BOOK REVIEWS

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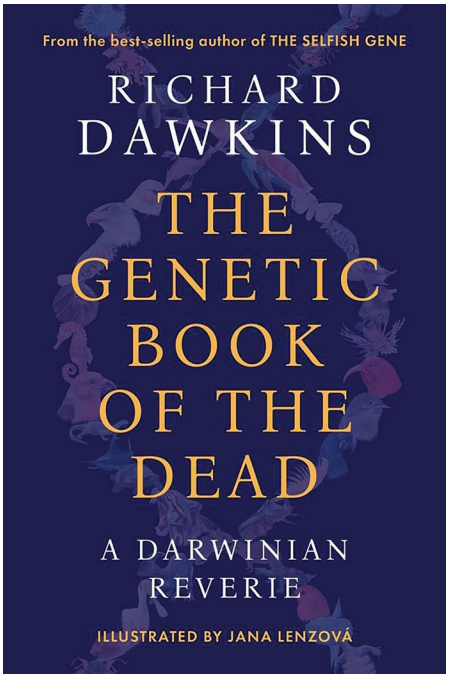
The Genetic Book of the Dead: A Darwinian Reverie. By Richard Dawkins. Illustrated by Jana Lenzová. 2024. Yale University Press. (ISBN 978-0300278095). 360 pp. Hardcover. $35.00. Ebook also available.



In *The Genetic Book of the Dead*, Dawkins provides another volume of lucid prose that is a pleasure to read. He explains what the bodies and behaviors of organisms can tell us about the lives and environments of their ancestors. The title refers to the metaphor that an organism is a palimpsest, having diverse layers or aspects beneath the surface. For example, the human skeleton and musculature are adapted to a lifestyle involving bipedalism and running. However, the prevalence of back pain is a sign that a quadrupedal anatomy has been 'overwritten' during the history of the lineages leading to us.

The palimpsest metaphor is even more salient at the genome level. Dawkins compares the genome to a computer disc drive. When a computer file is deleted, it is not removed from the disc. All that happens is that the index that marks the file's location is changed to indicate that the space on the disc where that file is located is now open, and the file can be overwritten by new files in the future. The deleted files are compared to pseudogenes. Just as a deleted file can be gradually overwritten by new files, pseudogenes are gradually overwritten by mutations. Examples of pseudogenes include the 400 human smell receptor pseudogenes that indicate that our ancestors relied more heavily on the sense of smell.

The book's subtitle, *A Darwinian Reverie*, refers to the author's musings over the power of natural selection to produce the many wondrous adaptations described. Dawkins begins with seven chapters describing a variety of anatomical and behavioral adaptations produced by natural selection, including camouflaged lizards, fish that pass as seaweed, and how a male bird's song influences his rivals and attracts females.

Chapters 8 and 9 briefly explain and defend the gene's-eye view of evolution previously presented in *The Selfish Gene* and *The Extended Phenotype*. According to the gene's-eye view, the central focus of evolutionary theory is the gene, the only feature of living systems that is potentially immortal. Genes are accorded a special status as replicators that can make faithful copies of themselves generation after generation. No other feature of living systems persists like the gene. Organisms are merely the vehicles that genes use to copy themselves.

The remaining chapters apply the backward gene's-eye view, the idea that a successful gene that contributes to an adaptation can look back on an unbroken line of ancestral genes that also contributed to the survival and reproductive success of the vehicles that harbored them. In these chapters, Dawkins discusses a variety of interesting phenomena, including nest parasitism by cuckoos and behavioral control of rodents by *Toxoplasma gondii*, among others.

Dawkins' selfish gene theory fits squarely in the philosophical tradition known as reductionism, where the goal is to provide explanations of complex phenomena in terms of the most fundamental level, in this case, the gene. The reductionist approach has been exceptionally successful in biology. We have progressed from rediscovering Mendel's work in 1900 to sequencing the human genome in under a century. During the same period, our understanding of cells progressed from bags of protoplasm to complex structures populated by protein machines that organize and carry out life processes.

Similarly, Dawkins' reductionist gene's-eye view has successfully answered many evolutionary questions, explaining altruism and selfish genetic elements, among other phenomena. According to the gene's-eye view, central to the Modern Synthesis of evolutionary theory, the only crucial causal chain flows upward from the gene to cells and ultimately to the organism.

Critics of the gene's-eye view say that an Extended Evolutionary Synthesis is required to explain recent advances in physiology, developmental biology, genomics, and ecology where higher-level processes are seen to constrain the action of genes (Laland et al., 2014; Noble, 2017). Dawkins addresses these criticisms here in his defense of the gene's-eye view.

