



A hyena hunting flamingoes in Kenya.

EVOLUTION

# Doing the locomotion

Kevin Padian assesses a study on how animals came to fly, wade, creep and glide.

It would be hard to find a more companionable guide to the marvels of locomotory evolution than Matt Wilkinson. In *Restless Creatures*, the zoologist and writer rehearses twice-told tales of animals becoming bilateral, exiting the sea for the land and evolving flight, but makes them fresh. These are wonderfully adept and informed explanations of locomotory modes — whether in birds, gliding snakes, eels, sharks or a host of fossil vertebrates — and there is not a single vignette that I failed to learn something from. His prose is knowing and wonky enough to sound as if it comes from the reincarnation of that senior lecturer you had who knew too much for most of the undergraduates, but was hip and amusing out of class.

Wilkinson's thesis is that locomotion drives the evolution of all other features. This is laid out in his introductory chapter, which begins by insulting most people with religious sensibilities: "Righteousness apparently requires that we take everything for granted." He then immediately takes natural selection for granted, declaring that "living things are as they are largely as a result of the process of adaptation". But he provides no demonstration of this, making it seem as if the only

difference between the world views of science and religion is taste, because the believers of neither feel a need to test it.

Wilkinson does modify the claim that natural selection answers all questions about life by writing that it is only "sort of true", because it neglects the effects of mutations and the environment. But this is a 1960s view of evolution, of the kind propounded by Ernst Mayr. Yes, natural selection, mutation and environment are important. But there are also the inherited constraints of development, material properties and other functions of organisms, such as metabolism and reproduction, which are not necessarily optimized by natural selection. Sometimes they even work against it. The peacock's tail, for example, has long been thought (perhaps erroneously) to be a disadvantage in escaping predators quickly. The idea that the need for some form



**Restless Creatures: The Story of Life in Ten Movements**  
MATT WILKINSON  
Basic: 2016.

of locomotion has driven the whole evolution of plants and animals is a risky conceit.

But a deeper problem pervades *Restless Creatures*. About 40 years ago, evolutionary biologists such as Niles Eldredge and Joel Cracraft began to set hypotheses about the evolution of major features in phylogenetic context. Defining and dissecting an adaptation's components and then mapping them on an independently derived tree of relationships help us to visualize the sequence in which these traits arose, and therefore to test ideas of how functions evolved. We know that to fly, an animal does not need hollow bones or a perching foot. But it does need a wing capable of generating a specific kind of stroke, and the energetic and neuromuscular capacity to sustain flight. If you can work out in what sequence these traits appeared on a phylogenetic tree of the first members of a group, then your ideas about how flight evolved can become more explicit and testable.

But none of this is in Wilkinson's book. The older and ultimately unsatisfactory approach that he uses involves modelling (or

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assuming) the functional efficiency of a structure in a single animal, and then imagining how natural selection would have shaped it. This is a good approach up to a point, but how do you know if you are wrong? One way is to check whether your hypothesis matches the phylogenetic pattern. But there is not a single phylogeny in this book to provide an independent test, even though that would provide a pictorial ‘flow chart’ to clarify the proposed direction of evolutionary change.

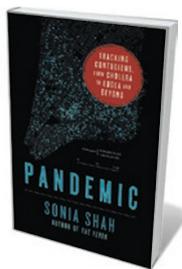
In the chapter on flight, on which he has published original research, Wilkinson begins by discussing some of the physical parameters (such as lift and drag) that constrain flight. This is straightforward and well written, although he does not sufficiently distinguish the kinematic and aerodynamic differences between gliding, flapping and other modes of flight. He assumes that all flying animals had gliding ancestors. But gliders such as the colugo and flyers such as bats are on completely different branches of the vertebrate tree — and their ecologies are completely different. Moreover, no one has convincingly shown how to transform a gliding wing into a flapping one, or that this ever happened. It cannot be assumed that stiff-limbed, quadrupedal gliders evolved the specialized flight stroke. This is why phylogeny matters.

Wilkinson acknowledges that opinion differs on the evolution of feathers, but he ignores the literature that has placed early feather types and their inferred functions — insulation, colour, brooding, inclined running and flight — in phylogenetic order (see R. O. Prum and A. H. Brush *Sci. Am.* **288**, 84–93; 2003). He does not explain the anatomy and functional morphology of flying animals, and pays little attention to kinematic studies of living animals that describe the uses of forelimbs and feathers (see, for example, K. P. Dial *et al. Nature* **451**, 985–990; 2008).

