

Book Reviews

Magnetic Orientation in Animals. By ROSWITHA WILTSCHKO & WOLFGANG WILTSCHKO. Berlin: Springer-Verlag (1995). Pp. 297. Price DM198.

Animal orientation in relation to the geomagnetic field has long been a controversial field of research, filled with scepticism and disagreement among biologists. Recent scientific progress in this field has generated a huge number of experimental results and greatly increased our knowledge of behavioural responses and of the physiology of magnetic orientation in different organisms. Widely different approaches have been used to study the magnetic compass with interest focusing on the function of the compass and mode of perception. Although behavioural responses to magnetic field manipulations are fairly well described in many species, how the magnetic field is perceived is still largely unknown. Plausible mechanisms for magnetic field detection have been described only for the so-called magnetotactic bacterium (magnetite) and elasmobranch fish (ampullae of Lorenzini).

Magnetic Orientation in Animals is an extensive survey over geomagnetic field effects on animal behaviour and orientation. The book is divided into five main parts, each with a number of subheadings. The titles in the contents list give a good summary of different research areas and allow easy access to fields of specific interest, making it a valuable reference book. Most aspects of magnetic orientation are covered, with a bias on behavioural studies on birds merely because bird orientation has been most thoroughly investigated. In the first part, the reader gets a physical description of the Earth's magnetic field and is introduced to experimental techniques for manipulating direction and strength of magnetic fields. In the second section the authors cover passive magnetic field alignments in bacteria and insects and behavioural responses to magnetic field manipulations with more or less unclear biological significance. The following sections deal with magnetic compass orientation and the inter-relationship between the magnetic compass and celestial compasses (i.e. star, sun and skylight polarization). Map navigation based on magnetic field parameters and the effects of temporal vari-

ation of magnetic field strength on biological clocks are discussed. In the fourth part, the authors review the host of behavioural, anatomical and electrophysiological studies that have investigated possible mechanisms of magnetic field perception. The data indicate perception based on induction (elasmobranch fish), ferromagnetic material (i.e. magnetite; for example in bacteria and honey bees) and excited state molecules (i.e. photopigments; salamanders, birds and fruit flies). However, magnetic field stimuli penetrate the whole body and are relatively stable in time and space. In theory the magnetic field can be perceived almost anywhere in the body and this has resulted in slow progress in locating the magnetoreceptor. A detailed and informative review on the plausible receptor mechanisms is given in the book.

It is a great achievement to summarize the literature from so many different research disciplines published during the last five decades on magnetic orientation in animals. I believe this extensive and valuable overview will serve as a reference book on magnetic orientation for many years to come. I can understand the authors' hesitation, but I think the book would have benefited from a more extensive treatment of some of the contradictory results achieved particularly on bird orientation, which demonstrates the complexity of the orientation system as well as the impact and importance of different ecological factors on orientation. For instance, the magnetic compass of the bobolink, *Dolichonyx oryzivorus*, was first found to be based on polarity (Beason & Nichols 1984), but later was reported to be an inclination compass (Beason 1989). Trackings by radar and satellite transmitters have demonstrated that birds on migration are greatly affected by topography and that their migration routes sometimes deviate from the expected compass course (e.g. Bruderer 1982; Gudmundsson et al. 1995). How will these deviations affect a migration programme based on an endogenous time programme and an inherited compass course? A great number of cue-conflict experiments performed in manipulated magnetic fields with nocturnal passerine migrants under natural sky conditions have resulted in increased scatter in vertical fields

or only minor shifts along with the magnetic field deflections (e.g. Able 1993; Åkesson 1994 and references therein). These results suggest the importance of a combination of visual and magnetic cues for proper orientation during natural migration.

The orientation system of birds and other animals is clearly complex and many questions remain unresolved. I agree with the authors, that in the near future we shall certainly learn more about new theories and intriguing results within this fascinating field of research. For a start, reading Roswitha & Wolfgang Wiltschko's book gives a good review of the state of the art.

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- A Natural History of Amphibians*. By ROBERT C. STEBBINS & NATHAN W. COHEN. Princeton, New Jersey: Princeton University Press (1995). Pp. xvi+316. Price \$29.95.

