

# Incredible Journeys

1981

## THE MYSTERY OF MIGRATION

Robin Baker, Chief Contributing Editor  
Viking Press, 256 pages, \$29.95

### REVIEWED BY ARCHIE CARR

**M**IGRATION is rife with mysteries. The ability of some species to make long-range, overseas journeys and arrive on schedule at pinpoint destinations ranks as a pinnacle of natural selection. The orienting senses and cues used in these journeys have received a great deal of attention from biologists during the past thirty years, but they are still not well understood. It is not even clear *why* some species make outlandishly long voyages to breed, passing by, en route, what a human might consider perfectly suitable habitats. Where long, open-ocean flights are made to nesting sites on tiny islands, it is difficult to reconstruct the evolutionary origin of the hazardous habit, when the first colonizing waifs were few and obstacles to survival and return were—seemingly—insurmountable. We simply do not know how animals navigate.

Experimentally, the most baffling migratory phenomenon is the ability of an over-water migrant, displaced by wind, waves, or human experimentation, to reorient on a correct course of travel. Twenty-five years ago it seemed likely that we had at least part of the answer. Birds, bees, and other species had proven capable of keeping track of

---

Archie Carr is in the department of zoology, University of Florida, Gainesville. He is Technical Director of the Caribbean Conservation Corporation and Chairman of the Marine Turtle Specialist Group of the International Union for the Conservation of Nature. His chief research field is the ecology and migration of marine turtles. One of his eight books, *THE WINDWARD ROAD*, originally published by Alfred A. Knopf, was recently reissued in paperback by the University of Florida Press.

time without any sensory cues from the outside world, and the discovery of this innate biological clock caused great excitement. It was clear that the inner clock was involved in the compass sense that many animals had been found to possess. They could use the position of the sun, or the stars, along with the time of day, to find north.

But simple compass sense is not enough to account for the ability of a bird to navigate the open ocean. If a petrel flying east is blown off course hundreds of miles south in a storm, the new course it must take is not simply east, but northeast. When *human* navigators are blown off course at sea, they can determine their exact position on the face of the Earth by celestial navigation, which requires a good clock and a set of astronomical tables. Perhaps, scientists thought, since the animals are able to use the biological clock to give them compass sense, they also use it to find their precise position on the Earth, fixing their latitude and longitude by celestial navigation almost the way human navigators do. In the heady days of the fifties, when such research was booming, Gustav Kramer, Franz Sauer, and G.V.T. Matthews seemed sure to explain how these biological clocks made celestial navigation possible.

Albert Bierstadt, *The Buffalo Trail* (1867-68)



But today, confidence in theories of celestial navigation has waned. The early, groundbreaking experiments were exciting, but scientists have been unable to repeat each others' results. Slowly, they have turned away from the investigation, and only two or three still have the confidence to continue. Celestial navigation could still turn out to be at least part of the answer, although it does demand of the animals an altogether fantastic map sense—it requires that almost every bit of the zodiac—the orbits of the sun, moon, and stars—be associated for the animals with a specific position on the face of the Earth. How this map sense could be either inherited or learned seems almost incomprehensible.

Even though position-finding navigation remains unexplained, many advances have been made recently in the study of migration. Several years ago, for example, the winter haven of the monarch butterfly was discovered—one of the most spectacular finds in animal behavior and migration in some time. In one small part of the Sierra Madre Oriental range in Mexico, the butterflies cluster so thickly on the trees that one can hardly see the branches. People had long wondered where the southward migration was leading the monarchs, and this Mexican locality

may be the meeting place of the entire species, throughout North America.

Perhaps even more exciting is the news that butterflies, bees, birds, and even bacteria have been found to have a magnetic sense, and that tiny particles of magnetite, which appear to mediate the sense, have been discovered within the creatures. Because bacteria carry these grains of magnetic material within them, even they are able to guide themselves, traveling along the lines of force of the Earth's magnetic field.

While it is by no means true that the discovery of a magnetic sense explains how animals navigate, it is an exciting advance. A number of students are now trying to extend the data and to learn how many different species of animals possess the magnetic particles and whether they use them only to find compass direction or also in finding geographic position. It has been suggested that, using variations in the strength of the magnetic field, they can determine where they are on the face of the Earth. Pigeons, for example, are able to navigate through fog, continuing on their course when they can see neither the sun above nor Earth beneath. This suggests a use of magnetic fields, but nobody has been able to prove it. If some species actually do have the inherited ability to use an awareness of magnetic forces to figure out their precise geographic position, the phenomenon would seem no less fantastic than a map sense based on positions of the sun and stars.

