7 Johnson, D.D.P. *et al.* (2002) Environmental correlates of badger social spacing across Europe. *J. Biogeogr.* 29, 411–425
8 Kruuk, H. (1978) Foraging and spatial organisation of the European Badger *Meles meles* L. *Behav. Ecol. Sociobiol.* 4, 75–89
9 Waser, P.M. (1981) Sociality or territorial defence? The influence of resource renewal. *Behav. Ecol. Sociobiol.* 8, 231–237
10 Buckley, N.J. and Ruxton, G.D. (2003) The resource dispersion hypothesis and the 'future value' of food. *Trends Ecol. Evol.* 18, doi: 10.1016/S0169-5347(03)00154-X

0169-5347/03/$ - see front matter
doi:10.1016/S0169-5347(03)00155-1

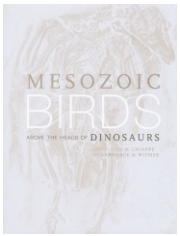
Book Reviews

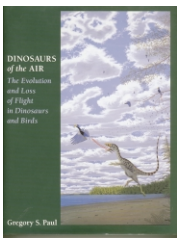
Counting the pages of books about dinosaurs and birds

Mesozoic Birds: Above the Heads of Dinosaurs edited by Luis M. Chiappe and Lawrence M. Witmer. University of California Press, 2002 £66 hbk (532 pages) ISBN 0 520 20094 2
Dinosaurs of the Air by Gregory S. Paul. The Johns Hopkins University Press, 2002. US$49.95 hbk (460 pages) ISBN 0 8018 6763 0

Gareth J. Dyke

Department of Zoology, University College Dublin, Belfield Dublin 4, Ireland





The past few years have been an amazing time for students of bird origins – exceptional new feathered and nonfeathered theropod dinosaurs, birds such as *Rahonavis* that don't look like birds [1], theropods, such as alvarezsaurs and the four-winged *Microraptor*, that do look like birds [2,3], even fake birds ('*Archaeoraptor*') that aren't even birds at all [4], have been discovered and described at an alarming pace. Because the number of new species of Mesozoic birds discovered and described over the past ten years more than triples those known for much of the past two centuries, keeping up with the recent literature in this area can be more than a little confusing. It is helpful then to sometimes consult books, and you could do worse than to read these two recent offerings.

Although essentially dealing with the same subject matter – the early fossil record of birds and their dinosaurian relatives – *Mesozoic Birds: Above the Heads of Dinosaurs* and *Dinosaurs of the Air* couldn't be more different. In the first of these two volumes, Chiappe and Witmer have assembled a sequence of authored papers (many addressing topics of interest for the first time) that deal with specific subjects tied together within the general arena of Mesozoic avian evolution. This book is primarily a collection of research contributions whereas Paul's thesis in *Dinosaurs of the Air* is to present a summary of the dinosaur and bird fossil record and to interpret it in light of his own ideas regarding the origin and evolution of flight. The first book then is less suitable for a general readership and the latter is eminently so; both fill a niche and have been long anticipated by the scientific community.

One great advantage of *Mesozoic Birds* is that it presents a status report of an active field of enquiry. Several chapters present detailed descriptions of taxa hitherto known only from short initial reports in the primary literature (*Shuvuuia* and *Vorona*), or summarize anatomical information pertaining to tantalizingly incomplete but informative fossils (*Avimimus* and *Alvarezsaurus*). Fossil material discussed in this book is very well presented, both adequately described and evaluated in context with the use of convincing character analyses. Descriptive chapters are augmented with contributions presenting 'state-of-the-game' systematic analyses for non-avian theropods (Clark *et al.*) and basal birds (Chiappe) that bring readers up-to-speed with the current consensus. The editors of *Mesozoic Birds*, Chiappe and Witmer, have certainly achieved their goal – to synthesize this diverse field of study (comprising topics such as the origin of birds and the evolution of their flight with the taxonomy of *Archaeopteryx* and reviews of feathers, histology and tracks) without appearing clumsy (and more importantly, out-of-date). As is the case with many edited amalgamations of co-authored papers, *Mesozoic Birds* was long in the pipeline, a fact that is happily not reflected by the bulk of its chapters.

