temperature of an inanimate reference object the shape of a lizard and weighing 5 grams in the microclimate where a lizard perches. In practice, the GBTI is not measured directly but is predicted from measurements of solar radiation, air speed, and air temperature. The GBTI is useful in mathematical descriptions of the way some species of *Anolis* partition the habitat, but it does not predict the actual body temperatures of the lizards or their physiological responses to heat. In contrast, a large body of descriptive and experimental study has led physiological ecologists to generalizations about the ecological significance of exactly those features of the thermal biology of lizards. (For a review see R. B. Huey, in *Biology of the Reptilia*, vol. 12, pp. 25–91.) Consequently, the lack of correspondence between GBTI and conventional measurements of thermal ecology is disappointing. Is the concept of GBTI flawed, perhaps because of the two-steps-removed-from-reality method used to measure it? Or have the assumptions of environmental physiologists about the ecological relevance of the responses of organisms to temperature been too optimistic? Answering questions of this sort will clearly require the broadly integrative approach exemplified by the best papers in this symposium.

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Ungulate Behavior

Gazelles and Their Relatives. A Study in Territorial Behavior. FRITZ R. WALTHER, ELIZABETH CARY MUNGALL, and GERALD A. GRAU. Noyes, Park Ridge, N.J., 1983. xiv, 242 pp., illus. $28. Noyes Series in Animal Behavior, Ecology, Conservation and Management.

The subtitle of this book is precise: it is a study in territorial behavior, not a biology of the gazelles and their relatives (restricted here to *Gazella* plus springbok, blackbuck, gerenuk, and dibatag). The senior author began studying gazelles in East Africa in 1964 when, the preface claims, there were only "ten researchers in the whole world" engaged in such studies. The style of the book, both literary and scientific, owes much to those days of observational, descriptive, sometimes idiosyncratic ethology.

The central theme is the form of the model territory and the actions of the model territorial male. This is territory as viewed by the human observer: its shape and size; the features it contains; the locations and numbers of its dung heaps, paths, and scent marks. And actions as viewed by humans, too: ritualized urination-defecation; actions in marking; fighting techniques; courtship displays. This catalogues the form of territoriality: the typical territory has A, B, and C; the typical owner does X, Y, and Z. The model territory, with its full complement of dung heaps, scent marks, and "object agression sites," is, in the eyes of the authors, developed only after months of activity by an owner. Behavioral ecologists have tended to overlook this slow development of the perfect territory, assuming that even a recently acquired territory functions fully.

The book undermines some treasured assumptions about territorial marking. Static-optical marking, for instance, is said to involve no special displays. Scent marks are important, the authors believe, not in territorial defense but to the owner himself, aiding his orientation within his territory and enhancing his "self-security." Similarly the preorbital glands opened in agonistic and sexual encounters probably function for "self-stimulation and reassurance." The possibility that secretion from skin glands on the forehead is deposited on vegetation during "horning" is denied; bushes are instead subjected to "object aggression."

The writing is simple and qualitative, suiting a general audience. Yet the central theme and interpretations will be most critically read by those with preexisting knowledge of the many forms and functions of territoriality in ungulates. The authors set up the defense-of-sufficient-resources model of territoriality as a straw man before rejecting it in favor of the model of defended reproductive opportunity. Yet they believe that territoriality in the absence of females shows that reproduction is not its only function. Other possible functions discussed include effecting differential distribution in the population, aiding population surveillance of predators, and acting as a "brake" on the population's migration, for which nonterritorial males are the "pushing motors."

Strangely for a book centered on the model territorial male, benefit to the individual is underplayed. Indeed, adaptiveness of territory-holding as an individual reproductive strategy is not analyzed, nor are variant tactics compared. This is a verbally and pictorially well illustrated account of one form of territoriality to which the Antilopinae are shown as conforming. Readers who enjoy speculation about adaptiveness must supply it themselves; but they will be strongly reminded that there remain researchers who feel that form must be thoroughly catalogued before function dare be inferred.

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Neuromuscular Physiology

Muscles and Their Neural Control. GRAHAM HOYLE. Wiley-Interscience, New York, 1983. xiv, 690 pp., illus. $59.95.

Most books on muscle structure and function to date have focused upon a limited set of topics—the molecular basis of contraction in vertebrate fast-twitch muscle probably being the most frequently reviewed. This book by Hoyle is the only recent one that discusses neuromuscular physiology from a comparative, evolutionary viewpoint. The author covers a wide range of topics, including ultrastructure, biophysics, innervation pattern, development, and plasticity of invertebrate and vertebrate skeletal muscle. Many of these same topics are also covered for smooth and cardiac muscle. The text also has an excellent discussion of nonmuscular contractility, including amoeboid and ciliate processes.

With relatively few exceptions (such as a chapter outlining neuromuscular mechanisms in different classes of organisms ranging from the Coelenterata to the Chordata), the author takes a conceptual approach, rather than undertaking an encyclopedic listing of data. One strong advantage of the conceptual approach is that data can be organized to bear on more or less controversial hypotheses. This approach is perhaps best illustrated in a chapter on the evolution of muscles and their control mechanisms. For example, evidence is presented for simple reflex control, compared to evidence for control by various "motor pattern generators" or "sensory tapes." Similarly, the hypothesis that all muscles are phylogenetically related is discussed (pp. 601–602). The conclusion is, "The differences between muscle cells [in organisms from different phyla] are enormous and are such as to make it quite likely that Carl Pantin and the others have indulged only a speculative fancy. Until much more is known about the comparative ultrastructure and molecu-

lar components of a wide range of both cross-striated cells and smooth ones alike, the possibility of there being more than one molecular element generating contraction must be considered. Likewise, the possibility that they might have had independent, polyphyletic evolutionary origins is at least as good as an assumed homogeneity and common ancestry."

The conceptual approach in a single-authored text can lead to a tendency to select data to bolster one's own hypotheses and to slight alternative hypotheses. In this case, the tendency is exacerbated by the author's belief as stated in the introductory chapter that most scientists who have studied muscle have assumed that vertebrate skeletal twitch muscle should provide the model for all other muscle types. Often such scientists "are not familiar with, and act as if unwilling even to consider, available knowledge on more than a very few muscles" (p. 3). Perhaps in reaction to this situation, the author in presenting his own hypotheses and data sometimes extensively cites his own (quite significant) contributions while ignoring or citing only briefly the work of others in the field. There is also relatively little space devoted to the molecular events of contraction, perhaps because, in the author's view (p. 608), "The seriousness of the search for muscle's presumed 'Holy Grail,' the X bridge cycle, resembles nothing so much as that evinced in medieval times concerning how many angels may stand on the head of a pin. Now, however, the question concerns the type of dance they are performing on it." On this and other topics, Hoyle may present his personal viewpoints, but he is certainly not dull in either his hypotheses or his rhetoric. This book really should be read by the audience to which it is directed—research scientists in the field and students in courses on locomotion or the neural control of behavior.

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