**S**o *The Mystery of Migration* is a timely book. It was assembled by a team of six contributing editors, chief among them Robin Baker, lecturer in zoology at the University of Manchester. Baker is well known for an earlier massive treatise on migration [*The Evolutionary Ecology of Animal Migration*, Holmes and Meier, 1978] and for recent investigations of the possibility that humans too can detect—and sense the intensity of—the Earth's magnetic field.

The book begins with a review of the myths, legends, and theories that have arisen during our age-old bemusement over migration. There follows a chapter examining the biological basis of migration and proposing a new, greatly expanded definition of the phenomenon. Successive chapters then treat, in varying detail, the migratory lives of plants—yes, plants—insects, fish, amphibians, reptiles, birds, bats, aquatic mammals, land mammals, and, finally, people. The book is big, well written, copiously illustrated—in short, the most ambitious volume on migration ever written for the general reader. It is pleasant to read and replete with engaging natural history. However, the authors make fundamental reinterpretations and revisions of the field, and this is a questionable procedure in a book for lay readers, especially when the subject is already as elusive as animal navigation.

Many of the problems occur in chapter two, which amounts to a review paper on the status of this difficult field. It does some helpful stock-taking, but it also seems to me to introduce some confusion. I am not sure, for example, what is gained by the curious distension of the term migration. In this "bold, radically new concept," as the cover flap calls it, migration is equated with movement. "Plants," we are told, "in the same way as animals,

Courtesy, Museum of Fine Arts, Boston. M. and M. Kaulak Collection





Gaston Lachaise, *Dolphin Fountain* (1924)

are adapted for movement; but instead of legs and fins they have adaptations such as wings and floats to carry them away from their parents, enabling them to establish a separate existence."

In justifying this redefinition, the editors point out that some animals, such as birds and whales, move thousands of miles in migration, while plankton accomplish similar aims by moving through a few fathoms of vertical distance. From there they reason that "since we neither use the form nor the length of an animal's journey to decide whether it is migratory, . . . migration must embrace all movements animals make from birth to death." I doubt that many biologists will find irresistible logic in this. It is hard to see how any order is brought to an already complicated field by amalgamating the ecological phenomenon of migration with the reproductive dispersal of disseminules and with the long-term zoogeographic spreading of species across space and barriers. It is perhaps worthwhile to show that all forms of locomotion and travel run together at the edges; but once this is noted, it surely pays to keep apart the ideas of ecological habitat-shifting and biogeographic spreading.

In a few other rough places the problems may be mainly semantic, but they nevertheless make one uneasy. In defining and giving examples of the "familiar area" of the "lifetime track" of an animal, for example, the editors say that even a global migrant such as the arctic tern is traveling in familiar territory, not just in its summer and winter ranges, but also all along the vast open-ocean route between the two. Familiar territory is usually defined as a region in which the animal has landmarks it has seen, heard, or smelled before. When the Golden Plover, for

example, travels thousands of miles across the open Pacific from Midway Island to Saint Lawrence Island, it is crossing territory without a single fixed landmark. It cannot look down and say, "Oh, I remember those waves from the last time." I hope that the editors mean that a bird migrating over the trackless Pacific is not *lost*—that it will eventually reach the right destination. But to equate "not being lost" with being in "familiar territory" seems an obstacle to rational analysis.

In the section on navigation, orientation, and piloting, it is suggested that the "preferred direction" sense of animals may be the same as the feeling that some people have of always being drawn to a particular area. I am not one to cavil at anthropocentricity—some animals are obviously more anthropocentric than people—but it can cause trouble. The danger in this use of "preferred direction" is the implication that navigating animals are being drawn toward *goals*. To toy with that thought is bound to hinder any orderly analysis of guidance mechanisms. Animals in long-range migration are not traveling toward goals; they are merely reacting to successive environmental signals, in ways appropriate to *take* them to goals. The two ideas are worlds apart, and ought to be kept so.

The editors of *The Mystery of Migration* have offered few solutions to the problems they raise, and they may have created a few problems themselves. But the book seems sure to find a wide audience and to stir its readers with a healthy uneasiness over our feeble understanding of the imposing puzzles that it describes. Even if some of the mysteries are solved by future generations of scientists, migration will always remain one of the most arresting features of animal behavior. □