One of the more encouraging trends in animal behaviour is the integrative nature of the subject. An increasing number of researchers in our field

now realize that details of animals' ecology, evolution, physiology, development and genetics can be crucial to understanding why they behave as they do. Robert Stebbins & Nathan Cohen offer a compact, informative and quite readable guide to the biology of amphibians (salamanders, frogs and caecilians) that will be a useful reference for those interested in any aspect of this subject. It should be especially useful to those who study amphibians but are not well informed about the general biology of this class of vertebrates.

The book contains 20 chapters; it begins with reviews of the basic morphology and physiology of amphibians and ends with a timely discussion of their world-wide decline. More than a dozen of these chapters relate to animal behaviour, including nose and chemoreception, eyes and vision, food habits, ears and hearing, voice, protection against predators, home range and movements, territorial behaviour and fighting, homing and migration, reproduction and parental care.

The strength of this book is its broad coverage of amphibian biology and the sheer volume of facts that are presented. Even those well schooled in general herpetology will find something new. The chapters on animal behaviour are informative but, unfortunately, are not up to date and do little to capture the excitement of recent advances in some of these fields; kin selection and sexual selection, for example, are not listed in the index. But those interested in either of these topics will find a quick and useful reference to details of the chemosensory and auditory system, as well as to the natural history of the group they are studying.

This book is reasonably priced and I recommend it to anyone needing an introduction to the biology of these marvellous creatures. I also recommend this book to those who are using amphibians as model systems, whether in behaviour, physiology, development or genetics, but who are generally uninformed about these beasts. How much more interesting clawed frogs (*Xenopus*) would become when a researcher understands that these are real animals with real biology.

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Bombardier Beetles and Fever Trees: A Close-up Look at Chemical Warfare and Signals in Animals and Plants. By WILLIAM AGOSTA. New York: Addison-Wesley (1996). Pp. 224. Price \$25.00.

Chemical ecology is a multidisciplinary field of science that is devoted to the unravelling of chemically mediated interactions between organisms. Even though chemical ecology is still comparatively young, a wealth of information regarding the role of so-called secondary metabolites as intra- or interspecific signals has been compiled in recent years. Giving both a comprehensive and an authoritative overview on the rapidly expanding area of chemical ecology is by no means an easy task, considering the diverse ecological functions of secondary compounds in nature that may, for example, work as pheromones, as defence metabolites against predators or herbivores, or as chemical clues in three trophic interactions, just to name a few. Keeping these difficulties in mind, William Agosta has succeeded in compiling an exciting introduction to chemical ecology that covers most of the important areas or aspects in this rapidly expanding field. The book is also simply fun to read. No doubt this book will attract wide attention especially among lay readers, to whom it can be warmly recommended.

The book is divided into nine major chapters. Most of them highlight the significance of secondary compounds as chemical mediators in interactions between animals or between animals and plants, but two chapters describe how humans make use of these wonderful compounds in fighting diseases, relieving pain or controlling pests. All of these chapters are concise, well written and easy to understand for the lay reader. What is surprising and perhaps disturbing in this book, at least for readers with a more professional background, is the absence of any chemical structures, which may be appealing to readers with 'chemophobia', but which is a regrettable lack of information for those with a deeper interest in the subject. The absence of chemical structures as well as of tables or diagrams in Agosta's book may perhaps be tolerated. The lack of references, however, is more disturbing and sometimes even annoying when browsing through this book. Readers who have caught an interest in chemical ecology will find it difficult to hunt for further reviews or articles. Furthermore, it is not always

clear whether certain theories or opinions elaborated in the book are the author's own, or if they were derived from the published work of other authors. A short section of leading references would have greatly improved this book and its usefulness for students or researchers that are interested in chemical ecology.

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The Alpha Males: An Early History of the Regional Primate Research Center. By W. RICHARD DUKELOW. Lanham, Maryland: University Press of America (1995). Pp. xi+207. Price \$46.50.

The Regional Primate Research Centers (RPRC) are a unique research resource in the United States. This book, a labour of love by a former RPRC Program Director, provides an insightful history of the early days of a major, successful and ongoing federally funded research programme. Dukelow's careful documentation of the politics and chance events that resulted in the current system will be a valuable resource to anyone interested in the history of science, the early days of primatology or the politics involved in establishing a major collaborative effort between government and academia. As an RPRC faculty affiliate and staff member, I currently work in the environment that was moulded in these early days, and I have seen first-hand how successful the RPRC system has become in expanding our basic knowledge of primate biology and in generating research results that have been directly beneficial to humans. It was fascinating to read about how such a system developed.