Can the Modern Synthesis absorb and explain the advances in these fields, or do we need to 'rethink' evolutionary theory and develop an Extended Synthesis? Dawkins and other evolutionary biologists argue that existing evolutionary theory can account for anomalous phenomena raised by the critics (Laland et al., 2014). However, multiple perspectives will likely be necessary to fully explain the evolution of life, requiring an Extended Synthesis. The debate continues.

Teachers will find this an excellent update on the gene's-eye view, its

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importance to evolutionary theory, and Dawkins' responses to critics of that view. Like Dawkins' earlier books, *The Genetic Book of the Dead* is a pleasure to read.

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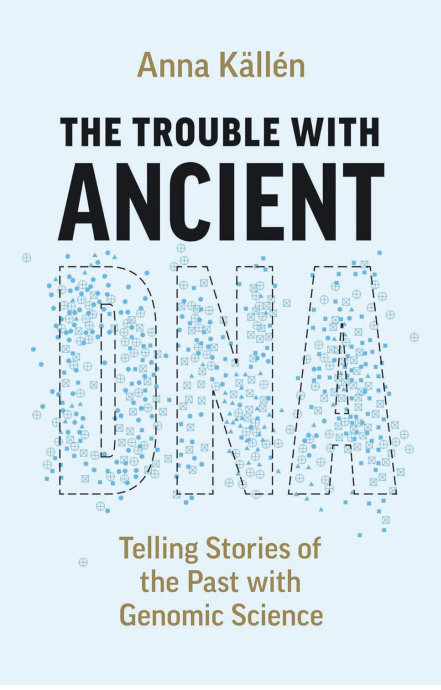
The Trouble with Ancient DNA: Telling Stories of the Past with Genomic Science. By Anna Källén. 2025. University of Chicago Press. (ISBN 978-0226821672). 163 pp. Paperback. $20.00. Ebook also available.



Because I've worked on projects considering how best to teach students about human evolution—which has occasionally involved addressing misconceptions in the scientific literature itself—I've spent many afternoons combing through data from ancient DNA studies. And I definitely understand the quasi-mystical reverence that people hold for these datasets! Long strands of DNA aren't particularly stable, and it seems almost miraculous that researchers can obtain *any* sequence information from forty-thousand-year-old samples. In a college-level biology course just twenty years ago, my professor announced that ancient genomics was "pure Hollywood fantasy"—now, several Nobel prizes later, we have access to so much more information about the past than many had believed possible.

In *The Trouble with Ancient DNA*, archaeologist Anna Källén exposes several ways in which our stories about the past aren't quite living up to the promise of all this new data. Källén argues convincingly that several common phrases and figure presentation styles that researchers use to communicate with each other are likely to reinforce misconceptions among non-specialists—I felt aghast when white supremacist groups reacted to data on the spread of ancient alleles for lactase persistence by hosting bovine-milk-chugging events. Källén also documents instances in which unverified (and likely inaccurate) ideas about race and tribalism are often lurking at the core of the statistical models that produce the ancient DNA datasets.

Källén thoughtfully considers how scientific information might be interpreted by members of the public who haven't had a lot of scientific training, or who might have last taken a science class many years ago. For example, we often illustrate the migration of human populations with arrows that arc across continents. Among an audience of biologists, who wouldn't balk at an equivalent diagram with arrows showing the migration of oak trees, the figure would be a clear, compelling way to convey important information. But to a general reader, such a diagram might conjure cinematic images of a group of people doggedly marching toward an intended destination, even though the rate of migration along the arrow might be less than a mile per year for thousands of years, compared to the hundreds of miles per year that actual nomadic communities cyclically travel as the seasons change. The idea that these arrows represent the actual migrations of human settlers who traveled in a single direction with the intent to conquer new lands is just as fictional as a marching army of ents (Tolkien's mobile tree people), yet it seems unlikely that everyone who encounters the figure will understand this.

Källén also works as a professor of museum studies, and is deeply invested in the ways that we as scientists construct models and tell stories based on incomplete information. We will never be omniscient; we have to draw conclusions anyway. Källén's objection is obviously not against using data from ancient DNA to help us understand the past, but rather the way that the invocation of DNA suddenly makes stories seem so much more compelling to general audiences, despite how many other forms of data also help us understand the past.

Precisely because Källén is not a specialist in the field of ancient genomics, and so began this investigation naive of assumptions that researchers doing the work might consider to be common knowledge, she does a good job of explaining the methodology of obtaining sequence information from ancient samples. For example, Källén describes the computation and statistical modeling in much more detail than Jennifer Raff in *Origin: A Genetic History of the Americas* (which I thought was excellent).

