

## Book Reviews

*Host-Parasite Evolution: General Principles and Avian Models*. By D. H. CLAYTON & J. MOORE. Oxford: Oxford University Press (1997). Pp. 486. Price £60.00 hardback, £25.00 paperback.

The study of host-parasite interactions is a booming discipline in ecology, evolution and behaviour. More books than ever before have appeared over the past few years, and research groups continue to pop up at universities all over the world. Why this interest, and why yet another new book? Since Price's (1981) revolutionary and now classical textbook, parasites have been considered, in most of today's hot spot areas of behaviour and evolutionary ecology, as one of the most important of selective agents. Sometimes it seems hard not to believe that the whole living world is driven and explainable by the effects of parasites: natural and sexual selection; morphology; evolution of life cycles and life histories; evolution of virulence; population dynamics and demography; or even the evolution of the fundamental process of sexual reproduction with a wasteful investment in males, to name just a few. Even conservation biology appears in a new light by some recent insights, although counter-intuitive, that the conservation of parasites may be important for the conservation of whole ecosystems. An end to all this development is not in sight.

Clayton & Moore's book on host-parasite evolution covers, in 17 chapters, five main topics of recent research on host-parasite relationships: the evolution of host traits and life histories through parasite-mediated natural and sexual selection; behavioural and immunological parasite defence; the effect of parasites on population dynamics and demography; community ecology of hosts and parasites; and host-parasite co-speciation. Chapters 1–12 form part I and are intended to illustrate general principles of host-parasite evolution, while chapters 13–17 fall in part II, termed Avian models, which is basically a review of all major groups of bird parasites from viruses to brood parasites. Finally, a large appendix provides good advice for the collection, identification and quantification of various bird parasites.

Goater & Holmes (chapter 1) first analyse the foundations of some basic assumptions required for parasite-mediated natural selection, namely

the correlation between parasite numbers and host fitness, and the covariation between parasite numbers and selected traits. The focus of their second analysis, the heritability of resistance traits, seems too narrow given their much broader aim to show that parasite-mediated natural selection is of relevance. The third part of the chapter analyses constraints acting on the evolution of parasite resistance and tolerance. The following chapter by Wakelin & Apanius is a highlight for those interested in the evolution and genetic control of immune defence. Embedded in a wealth of information is the central message that the degree to which hosts can control the level of parasitic infection through immune responses is genetically determined. Concerning the biological step preceding host defence by immune responses, Hart (chapter 3) provides a literature review on the evidence for behavioural control of parasites. Hillgarth & Wingfield (chapter 5) present, at an endocrine level, the many facets of parasite-mediated sexual selection, and provide an excellent state-of-the-art review of the experimental evidence regarding the effects of steroid levels on parasite intensity, of parasites on steroid levels, and of sexual hormones on the expression of secondary sexual characters. The evidence that circulating levels of testosterone are immunosuppressive or increase the level of parasite infections is actually weak, and Hillgarth & Wingfield suggest that corticosterone rather than testosterone acts as the regulatory hormone for the interaction between parasites and secondary sexual characters as proposed in the immunocompetence handicap hypothesis. Møller (chapter 6) reviews the interaction between parasitism and life-history evolution. One of the basic elements of life-history theory is reproductive effort, and Møller takes it as an example to illustrate both how parasites affect host reproductive effort and how reproductive effort affects parasitism. He also provides the link between the immunocompetence handicap hypothesis and the evolution of life histories that I had missed in the previous chapter. Hudson & Dobson (chapter 7), using Anderson & May's (1978) seminal theoretical analysis, discuss the conditions required for parasites to regulate host populations. The distinction between micro- and macroparasites is interesting, although I missed, for a review

