unique area that faces threats to its ecosystems. It analyzes, side by side, biogeographic data on the flora and several faunal components of the same geographic region. And it pulls together separate analyses to offer insight into a number of biogeographic principles and competing models. The tables on the distribution of organisms on Gulf islands and, in many cases, the neighboring Baja California peninsula and Sonoran desert provide a valuable biological data base. Most of the contributing authors address current theories, both in biogeography and with regard to episodes of vulcanism and land-bridge connections in the region. Many test their data against different models. However, extensive quantitative testing against null models is neglected, an omission that will rankle some biogeographers.

Setting the physical scene is a paper on the geology and ages of the islands by Gordon Gastil, John Minch, and Richard Phillips. Physical oceanography is covered by Linda Maluf. George Lindsay provides a chapter on the history of scientific exploration of the area. Donald Thomson and Matthew Gilligan analyze an impressive set of data to ask if Gulf islands are "biogeographic islands" to rocky-shore fishes. The results do not conform to predictions from the dynamic equilibrium model.

Understanding of terrestrial faunas usually depends on knowledge of the flora. Cody, Reid Moran, and Henry Thompson provide important work on the plants, looking at generalities as well as more specific ecological and evolutionary considerations for selected genera. Robert Murphy examines origins and evolution in reptiles and finds that patterns of extinction and deterministic aspects of the distribution suggest explanations deriving from paleogeographic legacy, rather than equilibrium theory. In a second excellent chapter on reptiles, Case does not entirely disagree with Murphy, but his approach is ecological and his style more along the lines of those involved with equilibrium theory.

Cody's chapter on land birds is an important study on the ecology and evolution of Gulf and adjacent mainland avifaunas. Daniel Anderson discusses distribution and feeding ecology of seabirds, for which food and predator-free nesting substrates are the most important determinants of distribution and abundance. A chapter by Timothy Lawlor is a major summary of the ecology and evolution of land mammals in the area, which seem to conform to legacy rather than to equilibrium theory explanations. Of special interest are Lawlor's ideas on the evolution of body size on islands and refinements of earlier thoughts on the relation of size to food availability, diet, and feeding behavior.

"Breeding brown pelicans (*Pelecanus occidentalis*) on Isla San Pedro Martír. Dense populations of pelicans and several other seabirds breed on this small and steep island." [From *Island Biogeography in the Sea of Cortéz*]

Conrad Bahre, writing on human impacts on the midriff islands, provides an interesting overview of occupation and use from earliest times, up through the egging and guano-gathering periods of more recent time. Commercial and sport fishing and the taking of sea turtles for food are cause for continuing concern.

The concluding chapter by Case and Cody addresses all of the current models in biogeography, providing a concise summary of the theory and practical aspects and comparing the results obtained by each of the contributors. Ultimately, the islands in the Sea of Cortéz are limited with respect to testing the equilibrium model. Instead, we are reminded that support or confirmation of competing theories in biology often depends on which organisms are studied. Brief overviews are also given of competition, predation, coevolution, historical legacies, and the taxon cycle as they relate to island biogeography in the Gulf. There is still much to debate, but it is not a matter of what Case, Cody, and the contributing authors say, or fail to say. Rather it is a manifestation of the dynamic state in which biogeography is found at the present time.

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Biological Structures and Processes

A Mammalian Appendage

Deer Antlers. Regeneration, Function, and Evolution. RICHARD J. GOSS. Illustrated by Wendy Andrews. Academic Press, New York, 1983. xvi, 316 pp. $45.

One of the beauties of biology is the plethora of apparently erudite topics that, in the hands of an appropriately literate author, can form the basis of a book of the "cannot-be-put-down-until-finished" variety. Deer antlers are such a topic; R. J. Goss is such an author; and this is such a book.

Goss, widely known for his publications on regenerative phenomena in animals, here summarizes his 25-year fascination with the only known mammalian appendage capable of total regeneration.

The first three chapters introduce the topic, familiarize the uninitiated with the "dramatis cervidae" in thumbnail sketches, and distinguish between antlers and the more widespread horns and tusks. The chapter reviewing the evolution of deer reveals that, though cervid artiodactyls are the only extant forms with renewable antlers, several extinct

taxa possessed an exuberance of cephalic appendages, many of which were apparently replaced in a similar fashion.

The consideration of the social significance of antlers, explanations for which are much less clear-cut and much more diverse than most biologists probably realize, permits Goss to lay the foundations of a theme that permeates the rest of the volume: biological phenomena (one is tempted to emphasize especially those associated with development, sensu lato) cannot be understood unless appropriate attention is paid to the organisms living in their natural environments.

