

REVIEWS

Edited by G. W. JOHNSTONE

BOOKS

Avian Biology edited by D. S. Farner and J. R. King, taxonomic editor K. C. Parkes. London: Academic Press. Vol. 4, 1974. Pp xxii + 504. \$A57.70. Vol. 5, 1975. Pp xix + 523. \$A74.00. B. & w. pll, figs. 235 x 150 mm.

These are the fourth and fifth volumes of an outstanding treatise, which has the dual aims of summarizing the established facts and principles of avian biology and reviewing its recent advances. Hence the series attempts to serve as a source of references as well as of instruction. In general, most of the contributions to the present volumes fill these roles reasonably well although several authors have limited their assessment of the traditional literature in their efforts to promote research in more contemporary directions. Each chapter is written by a leader in its field and the treatment is advanced and invariably of high quality.

As happened with the preceding volumes (reviewed in *Emu* 75: 45-46), the weaknesses are mainly editorial. The logical sequence of topics is weak and their allocation to volumes appears almost arbitrary; indeed, the prefaces to each volume are all but identical. There is almost no cross-referencing between chapters and in some there is overlap and repetition. This lack of editorial interference is also the source of the great strength of the series: it gives the authors a free hand to make large contributions from their own perspectives. A comprehensive index at the end of each volume ought to help the reader integrate the various chapters. The editors have maintained a production where the quality of writing is high and even, and largely free from error (though there is something badly wrong with Fig. 10, Ch. 5, Vol. 5).

Volume 4, which is fundamentally anatomical and physiological in approach, begins with a review by T. Bennett on the detailed innervations of the peripheral and autonomic nervous systems of birds. Many facts are compiled but no principles emerge. The avian pineal organ is the subject of the next review written by M. Menaker and A. Oksche. To date, findings on the structure and function of this organ are few and their interpretations equivocal; not surprisingly, few facts or principles are established and, appropriately, the review is brief.

Although W. Bock's long chapter is called 'The avian skeletomuscular system', there is no summary of work on the skeletons and muscles of birds. The modern avian morphologist is less interested in the traditional morphological approach, where pure description is an end in itself, than in using avian morphology to solve problems of an ecological, functional, systematic and evolutionary nature. Bock believes that the skeletomuscular system lends itself particularly well to this modern approach. This field is in its nascency as indicated by the paucity of references cited, many of which are the author's own. In a didactic and authoritative manner Bock outlines the goals, methods and principles of the new discipline. He predicts spectacular successes for it.

The last two chapters deal with avian energetics and overlap somewhat. In Chapter 4, W. Calder and J.

King review the literature on the thermal and caloric relations of birds. They provide numerous equations, mostly based on empirical data, which, if the weight of a bird is known, allow one to calculate things such as the weight of its plumage, its standard metabolic rate, surface area, heat transfer coefficients and so on. They review the physiological and behavioural mechanisms of species that thermoregulate and those that undergo hypothermia to varying degrees. Chapter 5, by M. Berger and J. Hart, is on the physiology and energetics of flight. The physiological determinants of flight are reviewed; these include respiratory mechanics, respiration, circulation, water loss and temperature regulation.

Other aspects of flight are the subject of the first chapter in Volume 5 where C. Pennycuik uses classical aerodynamic theory to describe the mechanical basis of powered and gliding flight in relation to a bird's anatomy and performance. He first revises his 1969 model of powered flight in response to criticisms made by V. A. Tucker and then examines cruising performance and provides equations for calculating range, speed and duration of flight. The limitations imposed by frequency of wing-beats, and muscle power on a bird's weight and flight performance are calculated and the chapter concludes with a comprehensive review of the literature on gliding and soaring. His treatment is technical, involving more than seventy equations and numerous figures.

In Chapters 2 and 3 migration is reviewed from two different, but somewhat overlapping, points of view. P. Berthold reviews the extensive literature amassed on the control and metabolic physiology of migration. Unfortunately, many of the findings concerned with the inputs and mechanisms that control migratory phenomena are either contradictory or equivocal so that generalizations are difficult to make. This confused situation is partly explained by the notion that migratory behaviour evolved separately a number of times so that a corresponding diversity of solutions and mechanisms resulted. Conversely, the fuelling of long-distance migratory flights by the deposition of up to fifty per cent by weight of fat and its subsequent metabolism is understood reasonably well. Calculations based on energetic (Berger and Hart) and aerodynamic (Pennycuik) considerations agree with the observations reported by Berthold. Reserves of fat allow even the smallest of the long-distance migrants to cross the largest ecological barriers on earth with energy to spare, providing, of course, that meteorological conditions are not too unfavourable.

