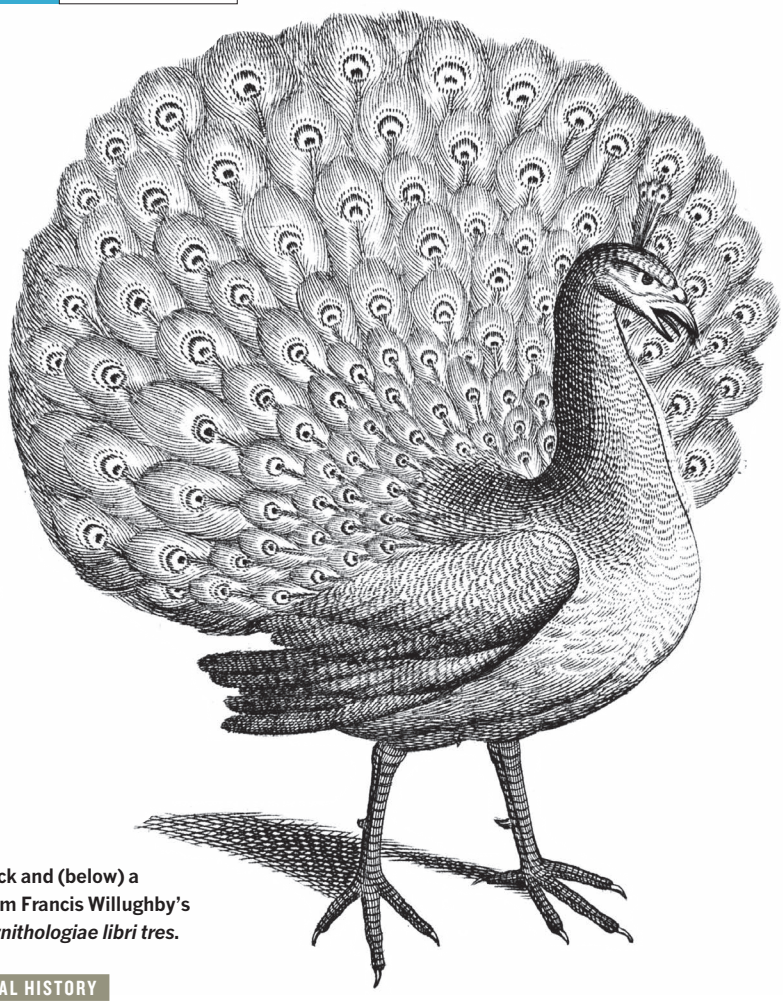

A peacock and (below) a dodo from Francis Willughby's 1676 *Ornithologiae libri tres*.

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NATURAL HISTORY

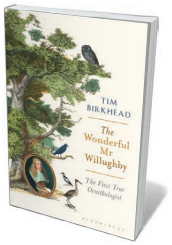
A prodigious namer of nature

Elizabeth Yale relishes a biography of a seventeenth-century polymath with a notable gift for collaboration.

Francis Willughby was a wide-ranging virtuoso in a virtuosic age. Remembered for a pioneering study of bird classification, the seventeenth-century natural historian pursued interests in entomology, botany, linguistics, games and chance, and the reform of biological classification. That he is not better known may be put down to his death at 36. In *The Wonderful Mr Willughby*, ornithologist Tim Birkhead brings his creative energies and contributions to life.

Born in England in 1635, the only son in an established family of the gentry, Willughby inherited estates in Warwickshire and Nottinghamshire. At the University of Cambridge, where polite young men usually acquired a smattering of culture and influential connections, he took a different path — into scientific discovery. He dived into the "new sciences", reading the works of Galileo Galilei, Francis Bacon and René Descartes. And he took copious notes, organized by topic, in his commonplace book — the database of the era.

A sociable man, Willughby found friends who spurred him on. As Birkhead relates, the most important was Trinity College fellow John Ray. Ray encouraged Willughby's interests in mathematics and took him botanizing. It was during these jaunts that Willughby observed puzzling transformations in caterpillars that sparked entomological discoveries. In the late 1650s, the pair embarked on a programme of "chymical" experimentation.



