in color that accompany the sloughing of the tips of feather barbules, or the colored compounds birds may use to stain their plumage.

Part III has three chapters on the control and regulation of color expression. R. T. Kimball (University of Florida) provides a most thorough, informative, and intriguing review of the endocrine influences on avian coloration. N. I. Mundy (University of Cambridge, UK) offers an overview of the genetic control of avian color variation. The first third of this chapter covers the more traditional aspects and examples of single-locus to oligogenic bases for inheritance patterns in color variation and polymorphisms in birds. Relatively little is known about the genetic regulation of avian color patterns at the molecular level, and what little has been elucidated largely comes from this author's work with the regulation of melanogenesis in birds. Thus,

Mundy devotes much of the chapter to describing our state of knowledge of how melanocortin-1 receptor (MC1R) activity may control melanin synthesis in the melanocytes of developing feathers. The author urges that research on the molecular genetics of avian color variation is needed. Perhaps more than any other line of questioning into the mechanisms of avian color variation, answers arising from the application of the dramatically and rapidly accelerating advances in molecular genetics will be the most enlightening. The need to update this chapter will undoubtedly be more imminent than any other component of the book.

The book concludes with a chapter by G. E. Hill on the possible environmental factors affecting coloration, for example parasite load, nutritional status, and social status. The magnitude of the influence of these factors on ornamental coloration remains equivocal, due to the interplay of the environment or any stressors therein with other more discrete and complex physiological mechanisms that ultimately determine how pigments are metabolized, transported, or deposited.

Such admirable attempts at synthesizing the state of knowledge on animal coloration have not been published since Fox and Ververs (1960) and Fox (1976). Denis L. Fox, the author of the latter review, served as professor of marine biochemistry at Scripps Institute of Oceanography in La Jolla, California, and curator at the San Diego Zoo. It was during his tenure in this latter position that Fox performed much of his pioneering work on the biochemistry of carotenoids in the Phoenicopteridae and established himself as one of the foremost experts on the biology of animal colorants. Certainly, the field of avian coloration has advanced tremendously since then, and while much of the research has focused on the evolutionary significance and function of coloration in birds (nicely summarized in this book's companion, *Volume II: Function and Evolution*), the mechanistic bases for color variation in birds has acquired increased momentum in the last decade.

Thus, this volume's synthesis of over 1500 primary research and review papers, beautifully supplemented with 32 striking color plates, represents a timely and epic tome that is best suited for those working in the field of avian coloration due to the highly technical nature of many of its chapters.—CARON Y. INOUE, Department of Biological Sciences, California State University, East Bay, Hayward, CA 94542. E-mail: caron.inouye@csueastbay.edu

LITERATURE CITED

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