Chapters 6 through 8 review the postnatal appearance and histogenesis of normal antlers and compare the information with that for other regenerating systems. Chapters 9 and 10 address the subject of abnormal antlers and discuss the matter of symmetry versus asymmetry. The latter question is part of an issue of great current interest to developmental biologists, pattern formation, and thus deserves wide attention. In addition these data lead the reader from consideration of the genetic underpinnings of antlers to consideration of the effects of external environmental cues, especially light, and the internal environment on their growth. Because most biologists probably assume that sex steroids are predominantly important in this context, two issues should attract the attention of endocrinologists. First, whereas circ-annual patterns of circulating titers of testosterone correlate clearly with the cycle of antler production, spermatogenesis and sexual behavior, each equally influenced by the steroid, vary subtly in their relation to antler growth and shedding in different species. Second, in spite of the copious documentation of the effects of photoperiodicity on the cyclic production of antlers, experiments involving pinealectomy have proved quite inconclusive—the cycles remain, but are delayed. The author emphasizes the promise the study of antlers offers to further our understanding of biological rhythms.

Chapters 13 and 14 provide ample evidence of the value of studying "exotic" phenomena with regard to furthering our understanding of clinical problems. Castrated deer produce antleromas, which, because they grow continuously, not only are extraordinary models for studying tumor growth (although, in contrast to horns, where squamous cell carcinomas occur, antleromas never metastasize) but also manifest cellular pathologies comparable to keloids or hypertrophic scars. That antlered does and antlerless bucks are known to be fertile is, in the author's words, "a reminder of how fragile the distinction between the sexes can be" (p. 288); reference to and discussion of human clinical malformations and dysfunction with reference to the anatomy and physiology of reproduction accompany these data.

The final chapter, on the medicinal uses of antlers, is historically and ethnologically fascinating but simultaneously evokes hope and sadness concerning the relation between humans and nature. Goss refrains from speculation on how or when in prehistoric times some Oriental (?) shaman proposed a variety of therapeutic purposes for antlers and other cephalic appendages. What are currently known as Grade A cervid antlers must be obtained at a stage in their development when they contain a maximum of testosterone, a fact that gives some credibility to the putative aphrodisiac qualities of cephalic appendages. The world's rhinoceroses are being slaughtered at a horrifying rate on the patently impossible assumption that their horns (concentrations of hair) have such properties. Europeans carelessly introduced deer into New Zealand to the detriment of the endemic flora and fauna; when their populations began to damage pasturelands they were slaughtered en masse from the air. A new business of farming antlers, a renewable resource, has developed in New Zealand over the past 20 years to meet the demands of the Oriental marketplaces. However humane the methods used in this industry, one wishes that *Homo sapiens* in the late 20th century would not earn money by mutilating one species, even if others might survive, albeit marginally, as a result.

Goss's precise yet fluid style of writing highlights our areas of knowledge and ignorance. A reviewer cannot begin to convey the wealth of fascinating data in this handsomely produced volume with excellent bibliographies for each chapter and a comprehensive index. Its contents reveal how unicorns *could* have been recognized (at least those with cloven hooves) and will have broad appeal to a large audience. The layman who studies deer along the sites of a hunting rifle has provided many useful data in the past and will find here more useful things to look out for; professional biologists from every discipline will find this book a source of enormous delight and interest.

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Microbial Growth

Growth of the Bacterial Cell. JOHN L. INGRAHAM, OLE MAALØE, and FREDERICK C. NEIDHARDT. Sinauer, Sunderland, Mass., 1983. xii, 436 pp., illus. $25.

This textbook on microbial physiology was written for advanced undergraduate and graduate students who have a background in biochemistry and genetics. It would be an appropriate textbook for a specialized course on microbial biosynthesis that followed a broadly based course on microbial physiology. The book is concerned with the biosynthesis of cell material and covers the energetics and regulation of cell synthesis in great detail. Only 20 pages are devoted to catabolism of organic compounds, and these primarily show how catabolic pathways provide the precursors for biosynthesis. The authors have restricted themselves to results obtained with *Escherichia coli* or its cousin *Salmonella typhimurium*. This approach excludes a number of interesting topics, such as the cell cycles of *Caulobacter* and myxobacteria and sporulation in *Bacillus*. However, it does keep the development of topics on track by avoiding bacteria that have unique characteristics. Furthermore, as the authors correctly point out, many of the critical discoveries in microbial physiology were made with the use of enteric bacteria. The book emphasizes an experimental approach to the topic. Several chapters include some discussion of applicable experimental techniques, and this material is very appropriate in an advanced textbook.

After an opening chapter on the composition and structure of *Escherichia coli* to orient the reader, the authors begin their discussion of biosynthesis by considering the assembly of supramolecular structures in chapter 2. In the next chapter, macromolecular polymerization and the biosynthesis of building blocks are covered in a novel and illuminating fashion. Not only are mechanisms and pathways discussed, but in a series of tables the energetic costs of macromolecules and building block biosynthesis are calculated. This approach provides much insight into what is involved in the synthesis of an *E. coli* cell. For example, the tables illustrate that 96 percent of the energy costs for polymerizing macromolecules is expended in making protein and that *E. coli* expends seven times more energy in a minimal growth medium than in a rich medium to provide the building blocks for macromolecular synthesis. This chapter is the strongest in the book,