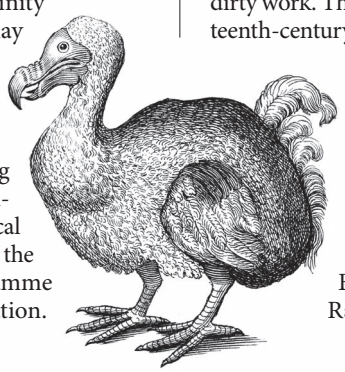
The Wonderful Mr Willughby: The First True Ornithologist
TIM BIRKHEAD
Bloomsbury (2018)

"Chymistry", as practised by Robert Boyle and other natural philosophers, was then evolving from medieval alchemy to modern chemistry. It sought the transmutation of base metals into gold even as it was harnessed for applications such as weapons manufacture. Eventually, Willughby and Ray criss-crossed England and Wales on their birding and plant-hunting expeditions.

Around 1662, they set themselves an ambitious goal: observing, describing and classifying all species. They felt that both the literature and the nomenclature sowed confusion. Swiss naturalist Conrad Gessner's *History of Animals* (1551–58), for instance, mixed ancient knowledge with observation. By contrast, Ray and Willughby grounded their system in precise anatomical description, distinguishing between even closely related species. Beginning with British species and extending to mainland Europe, they established a taxonomy that would be built on by centuries of naturalists, including Carl Linnaeus in the mid-eighteenth century. Dividing birds into land and water fowl, they deployed attributes such as beak shape to create a branching classification key.

Willughby thrived on collaboration, and used his wealth to enable it. In 1662, Ray resigned his college fellowship, rather than subscribe to the Act of Uniformity passed by Parliament to fortify Charles II's newly restored monarchy. Willughby invited his mentor into his household. The next year, Willughby was elected an "original fellow" of the Royal Society, and he and Ray, with Ray's students Philip Skippon and Nathaniel Bacon, ventured on a tour across Europe.

They attended university lectures and visited cabinets of curiosity — troves of exotica where they handled a hornbill's head and an elephant's tail. They collected birds' eggs and a book of paintings of birds and fish from Leonard Baldner, keeper of forests in Strasbourg, now part of France. In rented rooms, they dissected and drew fish from Venice markets, a servant often doing the dirty work. They visited the museum of sixteenth-century naturalist Ulisse Aldrovandi in Bologna and attended human dissections. Of this very Protestant crew, Willughby alone braved the dusty roads of Catholic Spain, which he viewed as a forbidding closed society.



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After they returned to England in the mid-1660s, Ray stayed on at Willughby's

estate as the latter married, had children and managed his lands. Birkhead gives a wonderful sense of the pair's delight in nature, even as Willughby, never robust, began to have recurring fevers. Inspired by physician William Harvey's discovery of blood circulation, published in 1628, Willughby contemplated the movement of sap in trees years before the subject surfaced in the Royal Society's journal, *Philosophical Transactions*. He was the first to classify insects by their metamorphoses, recognizing that a caterpillar, pupa and butterfly were life stages of one insect, not separate species. He asked astute questions, such as which birds survive winters by migrating. He observed the life cycle of a leaf-cutter bee, later named after him — *Megachile willughbiella*. He even wrote a study on games, from football to cards.

Birkhead's account is vividly textured, drawing from his collaborations with science historians. We follow Willughby from seabird nesting grounds on the Isle of Man to glass-making factories in Murano, Venice. Willughby's letters and notebooks, full of his swift, impatient writing, tell how avidly he worked. The strangeness of his scientifically liminal century shines through, exemplified by an "insect" collected in Italy, a fake made from a moray eel's jaws and a thorny plant. Birkhead tightens the links between Willughby's work and modern biology, confirming that he and Ray identified some 90% of around 200 bird species often seen in England and Wales.

As Birkhead emphasizes, the bond between the restless Willughby and the more restrained Ray was extraordinarily fruitful. Yet there were challenges, not least differences in social circumstances. Willughby was a gentleman, Ray a blacksmith's son — disparities they finessed in life. That became more difficult after Willughby's death. In exchange for an annuity, the family expected Ray to educate Willughby's children; he was reluctant. They also resented Ray's control over Willughby's posthumous legacy. They quarrelled over access to Willughby's collections and papers as Ray produced *The Ornithology* (1676), *The History of Fishes* (1686) and *The History of Insects* (1710), based on his joint work with his friend. Subsequently, historians have struggled to divide the credit, sometimes favouring one man, sometimes the other.