chapter, more thorough reference to the literature. Dobson & McCallum (chapter 8) apply the current knowledge of host-parasite interactions to bird conservation. The risk of introduction of pathogens in wild populations arising from captive breeding and release of endangered species is illustrated and the preventive measures required are discussed. Finally, recent parasite community models (Dobson & Roberts 1994) are taken to show that parasite diversity will decrease with high host fecundity and reduced longevity, with dissimilar parasite life histories, with low parasite aggregation, and with increased host density. Simberloff & Moore (chapter 9) point out that our understanding of the community ecology of parasites is hampered by a poor knowledge of infra-communities and the autoecology of parasites. Factors governing species richness, and parasite assembly rules for predicting coexistence of parasite species in host individuals, populations and ecosystems are discussed. Gregory (chapter 10) analyses the value of the various comparative methods used for understanding the evolution of parasite communities, and concludes that experimentation and manipulation of parasite communities will be a more efficient research strategy than even more surveys and comparative analyses. Both of the last two chapters of part I of this book review the methods for analysing host-parasite co-speciation. While Hoberg et al. (chapter 11) emphasize the use of Brook's parsimony analysis for the demonstration of co-speciation, Paterson & Gray (chapter 12) believe that component analysis is more powerful and allows more detailed inferences about the coevolutionary history of hosts and parasites.

I was surprised that in several of the chapters literature citations stop in 1994, which seems way back for a book appearing in 1997 and in a field with an exponential rate of productivity just in the past 3 years. Nevertheless, most chapters indicate ideas and priorities for research still not undertaken today. In contrast to some other recent books on host-parasite evolution containing rather original research articles, all contributions to this edited volume are reviews, and as such most of the chapters provide a good starting point to the specific themes and an access to the recent original literature. It is useful for students who intend to work on one of the topics outlined above, or for teachers of an advanced course on host-parasite evolution, and certainly a worthwhile acquisition for biological libraries. The beautiful cover illustration, depicting a colony of tick-infested macaroni penguins, will imprint the reader's memory with what is

clumsily called 'aggregated parasite distribution' or 'overdispersion'.

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- Bats: Biology & Behaviour*. By JOHN D. ALTRINGHAM. Oxford: Oxford University Press (1996). Pp. ix+262. Price £35.00.

It is an odd coincidence that the first significant monograph on bats to appear in the U.K. (Yalden & Morris's *The Lives of Bats*) and the most recent were both written by biologists known for their contributions to the primary literature on subjects other than bats. Yalden & Morris were, however, experienced mammalogists and their book has stood the test of time and is still widely cited. Altringham is one of Britain's leading muscle physiologists, who joined his local bat group while a postdoc at St Andrews. After joining the teaching staff at the Biology Department of Leeds University, he realized that bats could be used to illustrate a wide range of concepts, systems and adaptations that he wanted his students to understand. He developed a lecture course on bats which was so well received that he expanded it into this book. His easy style and clear explanations, together with his grasp of a huge and burgeoning literature, give the book breadth and depth and ensure its place in reading lists for many years to come. It will be essential reading for undergraduates and postgraduates, and will be of interest to the growing number of bat enthusiasts from all walks of life. Its accessibility is further assured by extensive illustrations consisting mainly of Tom McOwat's excellent drawings.

The book's opening chapter on Evolution and Diversity of Bats presents an opportunity to review the controversy, not yet fully resolved, as to whether bats are mono- or diphyletic and thus whether flight evolved once or twice in mammals. The arguments for and against are set out in an

easily assimilated way, and will be greatly appreciated by readers. There follows an in-depth account of bat flight which ranges from vortex wake theory to ecological aspects. Echolocation receives similar treatment ranging from its neural basis to ecology. Up to this point in the book, Altringham takes the opportunity of presenting, in shaded boxes to separate them from the main text, explanations of more general principles behind what is being illustrated with respect to bats, such as molecular taxonomy, cladistics, power for flight and sound. This useful practice, which is increasingly common in textbooks, now ceases. This struck me as rather odd particularly since there are plenty of opportunities in subsequent chapters for such asides. However, the book continues with chapters on torpor and hibernation and reproduction and development. Because this is my own field I am perhaps more critical. The capacity for powered flight and such aerobic feats as stall turns together with the acuity of echolocation, enabling nocturnal foraging in cluttered environments, are unique to bats and receive appropriate treatment, but so too is sperm storage for the duration of winter. No other mammalian group has incorporated such a mechanism as a standard feature of its reproductive cycle as do all temperate zone bats and it receives rather brief treatment. The chapter on reproduction also contains an odd contradiction: 'once the fetus has begun to develop, most bats have little scope for putting the process on hold or speeding it up'. Altringham then goes on to show (in describing my own work) that they do just that, with a 25% difference in gestation period in the same colony in successive years. This, too, is unique among mammals, where the gestation period is normally fixed by the fetal genotype and is remarkably resistant to alteration by environmental factors. More trivial perhaps is the common error of misspelling oestrus which ends -ous only when used adjectively.

