

## Why Evolution is True

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to minimize suffering. But no, he says; “the world of nature seems to take no steps at all to reduce the sum total of suffering.” Ichneumon wasp larvae are selected to eat the innards of caterpillars, keeping their host alive until they have completed their own development. “I don’t know whether caterpillars can feel pain,” Dawkins writes, but wasp larvae would not profit from minimizing whatever pain they cause, nor would selection favor caterpillar genes for insensitivity to pain. Natural selection is indifferent to suffering unless it affects survival or reproduction.

This may be an unappealing conclusion, although explanations of evil from theological theodicy are hardly more reassuring. But as Dawkins reminds us in his final chapter, value judgments—whether good, bad, evil, or immoral—do not bear on the factual content of a hypothesis. Much of the opposition to teaching evolution is based on the presumption that it justifies or encourages immorality. But even if that were true (and there is not the slightest shred of evidence that it is), “that would not imply that the theory of evolution was false. It is quite astonishing how many people cannot grasp this simple point of logic.” I learned from Dawkins that this logical fallacy is called the *argumentum ad consequentiam*—the argument that a statement is true or false because I like or dislike the consequences.

Were there to be a second edition, I might suggest that Dawkins add more concrete examples to his conceptual explanations of some topics and address the balance between development and evolution in treating what Darwin, in a letter to Asa Gray, called “by far the strongest single class of facts in favour of change of form.” Dawkins remarks, “I know that not all my readers like my digressions,” and I confess that I am among them, but really, some of the longer digressions do risk the reader’s losing the thread of the argument altogether. But these are minor points. If readers are at all sympathetic to science or are honestly interested to learn why biologists prize evolution as the central fact and organizing principle of their science, they will enjoy reading *The*

*Greatest Show on Earth*, and they will find insights on every page.

Coyne (2009) and Dawkins make many of the same fundamental points and even use some of the same examples, but they differ in style. Readers who want a short, quick, straightforward account of the evidence may find that Coyne (who focuses on evidence for evolution, not refutation of creationism) suits them better; those who prefer their science served with more anecdotes, a chattier style, and explicit revelation of the failures of creationism may opt for Dawkins. Better still, read both, assign both to your class, make them a gift for all your friends and relatives. *Why Evolution Is True* and *The Greatest Show on Earth* are among the most important books on evolutionary science for a broad audience in decades. Both desperately needed to be written and need to be read.

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### THE “IF..., THEN” OF EVOLUTION

**Why Evolution Is True.** Jerry A. Coyne. Penguin (Viking), 2009. 304 pp., illus. \$27.95 (ISBN 9780670020539 cloth).

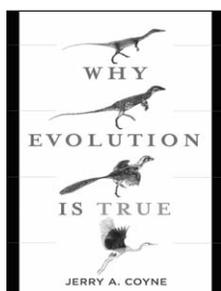
The evidence for evolution is overwhelming, yet a substantial proportion of Americans (and people of other nationalities) have doubts about the reality of evolution. These doubts tend to come in two related flavors: Darwin’s theory of evolution is, after all, “only a theory”; and creationism (and its close relatives, such as “intelligent design”) represents a plausible scientific alternative to evolution. Despite a long history of legal rejections of these notions, including the *Kitzmiller v. Dover* decision in 2005, this distrust and misunderstanding of evolution remains pervasive. When your seatmate on an airplane or your uncle Ernie at the dinner table asks what you, as a biologist, think this evolution stuff is all about, how should you respond? Tell them what I would: Read Jerry Coyne’s excellent new book, *Why Evolution Is True*.

Coyne, a distinguished evolutionary geneticist at the University of Chicago and a regular contributor to National Public Radio and *The Times Literary Supplement*, begins by defining the modern theory of evolution in terms of six components: evolution, gradualism, speciation, common ancestry, natural selection, and nonselective mechanisms. What distinguishes Coyne’s treatment from many previous books on the topic is a determined focus on prediction and retrodiction: “If evolution is true, then we predict that....” Throughout the book, Coyne uses this simple but powerful device to illustrate how scientists have accumulated the evidence demonstrating how and why evolution happened and continues to happen.

This approach is particularly successful in discussions of the evidence for evolution, gradualism, and common ancestry in the first half of the book. In lucid prose, Coyne leads the reader

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through the logic of how evolution makes specific predictions about the fossil record and the structural, developmental, and genetic characteristics of organisms. Many of the examples here—the evolutionary transitions of amphibians, birds, and whales—are well known but engagingly presented. The discussion of vestigial structures and pseudogenes is particularly compelling, clearly conveying how such features can make sense only in the light of evolution.



