

Berlin 1910: 589–702) and the relationship between bird and egg mass and incubation time (1922, J. Ornithol. 70: 172–285). In contrast, ‘Die Vögel Mitteleuropas’ is essentially descriptive and partly quantitative with weights and measurements from hatching till after fledging summarized in tables. The well-chosen extracts from the species texts provided in the second part of ‘Die Vogel-WG’ illustrate the point. The love for the birds in their care is plain to see, although many ended up in the cooking pot or as a specimen in the museum’s collection, either as skin or part of the menagerie. But also the stress and failures are detailed, the adventures, the bird’s step-by-step growth and development (hence the long subtitle of the handbook: ‘in allen Lebens- und Entwicklungsstufen photographisch aufgenommen und in ihrem Seelenleben bei der Aufzucht vom Ei an beobachtet’), field observations even, romantic asides and the occasional reference to homologies between species. As the work progressed under an extremely tight schedule, the narrative style is unpolished, even rambling in places. This may deter some readers, but it also adds a special flavour to something that is already special in itself. Quotes and anecdotes from ‘Die Vögel Mitteleuropas’ inevitably pop up when watching bird behaviour in the field, a reminder of the impressionistic style of the stories.

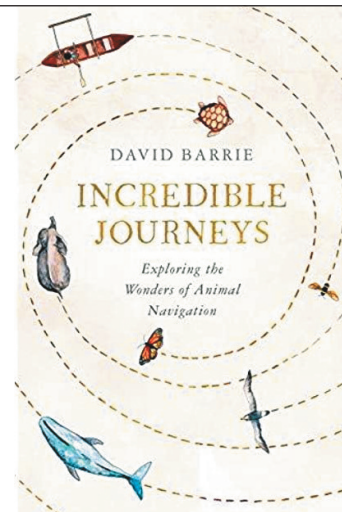
The Heinroths’s opus magnum was, and still is, compulsory reading for anyone interested in the life-history of birds, just as it was for Stresemann, Kortlandt, Tinbergen, Lorenz, Morse Nice, Verwey and all those pioneers in ornithology, especially in behavioural ecology (then named ethology or animal psychology). The good news is: the first edition probably amounted to 5000 copies and an exact reprint was published in 1966–1968 by Edition Leipzig. There is no scarcity of copies in the used-books circuit. And German not part of your curriculum? Another reason to start learning German pronto. ‘Die Vogel-WG’ can be used as an attractive appetizer.

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Morse Nice M. 1979. Research is a passion with me. Consolidated Amethyst Communications Inc., Toronto.

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Barrie D. 2020. Incredible journeys. Exploring the wonders of animal navigation. Hodder & Stoughton, London. 323 pp. ISBN 9781473656857. €15. (Published separately in the USA as ‘Supernavigators. Exploring the wonders of how animals find their way’. The Experiment, New York.)



The phenomena of animals displaying a sense of direction (orientation), and successfully travelling between locations that matter to them (navigation), take place at all spatial scales on offer on Earth. Orientation and navigation involve a bewildering variety of sensory and processing mechanisms; they represent a huge research field with advanced and sophisticated specialisms, another reason for bewilderment. Inspired by a lifelong fascination with oceanic navigation-without-GPS, sailor-scientist-storyteller David Barrie takes us on a fantastic journey into animal navigation, easing some of the perplexity along the way.

Taking his examples from all walks of animal life, not just birds, Barrie presents his case in three sections, with respectively 17, 8 and 2 chapters each. Every chapter is capped by a natural history story, introducing many examples of the surprising ways and capacities of moving animals, ranging from a homing sheepdog to dragonflies migrating across the northern Indian Ocean. Each of the chapters has a focus on a phenomenon, and several are enlivened by travel stories to reach navigation scientists at work in the field or in the lab. This brings in a range of personal perspectives.

In the first section on ‘Navigating without maps’, Barrie introduces the principles of reconstruction, by the summed lengths and orientation of step-lengths, of one’s position relative to the starting point of a journey. This technique is called ‘dead-reckoning’ and may

derive from ‘deduced reckoning’, but as the term dates from the 17th century, the author reckons “it was coined by an Elizabethan sailor with a dark sense of humour”. Dead-reckoning was notoriously imprecise. In the first section he also reviews the ways by which animals orient themselves in space on the basis of information in the sky (Sun, stars, Moon and polarization patterns), the air (smells and sounds) and in the ‘ether’ (magnetism).

The second section is on ‘The holy grail’, bringing together the evidence that birds, sea turtles and some other animals do actually possess (programmed in the genes?) or acquire (by targeted learning in the course of their lifetimes?) maps of a kind. The section rounds up with a discussion on the mysteries of arguably the biggest contender for providing the base of maps, the magnetic sense (Mouritsen 2018). How does it work, where is it located, what are its brain equivalents, and what does it all mean for the human animal? Perdeck’s (1958) Starling *Sturnus vulgaris* displacement story in Ardea, as so often, plays a leading part, and is granted a figure with the schematic map of key findings. Barrie is not alone (see Piersma *et al.* 2020) in repeating the misunderstanding that Perdeck himself concluded, on the basis of the different recovery locations of juvenile and adult starlings displaced from The Netherlands to Switzerland during autumn migration, that “the capacity for ‘map and compass’ navigation was innate”. The confusing issue of whether behavioural traits are ‘possessed at birth’ (i.e. one possible definition of ‘innate’), or ‘acquired during a lifetime’, underlies several of the accounts in the book, but is not made explicit. Will this fundamental biological problem, along with the mechanistic basis of a, or several, magnetic sense(s), be revealed in the years to come? Are Cuckoos *Cuculus canorus* really the lone migrants born with inherited geo-referenced maps – as they are portrayed in this book as much as in the scientific literature (e.g. Thorup *et al.* 2020)?

The final section is called ‘Why does navigation matter?’. It laments the loss of navigational capacities in humans growing up with GPS-based navigation tools. Barrie not only points out the sheer fragility of GPS-like systems, but is also worried by the lack of navigational schooling in modern humans now that everybody is using a phone that is so much more than a phone. Our ‘common sense’ of the world around us, and the interpretive abilities to help us navigate, have generally become lost. Indeed, the Polynesian seafarers sailing the entirety of the Pacific, had 20 years of apprenticeship before being considered skilled navigators (Crowe 2018). In the final chapter ‘So where are

we going’, Barrie cannot help but formulate his apprehensions about the state of our global ecology - from herbicides compromising the navigational abilities of honeybees to migratory shorebirds rapidly losing staging areas in coastal China. His last words: “In researching and writing this book, I have again and again been struck dumb with admiration by the extraordinary skills of the animal navigators that are its stars. Even if our own lives did not depend on the health and vitality of the planet we inhabit, the preservation of the almost infinitely complex web of life from which such wonders emerge is surely an ethical imperative.”

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