Educators and other scientific communicators will likely appreciate Källén's focus on the way that members of the general public might interpret scientific figures and statements. This book is as much about the philosophy of science as about the science itself, and I think you'd need to feel invested in someday learning more about human evolution—a field for which ancient DNA sequences are an invaluable resource—to get the most out of this. But if that description entices you, I think you'll enjoy this.

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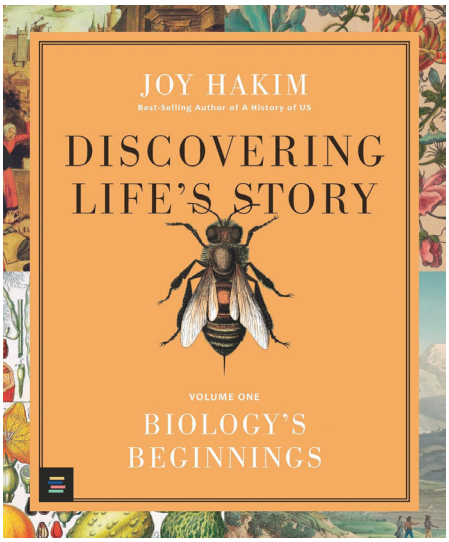
FIRST TWO BOOKS OF A SERIES FOR YOUNGER READERS:

Biology's Beginnings. By Joy Hakim. 2023. MITeen Press. (ISBN 978-1536222937). 192 pp. Hardcover. $22.99.

Joy Hakim's *Biology's Beginnings*, the first in what will be a four-volume history of biology for younger readers, is a delightful zip through ten centuries of discovery. Although imperfect in places, it provides a beautifully illustrated and easy-to-read introduction to most of the big names, places, and discoveries that laid the foundations for modern science.



Hakim's journey begins in eighth-century Baghdad, but by page 4, the House of Wisdom is destroyed by Mongol raiders and its books thrown into the Tigris River. What we get, then, is a mere nod to non-Western knowledge. In fact, not much before the sixteenth century gets more than a mention, as Hakim zooms through eight hundred years in thirteen pages. The pace slows significantly beginning in Chapter 2, and the next eleven chapters offer a fairly conventional "Greatest Hits" tour of early biologists and their work. You encounter Vesalius and his autopsies that revolutionized the understanding of the human body, a long exploration of the various attempts to overturn the idea of spontaneous generation, and a detailed recounting of how increasingly powerful microscopes unlocked knowledge. But it's not all biology—astronomy, philosophy, and geology get their due, as Copernicus, Galileo, Bacon, Steno, and others are featured. In fact, much of this volume is not so much about the history of biology as it is about the history of science in general.

In particular, Hakim seems to be recounting the origins of scientific methodology, recounting again and again how careful observation and documentation supplanted imagination and doctrine. It's all beautifully and subtly done—which is why I was so frustrated by Hakim's regrettable assertion that "the scientific method" is defined as "a process in which a problem is identified, relevant observations and experiments lead to a hypothesis, then that hypothesis is tested, often through experiments and observations that control for as many variables as possible. If the hypothesis passes the experimental test, you have scientific validation; given enough passed tests, you have a scientific law, which holds unless someone disproves it" (p. 72).

On the contrary, there is no one way that science is done, as Hakim's own history illustrates time and again! Controlling for variables is indeed important in some types of studies, but completely impossible in others (a case in point: paleontology). Further, scientific hypotheses, theories, and laws do not form a hierarchy. Mendel's "laws" are not better supported than Darwin's "theory." For a corrective to these (and many other) misconceptions about the nature of science, see the University of California Museum of Paleontology's Understanding Science website (https://undsci.berkeley.edu/).

That huge issue aside, Hakim's book was full of delightful details and insights that keep the narratives fresh and lively despite being about people and events in the past. Fires, a shipwreck, and untimely deaths stunt progress just as often as dumb luck and good fortunes enable it. Would Galileo have been spared imprisonment had his benefactor not died of fever at age 42? Would Linnaeus have become the "prince of botanists" and founder of binomial nomenclature had his father not spoken fluent Latin and raised him as bilingual? Or would Koch have developed his postulates of germ theory had he not received a microscope as a birthday gift from his wife? It's impossible to know, of course, but Hakim's inclusion of these little tidbits provide fodder for games of "what if?"

The overall narrative Hakim spins is perhaps too neatly linked, with one discovery teeing up the next. It reminded me of Stephen Jay Gould's essay "Life's Little Joke," in which he explains that early paleontologists such as O. C. Marsh often simply drew a direct line between two points in a lineage, claiming gradual, directional, evolutionary change. This, Gould wrote, was akin to laying a ladder atop a bush. The history of science, much like the history of life, is far more sprawling and looping than Hakim makes it out to be. But of course, this is a book for young readers, and her choice to highlight the big names is understandable, if a bit disappointing. That said, Hakim makes commendable efforts to include some voices outside the white male mainstream, with some boxed features and sidebars featuring women scientists and their (often more interesting) stories.