The chapter entitled 'Behavioural Ecology' deals mainly with ecology: roosting ecology, foraging ecology including different feeding specializations, and includes some sections on behavioural ecology sensu Krebs & Davis. The last full chapter on Community Ecology ranges widely over distribution, density, species richness, foraging guilds, predators and prey. Throughout the book, half of McOwat's figures are numbered and related to the text. The other half escape such treatment, such as the drawings of the African harrier hawk *Polyboroides typus* intriguingly shown trying to winkle molossid bats from a crevice with its talons. I would have liked to know where I can find out more about this, particularly

since the specialist African bat hawk that is mentioned by most sources is *Macheiramphus alcinus*.

The last chapter on Conservation is no more than a postscript and is the only real disappointment in an otherwise excellent book. One of the remarkable features of bat conferences in the last 30 years has been the steady increase in papers on bat conservation and management. Britain has, for example, led the way with a national survey of habitat preferences as well as a number of carefully designed studies of roost and habitat preferences of individual species. It is a pity that these did not receive fuller treatment since they are of great interest to the constituency that this book seeks to serve. That notwithstanding, this is a book that should be on all university shelves and will, like its predecessor, be cited for many years.

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- Machiavellian Intelligence II. Extensions and Evaluations*. Edited by ANDREW WHITEN & RICHARD W. BYRNE. Cambridge: Cambridge University Press (1997). Pp. xii+403. Price £80.00 hardback, £29.95 paperback.

It is almost a decade since Byrne & Whiten's edited volume, *Machiavellian Intelligence*, gathered together diverse strands of evidence suggesting that the complexities of social life might have played a key role in the evolution of intelligence in primates. Not only did that volume make a strong case for a direct relationship between primate cognitive abilities and social dynamics, based on what was known at the time, it also provided a starting point for many subsequent studies that have obtained data on social behaviour, learning and cognition in a variety of species. Now *Mach II* takes stock in view of recent developments. Most of the 14 chapters are written by contributors who did not feature in *Mach I*, with the result that the new volume introduces several fresh perspectives for primatologists interested in the evolution of intelligence.

*Mach II* is different from its predecessor in several important ways. One striking difference concerns presentation: while several of the chapters in *Mach I* presented quantitative data on social and learning processes in primates, tables and figures are all but absent in the present volume, in which the chapters are mostly overviews with proposed explanations of observed (or hypothesized, in the case of hominids) patterns of social-cognitive abilities. More importantly, whereas a decade ago the 'social origins' hypothesis regarding intelligence tended to be presented as a straightforward competitor to a 'non-social' hypothesis, there now appears to be less emphasis on confronting the two; instead, greater emphasis is given (by several authors) to the complementarity of social and non-social (foraging- and environment-related) factors as evolutionary selective pressures shaping cognition. This is partly a result of new data showing impressive foraging-related associative and extrapolation abilities of primates (see the chapter by Menzel). However, as Byrne's chapter points out, it is also due to some intrinsic limitations of the 'hard' version of the 'social complexity' hypothesis.

The last decade has seen the emergence of data from a variety of sources pointing towards some important differences between, on the one hand, humans and the great apes and, on the other hand, the remaining primate genera, on an array of cognitive abilities including imitation, self-recognition, representational problem-solving, and forms of tactical deception. The clarification of such differences, some of which are described in *Mach II*, is leading to refinements of the machiavellian intelligence hypothesis, as well as to intensification of the search for improved techniques for assessing cognition. More information is also available regarding brain structure and function. Barton & Dunbar's chapter addresses the issue of what neurological measures are the most appropriate for comparing primate species, and these authors conclude in favour of the 'massively parallel nature of social information' as being at the origin of extensive neural networks that characterize large anthropoid brains.

