BOOK REVIEWS

Comparative Oology

Egg Incubation. Its Effects on Embryonic Development in Birds and Reptiles. D. CHARLES DEEMING and MARK W. J. FERGUSON, Eds. Cambridge University Press, New York, 1992. xiv, 448 pp., illus. $195.

The egg of amniote vertebrates has been a key evolutionary innovation, allowing developing embryos to draw on a maternally provided package of micro- and macronutrients in the face of the hydric and temperature extremes that characterize terrestrial environments. With its precisely defined geometrical shape and its semipermeable shell with well-characterized physical properties, the egg is in many ways an ideal object for physiological inquiry. Fluxes of water and gases through the shell can be predicted from first principles of biophysics, and such predictions have been tested with elegant experiments and physiological measurements.

This volume provides an integrated perspective on amniote egg biology in a set of 27 review papers from diverse areas of biology. The volume is unique in the comparison it offers of avian and reptilian egg physiology. These two vertebrate classes are largely dichotomous in their strategies of egg incubation, reflecting divergence with respect both to presence or absence of parental care and to adult temperature regulation (endothermy in birds and ectothermy in reptiles).

Water and gas exchange are intimately related to temperature regulation. Temperature regulation of eggs can be effected by parental behaviors (as in most birds) or the eggs can be left to vagaries of the environment once a suitable oviposition site has been chosen (as in most reptiles). Endothermy permits birds to incubate eggs at relatively constant temperatures in spite of fluctuations in ambient temperature. With such temperature control, the flux and utilization of water in the embryo are quite predictable given a defined environmental regime. The avian egg begins with sufficient water to complete development, during which there is a net loss of water from the egg. The avian egg has a rigid shell with a defined size and number of pores through which water loss, as well as carbon dioxide and reciprocal oxygen exchange, is regulated. In contrast, most reptilian eggs require a net gain of water after they are laid, and a moist oviposition site becomes crucial for hatching success. However, the soil in and around the nest that provides the necessary water also dramatically limits gas exchange, and many reptilian eggs are endowed with a "parchment shell" that permits the rapid gas and water exchange necessary in the subsoil environment. There are exceptions to this pattern of differences, however. One example discussed in the book is the case of megapode birds, which bury their eggs in soil mounds, an environment very similar to that of the eggs of crocodilians and chelonians (turtles), and there are interesting parallels in the phenomena of gas exchange among these animals.

Most of us have encountered avian eggs in the natural environment, where they are in fact quite accessible. As is reflected in this volume, avian physiological ecologists have provided us with a wealth of studies on eggs in natural environments that allow interpretation of laboratory findings in ecological and evolutionary terms. In contrast, the inaccessibility of and difficulty of finding most reptilian nests, buried as they are below ground, has largely limited advances in the physiological ecology of reptilian eggs to the laboratory. For example, the temperature dependence of reptilian environmental sex determination has now been documented in many groups (crocodiles, turtles, geckoes), but there are only a handful of studies on the conditions in natural nests, and as yet no comprehensive studies on the ecological consequences of environmental sex determination. Interestingly, environmental sex determination, which is widespread in reptiles, is unknown in birds, in which all species for which data are available have chromosomal sex determination. This is not surprising given the more precise control of avian incubation environments.

There are other differences between bird and reptile eggs that are explored in this work, but the ultimate causes of these differences are not fully understood. Diapause during incubation, which is a state of embryonic "suspended animation," has evolved repeatedly in some groups of reptiles. Likewise, viviparity and ovoviparity, which both result in the birth of live young, are evolutionarily quite labile in reptiles. No birds exhibit either diapause or viviparity. Our understanding of these phenomena will depend critically on future studies of reptilian egg incubation in nature and of the hormonal factors leading to egg retention.

This book provides an authoritative summary of achievements in the physiological ecology of egg incubation of birds and reptiles, not only reviewing recent developments in this field but defining areas for inquiry. It is exactly what is required for advances in our understanding of the physiology and evolution of the amniote egg.

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An Appetite

Sodium Hunger. The Search for a Salty Taste. JAY SCHULKIN. Cambridge University Press, New York, 1992. xii, 192 pp., illus. $54.95.

The appetite for salt provides an excellent model for the study of motivated behavior because it is easy to induce and to quantify. The sensory stimulus is sodium, the sensory system is gustatory, and the key factors are hormones acting on the brain. In natural circumstances sodium appetite develops as a result of a nutritional deficiency or during pregnancy and lactation. In the laboratory, it is induced by creating a negative sodium balance. Jay Schulkin has provided a salient review of studies on salt appetite in this book. The five chapters that make up the core of the book cover salt-seeking behavior down to the possible neural circuits involved. Each chapter is flavored with behavior, hormones, gustation, physiology, and the central nervous system. The monograph is well illustrated and studded with chatty examples of other motivational systems to emphasize the generality of sodium appetite as a model.

Schulkin starts with the search for salt-seeking behavior, built upon Derek Denton's classic work, but despite the arresting picture on the cover of an elephant with its trunk deep in (presumably) salt-tasting soil, the book is not about the ecology of salt appetite. It is almost entirely about the laboratory studies that have been performed on rats. The innate hunger for sodium is clearly seen in the adrenalectomized rat. Without the adrenal gland the animal loses the sodium-retaining hormone, aldoste-