Formed for function

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Animals. By R. McNeill Alexander. *Cambridge University Press: 1990. Pp.509. Hbk £50, $89.50; pbk £19.50, $34.50.*

THE ways in which animals go about their business of catching food, moving about, protecting themselves, reproducing, growing, getting rid of unwanted material and the general housekeeping of their lives offer a fascinating series of problems for study by zoologists. There is, among animals, a bewildering variety of body plans, detailed differences in design between closely related groups and, in terms of diversity of species or abundance, great differences in the apparent success of different groups.

The classical approach to the study of animals has long been served by textbooks that offer a systematic framework, describe the comparative anatomy and, group by group, consider aspects of the biology of various parts of the animal kingdom. The distinction between vertebrates and invertebrates that appears at the level of the student textbook is traditional and, like many traditions, has an emotional basis: we are vertebrates — and mammals to boot — so we tend to feel more empathy with, and to be more intrigued by, rats or cats than by frogs or fishes, and to find squids, snails or jellyfish positively alien.

This ranking may blinker us from noting that such distinct groups as insects or mammals face similar problems; of desiccation or of living in a medium that does not support their bodies. Such problems share physical or chemical bases so it is hardly surprising that the two otherwise distant groups solve similar problems with somewhat similar mechanisms, exemplified by the evolution of water-retention mechanisms or of jointed legs in both arthropods and tetrapod vertebrates. The pathways by which they have evolved are very different but the ways in which legs are used are similar — crabs trot as do horses, albeit sideways and sometimes with eight or six legs.

Students of the comparative approach to animal form and function have been well served by two earlier textbooks by Alexander, *The Chordates* and *The Invertebrates*, which provide excellent accounts of how animals work, always with a systematic framework but with far less attention to details of classification or comparative anatomy than appear in other major textbooks. In my view, these two books offered the clearest most accessible and modern accounts of how animals live and function. The weakness of the approach is that it doesn't tell you much about what the animals are — but contrariwise, the classical approach tends to offer frustratingly little about how the animals work.

Animals, according to Alexander's own preface, covers the same ground as *The Invertebrates* and *The Chordates* in roughly half the number of pages. It treats all animal-like organisms from protists to mammals. It is aimed at elementary undergraduate courses, as an adjunct and complement to the more classical textbooks but also as a central textbook.

How successful is the new approach? I have always admired the clarity of Alexander's earlier textbooks, cited above, and have recommended them warmly, but I have warned students to look elsewhere for details of what the animals are or of their anatomy. *Animals* provides even less about the anatomy or interrelations though, in fairness, it does give extensive references from which this information may be obtained. This, too, is not about what animals are but about how they work.

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New light on bird flight.

It is an irritating feature of the treatment that certain animal groups, like the sponges, nemertines or Onychophora, at the borders between major groups of animals, are dismissed in a few words or paragraphs, but lungfishes and *Archaeopteryx* get far more detailed treatment. Partly, this reflects Alexander's greater emphasis on vertebrates than on invertebrates and may here be justified because the phylogenetic links and succession in vertebrates is well understood whereas that of invertebrates is a mess.

Alexander's great success is the way in which he draws parallels across the animal kingdom. Problems of respiratory exchange in water are compared between *Octopus* and fishes, of gaseous exchange between insect flight muscles and bird lungs, and so on. This approach is excellent because it bridges the traditional but artificial and dangerous gap that is fostered by the clumping of animals into invertebrates and vertebrates. The treatment is often uncompromising — you may have to work through calculations to follow a fine series of explanations and insights into how animals work.

Refreshing, too, is the amount of new material. Some old favourites, such as why flatworms have to be thin and flat to allow adequate gas exchange persist, but discussion of reptile feeding mechanisms or of the probable posture and speed of dinosaurs appear for the first time. Other topics receive a major update: the explanation of the function of fish swim bladders has been radically revised and improved, as have the accounts of bird and insect flight. There are also useful treatments of basic features of the embryology of worms, echinoderms and of various groups of vertebrates, serving, as always, Alexander's purpose of showing how these processes work and rarely stepping onto the minefield of drawing phylogenetic inferences. His main concern seems to be with the present problems of life and the solutions shared between animal groups or evolved uniquely as a key feature of a particular group: only where it is germane to how the animals work does he consider the history and evolutionary stages, as with the evolution of protrusible jaws of bony fish, or of jaw mechanisms from fish to amphibians, reptiles and mammals.

As with Alexander's earlier books, this is a *tour de force*, showing great understanding and with lucid explanations. I shall be recommending it warmly to my students — but I shall also remind them of the existence of its predecessors so that they can catch and benefit from the author's many earlier insights, inevitably omitted from this briefer and re-shaped account. □

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