The Regional Primate Research Centers have had a major impact on the field of primatology (perhaps even inventing it: one of the earliest documented uses of the term 'primatology' as a science was by Delta RPRC founding director, Arthur Riopelle, in 1963). Many of the best known 'primatologists' at work today received early training or staff positions at one of the seven Primate Centers, or acted as early advisors (people such as Stuart Altmann, Harry Harlow,

Niko Tinbergen, Irwin Bernstein, C. Ray Carpenter, Joe Erwin, William Mason, Ron Schusterman, Steve Suomi and Sherwood Washburn, to name a few). For those that are unfamiliar with the RPRC system, a brief history: in the late 1950s, NIH established a need for access to population(s) of primates for research in the United States. The original proposal for a single national research centre to act as a resource for primate research in the U.S.A. expanded into a programme of seven Centers, which have all survived to the present day. The first two Centers opened in 1962 in Beaverton, Oregon and at the University of Washington in Seattle, Washington. Shortly thereafter, five more Centers opened, most affiliated (to a greater or lesser extent and success) with academic institutions. The basic facilities of each Center are funded through five-year 'Core' grants through the National Center for Research Resources of NIH. The Centers are to provide basic research resources in primatology, including clinical/veterinary and husbandry support, to researchers in the U.S.A. and from overseas. A small faculty is partially supported by the Core grants, and there are large 'affiliate' researcher programmes at each Center.

Dukelow's history focuses on the personalities that were involved in hammering out the early structure of this system; hence the reference to 'alpha males' in the title. The book includes a chapter on the development of the RPRC system at NIH as the need for primates in research was being established, followed by chapters on each Primate Center (Oregon, University of Washington, University of Wisconsin, New England (Harvard), Yerkes (Emory), Delta (Tulane), California (University of California at Davis)). Each chapter includes a section on the pre-establishment politics, including the choosing of initial director, a brief biography of each founding director, and a longer history of each Center under the founding director, followed by a brief epilogue bringing the biography of each director up to publishing time. The book makes extensive use of NIH records of early meetings and negotiations, as well as personal reminiscences of living directors, core staff members (past and present) and past advisors.

Unfortunately, frequent typographical errors (one every two or three pages) plague the book and are quite distracting. Otherwise, this book does a thorough job of documenting the

development of an extremely successful federal programme and in doing so, provides some valuable insights into the politics of science, and many of the anecdotes are just plain fun to read. If you are a primatologist or are interested in the history or politics of science, you will enjoy and appreciate this book.

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Biological Perspectives on Motivated Activities.
Edited by R. WONG. Norwood, New Jersey:
Ablex Publishing (1995). Pp. x+434. Price
\$69.95.

Biological Perspectives on Motivated Activities is a brave, though ultimately unsuccessful, effort to bridge the gap between contemporary evolutionary perspectives on behaviour and the causal studies of motivation carried out in psychological laboratories during the 1970s and 1980s.

The volume's theoretical framework is provided by an opening chapter in which Cosmides & Tooby propose that an evolutionary psychology should be based on study of the domain-specific, information-processing systems that provide a crucial link in the causal chain connecting evolution and behaviour. This compelling restatement of positions that Cosmides & Tooby have developed in a series of landmark chapters published during the past decade is, like its predecessors, addressed primarily to those who study human cognition. Consequently, as its authors acknowledge, the introduction is not quite on target for a collection of nine empirical chapters that describe studies of motivation in non-human animals. Also, and unfortunately, only one of the other contributors to the book makes even passing mention of Cosmides & Tooby's work, and most seem not to have read each other's contributions. As a result, the volume's coherence depends almost entirely on its editor's introductions to each of the book's 10 chapters.

Wong often succeeds in drawing connections between diverse contributions, and he should be applauded for making the sort of effort that other editors of collected volumes (myself included) should make, but rarely do. The problem, and one that would be difficult to overcome, is that most of

the nine empirical chapters describe research initiated in a markedly different intellectual climate than that which prevails today. Perhaps as a result, discussions of evolutionary issues in the empirical chapters often seem tangential to the purposes of the studies of causal mechanisms of motivation that the various contributors describe.

As is almost always the case in an edited volume, the chapters are uneven; some are reviews of extensive literatures; others focus on the work of a single laboratory. All but one seem to have been written in 1990 or 1991. Porter & Levy's comparison of the olfactory communications mediating mother–young interactions in Norway rats, Egyptian spiny mice, rabbits and sheep; Raible's discussion of mechanisms controlling emergency, short-term and long-term regulation of feeding behaviour; and Schulze's insights into complexities of homeostatic mechanisms were particularly informative.