*Restless Creatures* runs the gamut from microorganisms to climbing primates (anthropoids, not clerics), although these are presented in no particular order. Wilkinson shows how locomotion is intimately related to breathing, metabolic rates, habitat and developmental genetics in a variety of groups. I was pleased that he also discusses the locomotion of pollen and seeds, because animal biologists so often ignore plants (see I. T. Baldwin *Nature* **522**, 282–283; 2015), even though they provide an alternate universe of evolutionary possibilities. There is a great deal in this book that is enjoyable and informative, but ultimately, I found it a less than satisfying guide to the evolutionary biology of locomotory studies. ■

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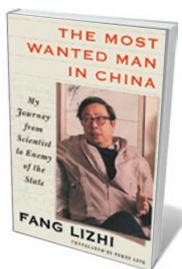
## Books in brief



### **Pandemic: Tracking Contagions, from Cholera to Ebola and Beyond**

Sonia Shah SARAH CRICHTON (2016)

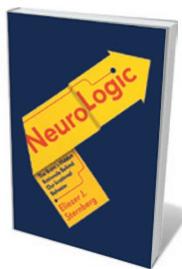
Cholera — the acute bacterial infection that can kill in hours — serves as a lens on new pandemics in this grounded, bracingly intelligent study. As science journalist Sonia Shah reveals, more than 300 infectious diseases have emerged or re-emerged in the past half-century, and epidemiologists predict a catastrophic pandemic in the next. Shah lucidly layers history into a tour of transmission hotspots, from incubators of ‘spillover’ animal-borne illnesses such as China’s wild-animal markets to globalized transport and hyperdense cities.



### **The Most Wanted Man in China: My Journey from Scientist to Enemy of the State**

Fang Lizhi, translated by Perry Link HENRY HOLT (2016)

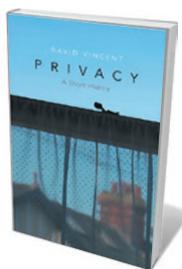
This memoir by late Chinese astrophysicist and dissident Fang Lizhi is a trenchant explication of science under siege. Fang learned English partly by studying Paul Dirac’s 1930 *Principles of Quantum Mechanics*, and carved out a career at the University of Science and Technology of China. Although his youthful love for Communism withered during the forced labour and expulsions of the Cultural Revolution and beyond, Fang’s “awe at the colossal thing called the universe” never waned, surviving surveillance and exile. Inspiring.



### **NeuroLogic**

Eliezer J. Sternberg PANTHEON (2016)

A man stumbling around in a brightly lit room insists it is dark. When a scan shows damage to his brain’s visual monitoring as well as its processing system, his internal ‘logic’ is revealed. This case study is just one of many marshalled by neurologist Eliezer Sternberg for his research-rich study of the neurological circuitry behind the narratives we use to make sense of things. Sternberg cracks open the brain’s “black box” to examine its parallel conscious and unconscious systems, and explores states from dreaming and acts on ‘autopilot’ to memory, hallucinations and trauma.



### **Privacy: A Short History**

David Vincent POLITY (2016)

Have the reports of privacy’s demise been greatly exaggerated, or is it the dodo of our digitized world? Social historian David Vincent examines that question in this deft study of privacy in houses, cities, correspondence and surveillance, from 1300 to today. We peer into the “fugitive spaces” where medievals scratched epistles; the Victorian dichotomy of fortress-like abode and sociable public transport; and today’s paranoia-soaked debates over digital media. Whether linked to ideas of sanctuary, secrecy or intimacy, privacy is a flashpoint in the charged relationship of individual to society.



### **Snowball in a Blizzard: A Physician’s Notes on Uncertainty in Medicine**

Steven C. Hatch BASIC (2016)

How do you pinpoint a tumour in a mammogram? About as easily as you find a snowball in a blizzard, writes medical academic Steven Hatch in this penetrating examination of uncertainty in diagnoses and treatment. It is both constant, he shows, and ignored by physicians at their, and their patients’, peril. He also shows why, looking in turn at issues such as false positives, mammography, hypertension treatments, drug trials and media reportage. **Barbara Kiser**