By contrast, and departing somewhat from current consensus, Paul's lavishly illustrated *Dinosaurs of the Air* is a work of art, albeit hanging by a thread of science. Readers will be left in no doubt about the artistic ability of the author and, indeed, about his ability to summarize effectively literature pertaining to the origin of birds in a concise and engaging manner. I would certainly recommend *Dinosaurs of the Air* to anyone entering the field for the first time – it is exceptionally well illustrated and provides a great introduction to the major fossil groups of dinosaurs and birds. Enough said? No, because there is a thread inherent to *Dinosaurs of the Air* that comes to the fore in later chapters – Paul has an agenda with this book. Following the opening (and very informative) descriptive and anatomical chapters, Paul draws us into his ideas about the evolution of flightlessness; in short, the hypothesis that many familiar groups of dinosaurs (troodontids and oviraptorosaurs among them) do not

Corresponding author: Gareth J. Dyke (gareth.dyke@ucd.ie).

comprise the sister groups of birds. His argument is that many of these taxa are actually birds that, for some reason, lost the ability to fly. Although he does not deny a close relationship between non-avian dinosaurs and birds, as the reader of *Mesozoic Birds* will realize, Paul turns the accepted shape of parts of the dinosaur–bird tree on its head. The jury is still out on this issue and, as such, this interesting idea should be taken with a pinch of salt. This book is, nevertheless, among the finest dinosaur books out there – it certainly belongs on the shelf of everyone with an interest in this area (even if your fascination is simply with fine dinosaur art).

My interest is sparked; both books make excellent reading and will no doubt form integral parts of the 'dinosaur research library' for many years to come.

References

1 Forster, C.A. *et al.* (1998) The theropodan ancestry of birds: new evidence from the Late Cretaceous of Madagascar. *Science* 279, 1915–1919
2 Chiappe, L.M. *et al.* (1998) The skull of a new relative of the stem-group bird *Mononykus*. *Nature* 392, 272–278
3 Xu, X. *et al.* (2003) Four-winged dinosaurs from China. *Nature* 421, 335–340
4 Zhou, Z. *et al.* (2002) *Archaeoraptor's* better half. *Nature* 420, 285

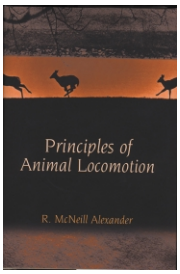
0169-5347/03/$ - see front matter
doi:10.1016/S0169-5347(03)00131-9

Physics of movement on land, sea and air

Principles of Animal Locomotion by R. McNeill Alexander. Princeton University Press, 2003. £35.00, hbk (376 pages)
ISBN 0 691 08678 8

C.J. Pennycuick

School of Biological Sciences, University of Bristol, Woodland Road, Bristol BS8 1UG, UK



In his latest book, Alexander examines the way in which the infinite variety of adaptations to walking, swimming and flying are shaped and constrained by Newtonian mechanics. Energy (kinetic and potential) is at the centre of the discussion, together with the storage and retrieval of energy in elastic structures and fuel reserves. From almost the first page, Alexander slips frequently into a mathematical idiom to illustrate what some 'ideal' animal would and would not be able to do, given simplified physical constraints. This is an immensely powerful approach for those who are used to reading an equation slowly, and thinking over its implications symbol by symbol. Sadly, not many biologists will do that, but those who persevere will be well rewarded. *Principles of Animal Locomotion* covers those animals that use muscles as the source of work for locomotion, and begins with an explanation of the sliding filament mechanism, and the mechanical implications of various types of muscle geometry. The need for mitochondria in aerobic muscles is mentioned, but (oddly) not their effect on the mechanical power output of these muscles. Throughout the book, the supporting physiology is less sharply focused than the mechanics of locomotion, perhaps because there is not much theory behind it.

Alexander is at his best with the intricacies of walking, running, jumping, hopping, burrowing, wriggling and climbing, modes of terrestrial locomotion that arthropods, reptiles, mammals (and Alexander) have made their own. His basic approach is to set an upper limit to the power that the animal requires, by calculating the work that must be done at each step or stride to generate kinetic and potential energy, and to overcome resistance in the outside medium. He then considers the numerous ways in which the average power can be reduced, by storing energy in elastic structures, and recovering it in a later cycle. Although the amount of this energy recovery has been measured in some cases, there is unfortunately no general way to take account of it. Generalizations about power are therefore quite limited, usually taking the form of predicting allometric trends for upper limits. Alexander is most authoritative on his home ground of mechanics, but tends to believe what he reads when he ventures into physiological territory. He makes especially effective use of the Froude number, combining the size of an animal with its speed and the strength of gravity, as a unifying principle in terrestrial locomotion, but fails to notice that 'cost of transport' is another such unifying dimensionless number, at least if one takes the physiological term 'weight' to have the same meaning as in physics.

Alexander analyses the mechanics of animals that run on the water surface, and those that swim down below by undulation, oars, hydrofoils, and jets. He is especially good on buoyancy, a topic to which he himself made notable contributions in his younger days. Taking to the air, he divides the flight of insects, birds and bats into gliding, hovering and powered forward flight, and hopes to avoid controversy by citing everybody, contradictions and all. He knows that birds exhibit none of the features so carefully explained in his own Chapter 7 about the gaits of mammals, yet he is puzzled that nobody has measured the speeds at which birds 'shift' between one nonexistent gait and another. The mathematical approach loses focus when it comes to reviewing the heterogeneous mass of material about flight, where some authors draw

Corresponding author: C.J. Pennycuick (c.pennycuick@bristol.ac.uk).