Several of the chapters propose the view that intelligence in general and social intelligence in particular is likely to be modular. The modularity concept has so far proved more popular among researchers in developmental human social cognition than among primatologists, and it will be interesting to see how this approach develops in the years ahead. However, while there may be considerable value in considering the possibility of modules for 'social contracts' (such as alliance formation and maintenance), 'social

encounters with unknown humans' (see chapter by Gigerenzer) and the like, it is worth recalling that the evidence for special primate cognitive abilities in the social as opposed to the non-social domain remains slight indeed. One of the developments we are likely to see over the next few years is an increase in direct comparisons of performances on tests of learning, memory, reasoning, etc., when both social and non-social stimuli or contexts are used. It is also interesting to note the absence of significant progress on getting experimental data on tactical deception, given that this type of behaviour played a central role in the early stages of the formulation of the machiavellian intelligence hypothesis. Developments in this area are eagerly awaited, not least because it still cannot be concluded that deception in primates is based on the intention to create false beliefs in others (pointed out by Whiten). The data from further studies in all of these areas will provide valuable evidence for continued evaluations of hypotheses about the origins and development of intelligence. *Mach II*, like *Mach I*, is bound to play a significant role in this endeavour.

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*Ecology and Behaviour of North American Black Bears: Home Ranges, Habitat and Social Organization.* By R. A. POWELL, J. W. ZIMMERMAN & D. E. SEAMAN. London: Chapman & Hall (1997). Pp. xvi+203. Price £24.99 paperback.

This is the fourth volume in Chapman & Hall's *Wildlife Ecology and Behaviour* series and is the first to deal with a large carnivore. The series aims to present research on animal behaviour and ecology at a scholarly level, while at the same time being both readable and affordable by interested members of the general public. The series editor and publishers have done an admirable job of the former; however, the book's content and price combine to overshoot the latter objective.

This book presents the results of long-term, intensive research done on black bears by the authors and their many colleagues in the Pisgah Bear Sanctuary (285 km<sup>2</sup>) of western North Carolina from 1981 to December 1994. Studies of this duration and scope on large, solitary, and rather elusive forest-dwelling carnivores are relatively few and results from such studies are eagerly



anticipated. This volume does an excellent job of summarizing the authors' work on the bears' home range, habitat requirements, food habits and availability and social organization. It is the most comprehensive treatment of these topics yet produced for black bears, and their efforts are sure to be welcomed, not just by ethologists, evolutionary ecologists and behavioural ecologists, but also by North American habitat, forest and wildlife managers and biologists with responsibility for conservation and management of black bears.

The title of the book is somewhat misleading because this is not so much a book about the ecology and behaviour of the black bear across its range in North America, which is extensive and covers a wide variety of habitats, but about the black bear in the temperate hardwood forests of the southern Appalachian mountains. As the series editor, R. J. Putnam, notes in his foreword, it is becoming more apparent that even within species there is tremendous flexibility in behaviour and ecology. Across its range the black bear regularly demonstrates this to researchers. However, many of the findings of this study are applicable to black and other bears elsewhere, and the techniques that were used to infer the reasons behind the bears' observed behaviours can certainly be applied by others.

The central aim of the authors' research was to study how habitat structure, distribution and availability of food, and access to potential mates influence home range and ranging behaviour of black bears in Pisgah Bear Sanctuary. We learn much about the study of home ranges in general, and about the home ranges of Pisgah's bears in detail. The coverage on the concepts of home range, core areas, peripheries and how home ranges can be measured and quantified may be remedial for some, but will be of considerable value to those just delving into what can be a very confusing topic.

Most telemetry studies of black bears, and there have been many, are fortunate to obtain 30 locations per radiocollared bear during the bears' active season. In this study, as many as 400 locations were obtained for individual bears from late April to early December, since radiocollared bears were tracked on the ground at 2-h intervals during 8-h data collection periods spaced 32 h apart. Motion sensors built into the radio collars determined whether a bear was motionless, slightly active or active for each location, which the authors prefer to call a 'location estimate' to acknowledge the error that exists when animals are located by telemetry and triangulation. This data set forms the basis for most of the book.

In addition to tracking their radiocollared bears, the authors spent a considerable time in the sanctuary quantifying the distribution and abundance of food and the other important components of forest-dwelling black bears' habitat: type of forest, amount of escape cover and abundance of potential den sites. The authors used these components to develop a Habitat Suitability Index (HSI) model for black bears in the southern Appalachians. This is the fourth HSI model developed for black bears in the U.S.A., but the authors emphasize that they are the first to test their model with field data. HSI models are used in the U.S.A. by natural resource managers to predict the importance of certain areas of land for different species and the effects of natural and artificial habitat change. The complete HSI model is presented in an appendix.