My favorite chapter was “The Geography of Life.” As in several other chapters, Coyne begins with a brief historical anecdote—here the real-life Robinson Crusoe (Alexander Selkirk) and the fellow (nonhuman) inhabitants of his remote island—to explore evolutionary predictions about why organisms occur where they do. Coyne’s diverse examples, drawn largely from terrestrial vertebrates and plants, interweave the themes of dispersal, contingency, and convergent evolution in explaining biogeographical patterns at both large and small scales.

The middle sections of the book focus on the mechanisms of evolution and diversification. Coyne clearly lays out the logic of natural and sexual selection and explains how these can lead to simple and complex adaptations. This provides a good summary of the abundant evidence we have for selection and adaptation, but the narrative flow of the material is sometimes clogged by the sheer number of examples—finches and field mice, test-tube evolution and antibiotic resistance, dogs and mustards. The discussion of speciation is masterful but a little pedantic—I kept wishing for jazzier biological examples here.

But Coyne returns to top form in his presentation of human evolution. Historical anecdotes, the abundant hominid fossil record, recent genetic and genomic analyses, and a little comic opera are combined to create a dynamic evolutionary history of us. It is hard for me to imagine an open-minded reader who will not be engaged and convinced by this presentation—evolution happened.

Coyne ends the book with a brief discussion of the extra-scientific dimensions of our challenge: Many people will not be convinced by logic and evidence alone, if they perceive “belief” in evolution as incompatible with their moral or spiritual beliefs. This discussion thoughtfully distinguishes between the evidence for evolution—and the high standards needed for such evidence—and the broader implications of evolution for human behavior, morals, and spirituality. *Why Evolution Is True* is a thorough and compelling introduction to the logic and evidence for evolution, for every monkey’s uncle.

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## CREEPY CRAWLERS AND TALL TALES

**Six-Legged Soldiers: Using Insects as Weapons of War.** Jeffrey A. Lockwood. Oxford University Press, 2008. 400 pp., illus. \$27.95 (ISBN 9780195333053 cloth).

The use of insects as instruments of warfare and torture dates back some 5000 years and is a testament to the ingenuity and the cruelty of the human species. Jeffrey A. Lockwood, a professor of natural sciences and humanities at the University of Wyoming, makes the history of entomological warfare morbidly entertaining in his book *Six-Legged Soldiers: Using Insects as Weapons of War*,

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thanks to a lively writing style that ranges from the sardonic to the arch. But Lockwood falls short as a historian by relying on secondary sources of dubious accuracy and by accepting at face value several apocryphal tales that at best strain credulity and at worst reopen settled controversies.

*Six-Legged Soldiers* describes three different types of entomological warfare: employing insects for direct attacks against humans, as vectors for transmitting infectious diseases, and as agricultural pests to destroy food crops. Two additional chapters focus on the utility of insects for defensive purposes (such as the use of fireflies to detect chemical nerve agents) and as models for the development of futuristic military robots.

Lockwood begins by describing the historical use of stinging or biting arthropods—among them bees, scorpions, rove beetles, and assassin bugs—for battlefield attacks, siege warfare, and torture. He then discusses the devastating military impact of vector-borne diseases such as plague (carried by fleas), yellow fever and malaria (mosquitoes), typhus (lice), Q fever (ticks), and dysentery (flies) in conflicts from the Napoleonic campaigns through World War I. Until the modern era, far more soldiers died from diseases spread by insects than from bullets or artillery fire. As Lockwood observes, “The probiscus proved mightier than the sword—or the cannon” (p. 55).

Armies also made deliberate use of vector-borne pathogens as weapons of war, a practice that reached its dark apotheosis during the late 1930s in Imperial Japan. General Ishii Shiro established a top-secret biological warfare program in occupied Manchuria, where Japanese scientists cultivated billions of fleas infected with *Yersinia pestis*, the bacterium that causes plague, and loaded them into porcelain bombs for attacks on Chinese cities. In 1945, Ishii conceived of a plan for attacking San Diego with *Y. pestis*-infected fleas delivered by kamikaze aircraft. At the last moment, however, the chief of the general staff called off the operation, fearing that it would make Japan a pariah in the eyes of the world.