has given us a handsomely illustrated demonstration of how he and other 20th-century herpetologists have relied on physical principles in seeking explanations of feeding, locomotor, and respiratory adaptations of amphibians and reptiles.

Gans restricts himself to four topics: egg eating in snakes, locomotion in snakes and other limbless vertebrates, burrowing adaptations in the amphisbaenians (a group of mostly limbless Squamata traditionally classified as lizards), and respiration in frogs. Superimposed on these four sections is a sequence of short expositions of basic physical principles, set off in boxes from the text but topically related to it. Thus, an introductory description of egg ingestion is used as an occasion for a boxed introduction to vector addition, illustrated by the forces that a snake's teeth exert on the egg's surface; a description of vertebral specializations for puncturing ingested eggs prompts a boxed disquisition on strength of materials; and so on. Sometimes the highly simplified treatments that result are not very happy from either a mechanical or a biological standpoint. The analysis of egg-biting neglects the frictional forces and cranial kinematics that characterize the real situation and so winds up giving the mistaken impression that forces exerted against a surface are always normal to it. A later analysis of a fingertip resting on a ledge, used to introduce concepts of couples and moments, is almost incomprehensible because some forces have been diagrammed as vectors and others as torques (and others not at all) and the distal interphalangeal joint has been treated as if it were immobile.

So, despite the title, this is not a book to go to for an introduction to vector addition or beam theory. What it does provide is an excellent introduction to the way in which a first-rate functional morphologist tries to figure out how animals do the things they do and why they are constructed the way they are. Gans tries to articulate some general principles of functional morphology in an introductory chapter condensed from another book in progress, but he need not have bothered; the care, clarity, and honesty with which he builds up the case for each of his interpretations of reptile morphology and the obvious pleasure he takes in defining unanswered questions communicate these principles much more impressively.

The longest and most fascinating section of the book is the analysis of burrowing in amphisbaenians. Four modal head shapes among amphisbaenians are described. By the end of the chapter, Gans's biomechanical analysis of anatomical and behavioral data has established that the most common head shape is associated with a tunneling mechanism in which soil is displaced by use of the head and trunk as a ramming piston sliding back and forth within a looser sleeve of scales so that friction is in effect eliminated during the acceleration of the piston. The other three head shapes correspond to burrowing patterns in which the head is rotated back and forth around one of its three principal axes. Gans's path to these conclusions takes him through expositions of moisture balance and energetics in subterranean animals, growth mechanisms and biomechanics of bone, pinnateness and length-tension relationships in muscle, deformed-coordinates analysis, the mechanical properties of soils, predatory behavior, the mechanics of cranial sutures, masticatory stresses in vertebrate skulls, and cochlear microphonics. These and other diverse themes are brought together into an ingenious set of postulated relationships between digging behavior, cranial shapes, auditory mechanisms, prey detection, and vertical and horizontal distribution in the Amphisbaenia. In the process, Gans draws some unobtrusive morals concerning the opportunistic nature of evolution and the folly of taking any animal as a typological representative of any of the groups it belongs to. Here and elsewhere, the book is both exciting and chastening. It is well worth the price of admission for any student of evolutionary morphology.

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Insect Endocrinology

Insect Hormones and Bioanalogues. K. SLÁMA, M. ROMAŇUK, and F. ŠORM. Springer-Verlag, New York, 1974. x, 478 pp., illus. $45.90.

Until publication of *Insect Hormones and Bioanalogues*, collaborations between biologists and chemists on this subject had resulted in mere anthologies, disjointed in theme and perspective. Sláma, Romaňuk, and Šorm have at last produced a comprehensive monograph to which researchers in the natural sciences at large, as well as specialists in insect endocrinology, can turn with relief. More than 20 years of research are integrated into 470 pages of text.

A pioneer in insect endocrinology, Sláma appears to have masterminded the project, since two thirds of the book is under his authorship, including surveys of insect neurosecretory mechanisms and general endocrinology. Romaňuk and Šorm review the chemistry of juvenile hormones, ecdysones, and many bioanalogues and offer in detail the published synthetic routes for their preparation. Extensive tables and bibliographies support each chapter and are characteristic of the tone of the book, which is documentative, rather than evaluative.

The description of insect endocrine anatomy and morphology is worthy of special notice, even though these topics have been covered by other recent publications; and readers will find the chapters on hormone physiology and bioassay evaluation to be equally instructive.

Yet, despite its significant merits as a repository of information, *Insect Hormones and Bioanalogues* must be cited also for its perhaps unavoidable shortcomings. For example, sections pertaining to endocrinology gloss over the behavioral and ethological implications of insect neuroendocrine functions, which are of pressing interest to insect physiologists and population biologists alike. More extensive coverage of the molecular and gross genetic foundations of insect endocrine action would also have been welcome.

Moreover, the presentations of developments in the study of hormone biosynthesis, distribution, metabolism, and mode of action are largely out of date. A similar criticism can be leveled at the sections on hormone structure-activity correlations for failing to focus on the alkyl 2,4-dodecadienoates—so-called "Entocons" introduced by Zoecon Corporation—novel bioanalogues that have shed more light on the practicability of insect control with hormones than any other set of analogues studied in the last 10 years.

This is a commendable book, in short, if it is approached by discerning readers as a guide to classical work in insect endocrinology or as an annotated glossary of the many obsolete bioanalogues prepared in the still unresolved quest for "third generation pesticides."

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