The authors present the results of their HSI model test, or validation, on both a population and an individual basis and obtain the seemingly incongruous result that the model predicts the behaviour of the population, but does not do so for individual bears. They propose two hypotheses to explain this incongruity, one of which suggests that the model may predict good bear habitat better than the bears themselves. An intriguing thought indeed.

A good discussion about when animals should and should not establish and attempt to maintain territories will be a review for most ethologists, but will be a fruitful introduction into a fascinating topic for students. Female black bears in some parts of North America, primarily in northern habitats, are territorial, but in richer habitats, such as in Pisgah, the home ranges of adult females show considerable overlap. The differences in territoriality among areas are attributable to habitat quality, specifically abundance and distribution of food. This study and others conclusively show that home range size and pattern for adult female black bears is a response to food availability.

Although adult female home range size is governed by food abundance and distribution, the home ranges of adult males, which also show considerable overlap, show no relation to food. A striking feature of the much larger home ranges of adult males compared to those of adult females is that the size of the males' ranges exceeds those of the females by a factor much greater than their differences in weight. The authors discuss two competing hypotheses that have been used to explain this disparity, one based on reproduction and the other on energetics. By use of an optimization model, they provide compelling data and arguments favouring the Reproductive Hypothesis. Adult male home ranges are sized to

cover the home ranges of an optimum number of breeding females (3–7 in Pisgah).

In their final chapter, the authors present many intriguing questions that remain unanswered even after their 14 years of study. What is the best way to improve estimates of home range size? Are adult females selective of adult males? What currencies are best for quantifying home ranges and territories? How do black bears communicate with each other? Why do male black bears scent-mark trees but females do not, when it is females that often are territorial and not males? These questions are all worthy of further study.

The detail and clarity of the data presented are the most attractive features of this book. Many researchers have investigated the issues tackled by Powell and his colleagues, but few have succeeded in using their data to investigate hypotheses about black bears in particular, and about polygynous mammals in general, with such finesse.

In summary, this book is recommended to students of bear behaviour and ecology, evolutionary and behavioural ecologists, and ethologists. The colour plates are a nice, if costly, addition and Consie Powell's line drawings to introduce each chapter are nicely done. The book is well laid out and the typeface is easy to read. Although it would be a great benefit if the price were not quite as high for a paperback of 203 pages, the book still deserves to be widely read. One can only hope that the authors continue their quest to answer at least some of the questions they pose in the book's final chapter.

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*The Raven.* By DEREK RATCLIFFE. London: T. & A. D. Poyser (1997). Pp. xxii + 326. Price £25.00.

The raven is one of those creatures that has always attracted human attention. It is a majestic and inspiring bird, deep-rooted in the consciousness of northern hemisphere peoples as a bird of myth and legend, and fascinating to naturalists and scientists alike because of its behaviour and the landscapes it frequents. Derek Ratcliffe has a vast knowledge of these landscapes in the British Isles based upon a lifetime of research; he has been observing ravens since boyhood. *The Raven* thus distills many years of observation by the author and correspondents (which read

like a who's who of British ornithology) with the published literature. The book would have been better titled 'The Raven in the British Isles', for it concentrates almost entirely on their fortunes in these islands with limited discussion of the species elsewhere. It follows the successful formula in his earlier work in the same series, *The Peregrine*.

