

## EVOLUTION

# Parallel lives

Kevin Padian hails a stunning, provocative book probing evolutionary mechanisms.

Early in Jonathan Losos's *Improbable Destinies*, the narrative goes off the rails. Losos sets up the problem of historical contingency in evolution by repeating the story that 66 million years ago, at the end of the Cretaceous period, an asteroid smacked into Earth, killing off the dinosaurs and paving the way for mammalian success. Had the asteroid missed, he writes, dinosaurs would have continued their domination and we humans might never have evolved.

There is one problem. Some research suggests that dinosaurs had been declining for millions of years before the impact as the climate changed, shallow inland seas receded and returned, temperatures dropped and inland environments destabilized. Their extinction rates did not increase at the end of the Cretaceous; rather, origination of new species plummeted, and so diversity dropped. If there were any dinosaurs left by the very end of the period, they would probably not have succeeded in the cooler, forested world of the Palaeogene period that followed. The Chicxulub asteroid and the large-scale volcanic activity around the same time may have been almost irrelevant to their fates.

Neither is it sensible to maintain that their demise paved the way for mammals. Recent discoveries show enormous ecological diversity in Cretaceous mammals, from swimmers to gliders; they rarely topped 10 kilograms at the time, but became larger in the Palaeogene. Just as importantly, they lived in environments quite different from those of the Cretaceous. So stories about “replaying the tape” of evolution can acquire a different cast, given further evidence.



**Improbable Destinies: Fate, Chance, and the Future of Evolution**  
JONATHAN B. LOSOS  
*Riverhead: 2017.*

Nevertheless, *Improbable Destinies* is deep, broad, brilliant and thought-provoking. Losos explores the meaning of terms such as fate, chance, convergence and contingency in evolution. Why do similar solutions — morphological, genetic and molecular — crop up again and again? He became intrigued by these questions when, as a student, he began to study the Caribbean *Anolis* lizards, following groundbreaking work by ecologist Thomas Schoener. These lizards inhabit a great range of island sizes and habitats, and tend to evolve similar adaptations and roles in similar circumstances. However, species on different islands that resemble each other aren't each other's closest relatives. Why not?

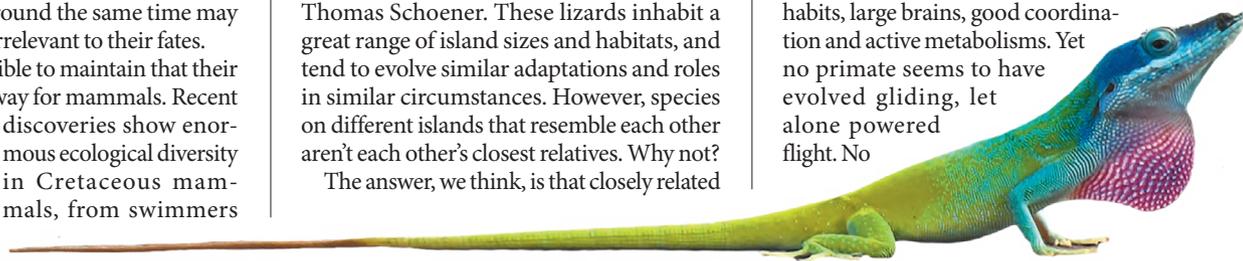
The answer, we think, is that closely related

lineages have similar genetic components, so under comparable ecological conditions they are likely to produce similar mutations that are then selected for. Many call this convergence; I prefer the term parallelism for closely related lineages. ‘Convergence’ is appropriate for reinvention in very different groups — the superficially similar wings of birds and pterosaurs, or the elongated grub-seeking fingers of the aye-aye (*Daubentonia madagascariensis*) and striped possum (*Dactylopsila trivirgata*). We can catalogue examples all day, but is there any real theory of convergence? We cannot assert that some lineages are ‘fated’ to converge on these features. Biological ideas of determinism went out with Jean-Baptiste Lamarck in the late eighteenth century.

Evidence against determinism is the prevalence of creatures whose adaptations have never been duplicated: the kangaroo, the platypus (*Ornithorhynchus anatinus*), the century plant (*Agave americana*, which blooms only once in its multidecade life) — and humans. Primates have the equipment apparently needed to evolve flight: arboreal habits, large brains, good coordination and active metabolisms. Yet no primate seems to have evolved gliding, let alone powered flight. No

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SIR FRANCIS CANKER PHOTOGRAPHY/GETTY



The knight anole (*Anolis equestris*), with its large head and toe pads, is adapted to live high in forest canopies.

evolutionary duplication is inevitable.

And how are we to predict these convergences? Losos resurrects palaeontologist Dale Russell's fantastic "dinosauroid" of the 1980s, a conception of what would have happened if bipedal, carnivorous dinosaurs with large brains and grasping hands had been selected for, had the asteroid not struck (Russell accepted the asteroid hypothesis). This three-fingered creature with a huge brain, a beak and chicken feet seems to have inspired the aliens in the 1980s science-fiction television series *V*, but scientists were uninspired.