S. Emlen gives a stimulating review of orientation and navigation by migratory birds. Data on actual navigational abilities are surprisingly scanty. However, Emlen believes that they indicate that most migratory species orientate by adopting simple compass directions rather than needing to possess abilities for complex bico-ordinate navigation. Most of the chapter is devoted to a survey of the types of directional cues available to and used by birds. He reviews the evidence for orientation by means of the sun, stars, topographical features, inertial and meteorological cues and the earth's magnetic

fields. He repeatedly emphasizes the finding that there is no single mechanism of orientation; all cues function as components in a complex navigational repertoire available to the migrating or homing bird. The components are highly integrated, mostly in an hierarchical fashion, and provide the system with much redundancy, which allows cross-checks for accuracy and provides a back-up ability should the primary method of navigation fail. The cues used by a navigating bird vary in importance according to species, age, experience, geographical position and prevailing meteorological conditions. Emlen gives a clear account of a difficult field and is not afraid to re-analyse the data of others. He also pinpoints problems that require further research.

The use of solar and stellar cues for navigation requires an accurate sense of time. Clock-shift experiments, involving manipulation of the phase of the photoperiod, have shown that birds possess an accurate chronometer that allows them to compensate for the earth's rotation. E. Gwinner reviews recent work on the various avian functions that depend on a biological clock for their circadian and circannual periodicities. His review is concise yet thorough, starting from first principles and quickly leading up to the most recent findings, specially those relating to his own work on circannual rhythms. He provides a good balance between general oscillator theory and empirical findings, knowing when to use models to explain or predict the latter.

'Vocal behaviour in birds' by F. Nottebohm contains three distinct themes: anatomy and physiology of voice production; size, function and structure of vocal repertoires; and vocal ontogeny in the individual and as an evolutionary problem. The review, while excellent, is too short and selective: all three themes could have been expanded and a section on the communicatory functions included. The editors should have allocated greater space to the subject given the very vocal nature of birds, the considerable mass of information available and the extent of recent advances since the last authoritative work on the subject in 1969. It is unfortunate that the review was written before Nottebohm's own recent work was published on auditory vocal preferences for song learning and his fascinating findings on the neural basis of song production with dominance by the left cerebral hemisphere and the hypoglossal nerve;

he has also shown sexual differences in the part of the brain that controls song.

In what one might naively think to be a tedious subject, R. Drent has written a fascinating account of incubation. He considers the length of the incubation period, the brood patch, the physical requirements for egg development, the parent as an incubator, hatching and the energetics of incubation; and he lists the most pressing problems for research. In common with other investigators, however, Drent fails to give due attention to those species, such as estrildines, that do not develop a brood patch. Data on the energetics of incubation of Zebra Finches differ from those for species that have brood patches. Behavioural responses to overheating of the eggs might also be different.

The final chapter of Volume 5, entitled Zoogeography, is by F. Vuilleumier. He writes in a loose unrestrained fashion about the forces in contemporary zoogeography, using avian examples to illustrate his arguments. Zoogeography has undergone a revolution in the last two decades because ideas on continental drift have become increasingly accepted and as a result of the postulational-deductive models of island biogeography formulated by R. H. MacArthur and E. O. Wilson. He condemns the aims, methods and results of traditional zoogeography, deplores the inadequacy of avian taxonomy above the level of species and advocates the study of what he calls theoretical or predictive zoogeography. This aims to understand the evolutionary and ecological processes of biogeography by means of theory, models and empirical data in the MacArthur-Wilson manner. This is controversial stuff but a reasonable reflection of some attitudes in zoogeography today. We must wait for the post-revolutionary period for a clearer perspective on zoogeography.

Avian Biology was originally planned in five volumes but two years ago the publishers announced that a sixth volume was in preparation. Publication of this review of Volumes 4 and 5 has been delayed for over a year in the hope that Volume 6 could also be covered. However, it is still unavailable (August 1978). Volume 1 cost \$A34 in 1974 and Volume 5, fifty pages shorter, costs \$A74 in 1978. At this rate, enthusiasm for the appearance of Volume 6 must be tempered with concern as to who will be able to afford to buy it.

R. Zann

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