The book begins with a short review of the raven in human history and the landscapes it inhabits in Britain. The British uplands contain a fascinating variety and complexity of habitats, owing to a combination of geology, climate and history of human land-use, and this chapter serves as an excellent short introduction to the main habitats. There then follows a long chapter detailing the trends in numbers and distribution of ravens in 11 regions of the British Isles. No doubt some readers of *Animal Behaviour* will find this chapter dull, even tedious in its detail, but to those of us with a special interest in the birds and their haunts it is precisely this detail that makes this series of books, and Derek Ratcliffe's writing in particular, so popular. Few people could even obtain, let alone synthesize, the huge amount of information from such diverse sources as is presented here. Ratcliffe then devotes four short chapters to reviews of food and feeding habits, social behaviour, dispersal and competition with other animals for nest sites and food. Raven breeding is covered in great detail in separate chapters covering the nest and nest site, the egg stage and chick-rearing stage. The author then discusses territoriality and population regulation at length. In the absence of persecution or rapid habitat change, raven populations are remarkably stable, with territories occupied by successive birds for generations, and yet densities between regions vary considerably. Ratcliffe presents a wealth of observations that support the hypothesis that food supply limits numbers, whilst pointing out that the mechanism by which this is achieved remains unclear. To round off the story of ravens in Britain, the next chapter outlines their fortunes in the face of modern pressures. Continued persecution in the interest of gamebirds appears to keep them from returning to areas where they were previously wiped out and the planting of huge areas with exotic conifers has caused dramatic declines in parts of their range. Still, the picture is not all bleak, as in some areas numbers have increased. This is apparently a result of increased food supply brought about by greater numbers of sheep on our hills (and hence carrion) due to government subsidies. However, as the author points out, the irony of this situation is that the raven is one of a very few species

that has benefited from this policy, whereas the resulting overgrazing is a disaster for most native flora and fauna.

The penultimate chapter is a short description of the subspecies of *C. corax* and other species of ravens elsewhere in the world.

The last chapter deals with intelligence in ravens. Pop natural history frequently cites the raven as the most 'intelligent' of birds, whatever that may mean. Ratcliffe casts a critical eye over many anecdotal tales of raven behaviour and, whilst they make interesting reading, concludes 'many of the time-honoured tales of ravens are the purest whimsy that say more about their human inventors than the bird'. Still, the behavioural repertoire of a tame raven was sufficiently complex to have made a deep impression on Konrad Lorenz.

Ratcliffe is a distinguished scientist and an international authority as a conservationist, ornithologist and botanist, but in *The Raven* he writes as a 'naturalist-scientist', to use an epithet he gives to some of his own sources. This is the great strength of the book; the text is given the authority of scientific discipline yet is always enlightened by the keen eye and insight of the all-round naturalist. This is more a book for the serious ornithologist than general student of animal behaviour. However, if you want to find out about the natural history and ecology in Britain of one of our most fascinating birds, this is where to turn. Bernt Heinrich claimed that 'ravens are near the bottom of the list as a sane choice for a research project', but this has not stopped him and his group conducting their excellent studies of raven social behaviour. Frankly, it is the challenge of fieldwork and the landscapes in which it is conducted, as well as the subject of study, that attracts many of us. Derek Ratcliffe does justice to all these elements in *The Raven*.

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*Handbook of Ethological Methods.* By PHILIP N. LEHNER. 2nd edn. Cambridge: Cambridge University Press (1996). Pp. 672. Price £50.00.

The first (1979) edition of this book was a delight. It managed to be both informative and informal, comprehensive and anecdotal; extraordinarily, for a handbook, a good read. We have all become

more sophisticated in nearly two decades, which makes it more difficult to achieve this happy balance of opposites. On the whole I think this new edition succeeds in this, even if in places it appears almost to be bursting at the seams with advice and information.

As this is a second edition, the term 'ethological' is retained in the title: perhaps something like 'Handbook of Observational Methods in Behavioural Biology' would otherwise have been more contemporary. Certainly the variations on the 'conceptual model of animal behaviour' elaborated in chapter 2 are rightly intended to encourage a synthesis of conditioning and other psychological approaches with the approach of classic ethology. Seemingly cumbersome, these models, Lehner assures us, work, by the acid test of helping young scientists plan their work.

Lehner otherwise makes few concessions to other scientists and practitioners needing to use direct observation of behaviour in their work (except vets), many of whom will be concerned primarily with observing people. Given the generality of its approach, this does not stop me recommending the book to them, although I would have welcomed some airing of problems arising when we try to observe ourselves, and the availability of special techniques, such as transcription of speech. The omission of humans enables Lehner to handle deftly the problem of anthropomorphism. He constructs a continuum from (1) the total absence of anthropomorphism, through (2) the use of human terms as no more than labels for behaviours which are fully defined technically, then (3) the 'metaphorical' use of anthropomorphic terminology, and so to (4) human terms freely used 'with all the underlying implications' (page 86). I doubt if Lehner would glibly say, as a wilfully simplistic philosophy professor of mine once did (Peters 1958), that at least you can be anthropomorphic in the description of human behaviour! So should we not beware the metaphor? Does not our very language itself induce us to import concepts and constructs from folk psychology which it is the business of a science of (both human and animal) behaviour to transcend?