Considered as a whole, Rod Wong's volume is an ambitious, but possibly premature, undertaking. Perhaps, in the not-too-distant future it will be possible to edit a volume of studies of motivation undertaken to explore the psychological processes that link evolution to behaviour. *Biological Perspectives on Motivated Activities* points the way towards, but does not reach, that goal.

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The Natural Science of the Human Species: An Introduction to Comparative Behavioral Research, The 'Russian Manuscript' (1944–1948). By KONRAD LORENZ. Cambridge, Massachusetts: The MIT Press (1995). Pp. 384. Price \$35.00.

It is hard to know just how to review this, the first book about ethology by Konrad Lorenz. Written as the introduction to a synthesis of comparative ethology he planned, this manuscript was composed while Lorenz was a Russian prisoner of war near Yerevan, Armenia from 1944 to 1948 and came to be known as the 'Russian manuscript'. Anyone who spent much time speaking with Lorenz learned about this manuscript when he described the plan it laid out for systematic studies of behaviour, summarized its history of ideas

anticipating ethology or puzzled over its mysterious disappearance some time in the 1960s. My own conversations with Lorenz over several years in the 1970s were often centred on his recollections of this manuscript or questions about the ideas it presented, all of which now seem remarkably true to the original text. Written using steel nibs or birds' quills with potassium permanganate or diluted ink on low-quality Russian notepaper or cut pieces of paper cement sacks, the manuscript he brought back from prison camp was 750 pages long. So this review could be about the writing itself. How did he get the writing materials, remember so many quotations from diverse sources, organize his thoughts so clearly or even manage to write at all with no desk or light in unheated quarters? He apparently had a library of one book, Goethe's *Faust I*, so the writing alone would be a daunting achievement for those of us wedded to on-line libraries, spell checkers and other modern tools of the trade. Truly a triumph of human spirit, the existence of this manuscript speaks volumes about the man who returned from Armenia with it, two birds in cages constructed from salvaged wire and not much else.

Or the review could be about the manuscript as the source of Lorenz's writing and research after his return. Indeed, in her insightful editor's foreword, Lorenz's daughter, Agnes von Cranach, identifies how parts of the Russian manuscript served as the inspiration and partial content for several lectures, articles and two later books. In some sense, the manuscript lays out the life work Lorenz chose, particularly bringing into focus his concerns about the human species, which occupied so much of his writing in later life. For scholars of Lorenz, this is a treasure trove of his views about the origin of ideas in ethology and an estimation of their relative importance. Imagine a scientist today who could (or would!) write a manuscript presenting a comprehensive analysis of a field, its origins and prospects. As such, it is a remarkable historical document, destined to become an important reference for practising ethologists.

Or, the review could be about the text itself. Thanks to the wise choice of Robert Martin as the translator, we can hear Lorenz's resonant voice call out from the pages. Martin, in a delightful foreword, describes the special literary surgical skill he developed through his translations of Lorenz's other works. Anyone who has read

Lorenz in the original and Martin's earlier translations knows to be grateful that we have his handiwork for this book. In every chapter, Lorenz's apt metaphors from soap bubbles to solar systems are invoked to make the complex ideas more accessible. We hear him struggle with the idea that phylogenetic rudiments of behaviour may stand in the way of human progress or listen to him chide the reader about learning versus reading. In a chapter reminiscent of much more recent writing, he contrasts the laws of the physical sciences that are independent of history with the laws of evolution that critically depend on both chance and history. He notes that under different conditions, the particular outcome of evolution on our planet could have produced '... quite different results'. Perhaps obvious now, but Lorenz uses this idea to introduce the notion of evolutionary relationships and their historical basis. Lorenz struggles with his notion that neither the word evolution nor development completely capture the way living things defy entropy. He proposes a new word, 'ectropy', as an alternative, hoping to bring clarity to evolutionary thinking. In short, the book is full of ideas and challenges. Some may seem old or obvious, while others are fresh ways of seeing animal behaviour and the origins of its study.

This book offers a rare glimpse into the mind of Lorenz and traces his views about the origins of the study of ethology. From philosophical insights to stories about jackdaws, it is pure Lorenz. I highly recommend it as a good read and a necessary reference.