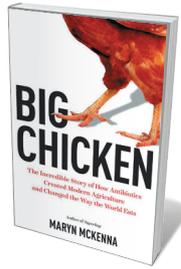
Evolutionary biologist Stephen Jay Gould wondered about the unique, fragile fauna of the Cambrian period (541 million to 485 million years ago) in his 1989 book *Wonderful Life* (W. W. Norton). Had the period's chordates — which included the ancestors of vertebrates — become extinct, we wouldn't exist. But as Losos points out, it's not a fair comparison: you're not replaying the tape, but running a different one.

The idea of contingency is perhaps best based on palaeontologist Dolf Seilacher's theory of constructional morphology. In this, features such as the elephant's trunk or the osprey's habit of catching fish with claws rather than beak result from three factors: adaptation (the selective component), evolutionary history (organisms must work with what they've inherited) and construction (how the material properties of living structures empower and constrain their form). From there, history takes over. Evolution is not a preordained, inevitable narrative. Neither is it a crapshoot, with random particulars disporting themselves until something works. Rather, it is like the game Monopoly. Where you go next is in part determined by where you are now; who you are is where you've been (your acquisitions); where you can go is determined by the throw of the dice, with limited possibilities and probabilities.

In staggeringly clear and engaging prose, Losos shows us remarkable vignettes of scientists working at personal and professional risk in all sorts of habitats — field, lab and museum — to elucidate stunning mechanisms of evolution (such as rapid adaptation in evolutionary biologist Richard Lenski's experimental strains of *Escherichia coli* bacteria). He is one of the premier writers in biology today: his book is my first choice to anchor a stimulating evolutionary biology seminar. ■

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## Books in brief



### Big Chicken

Maryn McKenna NATIONAL GEOGRAPHIC (2017)

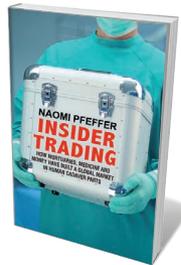
This superb scientific exposé by journalist Maryn McKenna skewers the use of growth-promoting antibiotics in chicken feed. The practice has left much US supermarket chicken laced with antibiotic-resistant bacteria; globally, such microbes cause 700,000 human deaths each year. McKenna tracks the method's rise from the 1940s, a harrowing story punctuated by disease outbreaks and regulatory laxity. More recently, she shows, a trend to ban antibiotic use and instead re-engineer the poultry-farm environment could, given the dominance of chicken, transform the global "meat economy".



### The Sky Below: A True Story of Summits, Space, and Speed

Scott Parazynski with Susy Flory LITTLE A (2017)

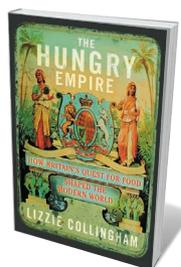
"I'm walking like Frankenstein on crack, but it's the best I've got." Thus writes astronaut and physician Scott Parazynski on climbing Everest with severe back pain, brought on by exposure to zero gravity. A veteran of five space missions, seven spacewalks and a stint as space pioneer John Glenn's personal medic, Parazynski is as disarmingly down-to-earth as he is heroically stoic. You're with him every minute in this hair-raising memoir, as he wrangles with wayward tethers outside the space station Mir, "sutures" a solar array to the International Space Station or gazes at the glittering tapestry of stars from Earth orbit.



### Insider Trading

Naomi Pfeffer YALE UNIVERSITY PRESS (2017)

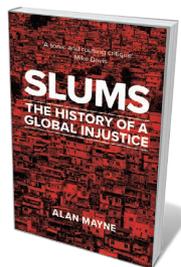
Organs for transplantation comprise only a fraction of the potential 'harvest' yielded by a human corpse. In this pacy, detailed chronicle, Naomi Pfeffer reveals how hundreds of products are traded in US and UK markets, from skin for dressing leg ulcers (plastic-packed "like American cheese") to the ground bone mixed into fixative for prosthetic limbs. Focusing on corneas, pituitary glands and skin, Pfeffer unravels the tangled ethics of this mortuary-fuelled industry, which has evolved over a century of medical experimentation and advances in extracting and preserving "cadaver stuff".



### The Hungry Empire

Lizzie Collingham BODLEY HEAD (2017)

Beyond gold and glory, an insatiable lust for foreign foods drove the juggernaut of British imperialism. So shows Lizzie Collingham in this rich economic history, drawing on annals military, mercantile and domestic to reveal the complex routes along which the fruits of colonial fields and fisheries were shunted to Britain's dining rooms. The 500-year journey begins with the role of Newfoundland salt cod ('poor John') in Tudor exploration, and progresses through imperial tales of class and cruelty by way of Jamaican rum, African rice and alarming dishes such as iguana curry and roasted opossum.



### Slums: The History of a Global Injustice

Alan Mayne REAKTION (2017)

A billion people live in the shadow cities we call slums. Alan Mayne's trenchant social history traces how perception of them shifted. Victorians saw them as labyrinths or vortices — "topsy-turvy" realms of otherness. Today, they are more likely to be viewed as resilient hubs of innovation. Yet developers' war on slums has seen no ceasefire. It's hard to refute Mayne's estimation: "We invent them to explain to ourselves the ugly traits, the logical incongruities and the social inequalities of modern capitalist cities." **Barbara Kiser**