Non-ethologists would be likely to benefit from the emphasis on the value of preliminary reconnaissance observation, again quoting Tinbergen's (1951) reservations about young number crunchers running into the field for quick results before they have acquired a good familiarity with their species in its habitat.

Lehner now makes a useful clarifying distinction between descriptive research and

experimental hypothesis testing, orthogonal to that of field observational versus laboratory experimental approaches: these four are now seen as a  $2 \times 2$  matrix of combinations. In this way direct observation provides a useful descriptive foundation for the generation of plausible hypotheses which can then be tested either by further observation in the field, or in the laboratory. Field tests would usually be non-manipulative ('mensurative'), laboratory studies more often 'manipulative'.

'Collecting the Data' covers sampling methods, inter-observer comparisons, identification of individual subjects, and equipment (from spectrograms to satellites) and gives some stimulating examples of studies. The section on videotape recording and analysis makes clear the advantages of previewing and repetitive reviewing that films provide.

Recommendations about equipment such as cameras, and especially software, must inevitably be ephemeral. For example, since the book was published, 'The Observer' software (my personal involvement with Noldus Information Technology precludes making any reservations about the seemingly objective accolade this receives) can now be combined with both analogue and digital videoanalysis systems. The caveat about the need to contact suppliers for updates should be heeded. Also in danger of going rapidly out of date is the section on information searching (how things have changed since the first edition!), although I personally think that this is an excellent inclusion.

In 'Analysing the Results' there is a large section on statistics which are not so simply 'cook-book' as the author avers, but are preceded by a thoughtful account of what statistics are, the nature of inference, the four scales of measurement and the selection of appropriate tests. Useful ethological examples are also given. However, I wonder about the inclusion of so much basic stuff, together with many appendix pages of tables, all to be found elsewhere. Has this not been at the expense of a fuller treatment of analyses peculiar to measures often confined to a nominal scale, such as the analysis of sequences? On this topic Lehner is not at his most fluent or comprehensive. There are few satisfying examples, and the subject is split between two places in the book.

When the results are in, proper and imaginative treatment is given to the diversity of ways in which data can be visually represented and pondered over. This is a valuable section of the book which I personally would like to see placed before the statistical matters. In the final section, on writing

up the research report, I am surprised no hints are given on how to leap the final hurdle of publication, nor on the crucial matter of obtaining funding.

From the production point of view, innumerable figures and tables admirably illustrate the text, and can be found conveniently close to it, although I would have liked the Golani codes and the Golani diagrams on the same or opposite pages, rather than on two sides of page 445-446. The only difficulty with internal reference is between chapters, which are sometime numbered incorrectly, for example, the cross reference in chapter 18, page 523 to the dendrogram in chapter 17 which is actually in chapter 16, pp. 469 et seq., and some of the page references in the index are inaccurate. If a paperback edition is planned it would be worth first eliminating numerous typos, and grammatical errors such as the incorrect inclusion of the apostrophe in some, but not all, instances of the possessive form of 'it'.

One possible course for the future evolution of this still lovable book might be adaptive radiation into a series of smaller (and more portable) volumes which between them would cover all the topics Lehner endeavours to deal with and even more besides. These could be updated independently at more frequent intervals. Students could afford to purchase the ones they needed most (which might reveal the competitive strength of a statistics cookbook volume with similar works on the market). The compulsion of collecting a series, and Lehner's gentle wit and philosophical approach, retaining the connection with classic ethology, would have most people buying the set, once they had discovered parts of it. Still more topics could be dealt with. There might be a human volume, and even a history volume. A volume of high quality illustrative papers, republished, would also be attractive, a star compendium in which illustrious animal behaviourists could aspire to be featured.

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*Principles of Animal Cognition.* By WILLIAM A. ROBERTS. Boston: McGraw Hill (1997). Pp. xvi+464. Price \$52.25 paperback.