Biology's Beginnings is two things at once: an enjoyable and informative read as well as a flawed and limited narrative. Its beautiful illustrations, clear and descriptive prose, and light touch make it worth the read despite its shortcomings.

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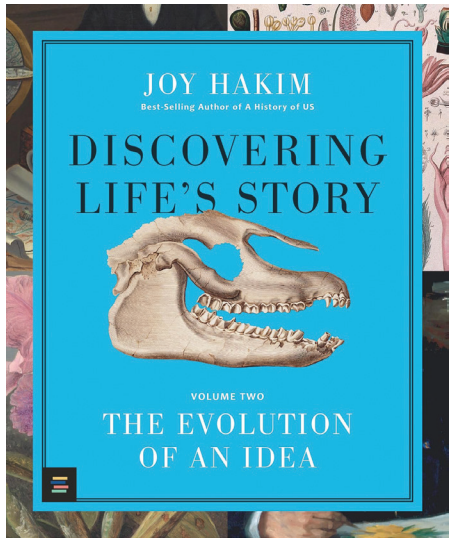
The Evolution of an Idea. By Joy Hakim. 2024. MITeen Press. (ISBN 978-1-536-22294-4). 192 pp. Hardcover. $22.99.



A popular writer of history for young readers, Joy Hakim is famous for her *A History of US*, a ten-volume history of the United States (1993–1995). She later turned to the history of science in particular, with a three-volume *Story of Science* (2004–2007). She is now engaged in composing a four-volume history of biology, *The Discovery of Life*, of which *The Evolution of an Idea* is the second volume, following *Biology's Beginnings* (2023, reviewed above), which ends with the discovery of viruses in the late nineteenth century.

The Evolution of an Idea backtracks a bit, to 1751, the year in which Denis Diderot (and Jean le Rond d'Alembert, unmentioned by Hakim) launched the *Encyclopédie*, thus situating the development of evolutionary theory in the context of the Enlightenment. The subsequent narrative is conventional and straightforward, proceeding from Linnaeus through Buffon, Erasmus Darwin, and Lamarck and Cuvier, to the early British paleontologists. Three chapters are devoted to the education, the around-the-world voyage, and the pre-*Origin of Species* ruminations of Charles Darwin. Alfred Russel Wallace receives his due in chapter 9, "The

Other Guy," and a discussion of the *Origin* occupies the bulk of chapter 10. In the final two chapters, the focus shifts from evolution to genetics, with Mendel's discoveries and their rediscovery in the early twentieth century under discussion. The book ends with a teaser about cell biology.

There are a few minor errors. For instance, Darwin is said to have studied natural theology at Cambridge University with William Paley. Necromancy would have been required, because Paley died in 1805, four years before Darwin was born. What's true is that Darwin studied the works of Paley, and with pleasure, describing them in his autobiography as "the only part of the academical course which … was of the least use to me in the education of my mind." There are also a few odd choices of emphasis. Hakim devotes a few sentences to the allegation that Darwin stole the idea of natural selection from Wallace, but she overlooks the allegation (leveled by no less a figure than R. A. Fisher) that Mendel's data were falsified. The legendary Oxford debate of 1860, where Thomas Henry Huxley tangled with Samuel Wilberforce over Darwin's recently published views, is not so much as mentioned.

Overall, however, *The Evolution of an Idea* offers a treatment of the history that is not only competent but highly readable. Hakim's prose is clear, uncomplicated, and lively, and her use of the historical present (e.g., "[Erasmus] Darwin is struggling to figure that out," p. 39) heightens the drama of the intellectual endeavors she relates. A few examples, such as Linnaeus's predilection for naming species of foul-smelling plants after his enemies and Darwin's chastisement by his father for his frivolous interests ("shooting, dogs, and rat-catching"), are particularly likely to engage young readers. Additionally, the book is lavishly illustrated, often with full-color photographs, and punctuated by explanatory boxes and sidebars. Relevant social issues, such as slavery in the New World and the challenges faced by women seeking to participate in the scientific community of their day, are appropriately discussed.

Like any important area of science, evolution has "a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time," to quote Appendix H to the NGSS. High school biology educators—or even middle school biology educators with particularly enthusiastic classes—who want to help their students appreciate that history will not be able to find a better book to recommend or to make available in their classrooms than *The Evolution of an Idea*.

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