"This game of spot-the-genius is inappropriate and unhelpful," writes Birkhead. He invites us to see a scientific life well lived, rich with ideas, adventure and companionship — and, in Willughby's profound collaboration with Ray, two very different personalities who saw further because they worked together. ■

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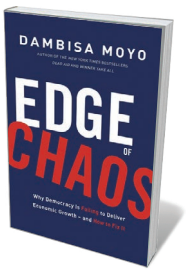
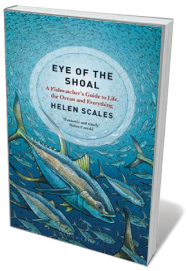
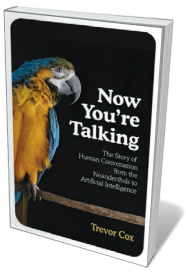
Books in brief



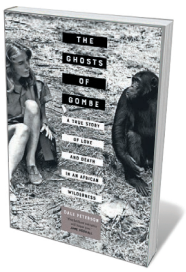
Edge of Chaos
Dambisa Moyo LITTLE, BROWN *(2018)*
Does the "new normal" in many democracies, from high unemployment to political turmoil, make them poor models for sustainable growth? In this trenchant analysis, economist Dambisa Moyo explores that provocative question. She examines growth across the political spectrum, from China to the United States, and probes entangled challenges such as debt and protectionism. Unsurprisingly, she points to an urgent need for political reform. Her blueprint for that (including civics courses for the electorate) is ambitious, but, as she asserts, "All the easy choices are behind us".



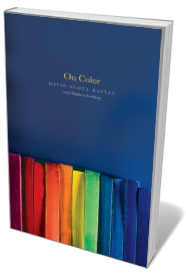
Eye of the Shoal
Helen Scales BLOOMSBURY SIGMA *(2018)*
Marine biologist Helen Scales's *Spirals in Time* (2015) opened up a whorled wonderland of marine molluscs. This gifted writer now deep-dives into piscine realms. Scales, whose research has spanned the South China Sea and Australia's Ningaloo coral reef, weaves the history of ichthyology with explorations of adaptations, such as how glycoproteins act like 'antifreeze' in the blood, and why shoaling saves energy. Perhaps most beguiling are the hums and pops of fish 'calls', which the creatures sense through the lateral line — a series of organs that effectively turn their bodies into giant ears.



Now You're Talking
Trevor Cox BODLEY HEAD *(2018)*
On average, humans utter 500 million words over a lifetime. And it's a crazily complex process, as acoustic engineer Trevor Cox reveals in this intensive survey. Speaking involves "anatomical gymnastics" linked to multiple brain regions; hearing is a subtle decoding of tone, timbre and sense. Cox's investigation sweeps from the putative protolanguage of human ancestor *Homo heidelbergensis* to the likelihood of creative algorithmic discourse. In between, he looks at the infant's acquisition of language, the neuroscience of beatboxing (vocally mimicking percussion instruments) and much more.



The Ghosts of Gombe
Dale Peterson UNIVERSITY OF CALIFORNIA PRESS *(2018)*
In July 1969, Ruth Davis — a volunteer at Jane Goodall's chimpanzee research centre in Gombe, Tanzania — disappeared. Her body was found below a waterfall six days later. Goodall biographer Dale Peterson probes the tragedy and its convoluted context in forensic detail, casting back and forth from the centre's primatological findings to the human stories of its researchers. Peterson's engrossing, sometimes dizzyingly kaleidoscopic narrative is bookended by nuanced analyses of how Davis might have died, and the aftershocks that still rock those who knew her best.



On Color
David Scott Kastan and Stephen Farthing YALE UNIVERSITY PRESS *(2018)*
Artistic innovator Paul Cézanne accurately noted that colour is a collaboration between mind and world. So remind literary scholar David Scott Kastan and artist Stephen Farthing in this vivid and erudite tour of a phenomenon that entwines microphysics and electromagnetics with human physiology and cognition. Their march through ten hues drives home why much of culture is deep-dyed in colour, from political affiliations (think the Greens, or Ireland's Orange Order) to blue notes in music, "uncanny microtonal slides and bends" expressive of emotional subtleties. **Barbara Kiser**