William A. Roberts is in a good position to write a textbook on animal cognition. His prolific research career has contributed to many areas in the field, including cognition of space (e.g. Macuda & Roberts 1995), time (e.g. Roberts et al. 1989), and number (e.g. Olthof et al. 1997), concept learning (e.g. Roberts & Mazmanian 1988), and memory (e.g. Roberts et al. 1984). The product is an up-to-date and comprehensive survey of the field, a good secondary reference source and an excellent textbook pitched to higher-year undergraduates.

The book begins with a comprehensive historical survey that I found well worth reading. The chapter includes a wonderful description of the Clever Hans affair, as well as a discussion of the ethics of animal research. Roberts also discusses but wisely steers away from the murky issue of the nature of consciousness in animals.

The next five chapters then run through information processing from the periphery inwards, starting with perception and attention in chapter 2. This chapter focuses on pigeons, with especially thorough coverage of attention and the literature on searching for prey. Here, I wished that Roberts had included a section on insect perception, an interesting and theoretically rich area. (Honey bees are represented in the chapter on space.)

Two chapters on working memory then follow. Major themes here are the active nature of memory, rehearsal and directed forgetting, and retrospective and prospective memory. This book on cognition has not left out the traditional stuff of learning texts, since the next chapter summarizes associative learning, classical and operant conditioning. No doubt this reflects in part the cognitive flavour that these areas have taken on of late. The sixth chapter covers memory, which Roberts' earlier research examined extensively. This chapter provides a terrific summary with the theme that most of forgetting seems to be retrieval failure of some ilk. Many kinds of reminders can bring back apparently forgotten memory.

The book is not divided into parts, but the next five chapters form a different part that reaches the Kantian sphere. The themes are space, time, serial order, numbers and concepts. Each of these is a burgeoning area of research, with space perhaps being the most sizeable. Beyond a summary of research, much theorizing, some of it difficult for undergraduates, needs to be explained. Roberts does a concise job of this explaining, deftly side-stepping the most difficult issues while retaining the essence. References are liberal so the keen

student can readily pursue any topic. The chapter on concept learning steers superbly through a difficult area. I especially liked the presentation of scalar timing theory of interval timing, which I have found to be a difficult topic for undergraduate students. I am encouraged by this chapter to teach it again this year.

The last chapter is on primate cognition, an appropriate final chapter for the book. Here we find the language-trained animals. A small section on dolphins learning signs belies the title of the chapter. Other topics beyond language learning include reasoning, theory of mind, self-awareness, social cognition and tool use. The last picture in the book, at the summary section, appropriately shows Kanzi the bonobo chimp using a tool. The topics here are more controversial than those in the rest of the book. Roberts gives them a fair and even-handed treatment.

Throughout the book, the coverage of the topics is comprehensive. The book has a long reference list, reflecting mostly work in North America, with a good proportion of Canadian work. The contents include the most significant findings on the mentation of (mostly) laboratory animals that psychologists have produced in the past 25 years or so. One can always wish for more and different topics, but the book is already sizeable, and what is included forms a coherent package. I am impressed with how thoroughly each of the topics is discussed, and this depth makes the book a better text. It would not be worth sacrificing this depth for more breadth.

Of the vast array of studies reviewed in the text, I spotted only one small factual error. In describing the wagging dance of honey bees (page 269), the vigour of the dance was said to measure the distance of the food from the hive. It is, however, the duration of the straight run that measures the distance (e.g. Seeley 1985, page 85).

I found the writing comprehensible, and it captured my interest. Difficult topics are explained well in simple terms. Figures and tables are liberally used, and they are helpful. A third-year student should find the text readable.

The layout and editing are on the whole fine. I found few typos, all misspellings of names. Some of the pages in the reference section look faint in my copy, and hopefully the publishers will remedy that. The indexing system should also be improved. Names in the index refer back only to the pages in the reference section and not to those in the text itself. Names of second authors should also be linked to those of first authors to facilitate the finding of a reference.

Although this book is meant as a textbook, readers of *Animal Behaviour* can benefit from an

interesting and thorough review of the laboratory study of animal cognition. Even those working in this field will benefit from the book as a reference source. As a textbook for the field, I believe that it will be the standard soon after it appears. I am teaching from it this year.

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