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Marine Mammals and Noise. By W. JOHN RICHARDSON, C. R. GREENE JR, C. I. MALME & D. H. THOMSON. New York: Academic Press (1995). Pp. 576. \$64.95.

This book provides a comprehensive review of the effects of man-made noise on marine mammals. Most students of animal behaviour are more used to studying responses of animals to natural than artificial stimuli, but this book is very timely given the growing interest and concern about underwater noise as a form of habitat degradation in

the marine environment. Although chemical pollution receives more attention than noise pollution, the acoustic properties of the sea cause noise to travel over much greater scales than we are used to in air. For example, a depth charge exploded off Australia could easily be heard in deep waters off Bermuda. Many marine invertebrates, fish and mammals have evolved auditory capabilities to take advantage of underwater sound, and some marine animals can be very sensitive to noise. For example, beluga whales in the Arctic may swim up to 80 km away from an icebreaker that is passing 35–50 km away, causing a disruption that may last one or two days. If underwater noise damages the hearing or disrupts critical activities of marine organisms, it may become an important conservation issue, particularly for populations already harmed by over-hunting or other forms of habitat degradation. This book focuses upon marine mammals, not because they are necessarily more vulnerable than other marine organisms, but because of the extra protection afforded them by U.S. law. The introduction to this book briefly discusses the regulatory framework for this issue in the U.S., as well as the history of research on the problem.

In addition to its applied relevance for conservation biology, this book also includes an excellent primer on marine bioacoustics. One cannot understand the effects of noise on marine mammals without an interdisciplinary review of ocean acoustics and how marine mammals use and hear sounds. Ocean acoustics is a complex field, and the authors have done a masterful job of providing a review basic enough for biologists to understand sound in the ocean. The book reviews acoustic concepts, units and measurement procedures in chapters 2 and 3. Chapter 4 reviews the propagation of sound in the sea, achieving a delicate balance between a simple exposition and providing enough detail and references to direct the reader into more complex parts of this field. This book should help to set the standard for improved acoustic analysis in studies of marine mammal responses to acoustic stimuli.

Chapters 5 and 6 review natural and man-made sources of noise in the sea. Since the oceans cover about 70% of our planet's area, we tend to think that the sea dwarfs the scale of human action. However, shipping dominates the average deep water noise in the frequency region from 20 to 200 Hz. It is hard to imagine the amount of

acoustic energy that ships must put into the sea to overwhelm the natural sounds of waves, wind and earthquakes in this frequency region. More localized sources of noise include a wide array of seafaring activities such as transport, dredging, petroleum exploration and extraction, sonars and explosions.

Chapters 7 and 8 review the vocalizations and hearing abilities of marine mammals. Knowledge of the functions of vocalizations is critical for interpreting the biological significance of disruption of vocal communication. For example, if baleen whale males produce songs as reproductive advertisements to females, then one must test whether noise masks the effective range of the songs enough to limit the ability of females to find or select a mate. The frequency range of vocalizations also helps one to infer the hearing range for species where audiometric data are lacking. For example, baleen whales cannot be held in captivity, and their hearing has not been tested. However, the common 20 Hz calls of fin whales suggest that these whales are capable of hearing this frequency, which is below the lowest frequency humans can hear. The frequency range of hearing helps to define the vulnerability of a species to noise. Hearing has been well studied in many seals and dolphins. Many dolphins and toothed whales have hearing specialized for high frequency echolocation, and this makes them vulnerable to high frequency noise.

Chapter 9 reviews disturbance reactions of marine mammals. This exhaustive review is particularly useful because many of the studies reviewed here were published as government reports and are not easily accessible. Chapter 10 integrates information from the preceding chapters to develop a model for zones of noise influence. Four zones are defined: audibility, behavioural response, masking and injury. The zone of influence model has helped to predict short-term effects of noise on marine mammals. The bottom line of conservation biology, however, concerns the mortality and fecundity rates of populations of animals. Chapter 11 addresses the biological significance of the effects of noise in an attempt to develop links to these demographic issues. This book does not just present the current state of the art, but chapter 12 also highlights gaps in data critical for protecting marine mammals. For example, nothing is known about what acoustic exposure levels cause damage to the auditory system in any marine mammal.

I strongly recommend this book for anyone interested in bioacoustics, marine biology or the conservation of marine mammals. It will be the standard reference for a large body of literature that is not integrated anywhere else.

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