DARWIN'S TRIUMPH

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One for the faithful: A review of the television series *Evolution*

***Evolution:* A seven-part, 8-hour series, coproduced by WGBH in Boston and Clear Blue Sky Productions.** For sale through the PBS Web site ($99.95 for the complete series in VHS or DVD; see *www.pbs.org/wgbh/evolution/shop/index.html*); teachers may videotape segments for limited classroom use.

Evolution is a series for believers—believers in evolution, that is. The series assumes the reality of evolution; its goal is to explore the evolution of life on earth, not to convince viewers that evolution is real or to debate evolution and creationism (although the last program does examine challenges to teaching evolution). The series also assumes a scientifically literate viewer, what has euphemistically been labeled "the typical PBS audience." Often, genetic and genomic terms and concepts—which may seem familiar to us but still confuse many in my parents' generation—are presented with no explanations or definitions, and geologic time periods and taxonomic groupings are introduced without explanation of their context or relationships with others. Such presentation would lend itself extremely well to constructivist teaching in the hands of a well-prepared teacher, but the lack of background information and reinforcing material may frustrate or confuse the average viewer.

Beautifully produced, *Evolution* offers both excellent story telling and amazing graphics and animations. From the opening credits, the visual presentation of *Evolution* is stunning. Especially in "Great Transformations," the visual depictions of ancient species and environments and the evolutionary transitions among them rival the best of the big-budget animated features.

Interestingly, the narrative style varies among the several segments of the series. I found the first two the most compelling, but that may be because of the story as much as the story telling. In the first segment, "Darwin's Dangerous Idea," dramatic re-creations mingle with analyses from modern scientists, who chronicle Darwin's development of the theory of evolution by natural selection from his days on the *Beagle* through the publication of *The Origin of Species.* "Great Transformations," the second segment, has a most engaging plot development, beginning with the specific, relatively recent evolution of whales and moving backward to the evolution of land animals, then back to the origin of modern animal forms during the Cambrian explosion.

The common storytelling employed in most of the other segments in the series humanizes science by integrating the stories of scientists with the science they study. The series also holds the viewer's interest by focusing on human evolutionary stories, although these tales, of course, link us intimately with other species on the planet, presenting a good mix of evolutionary diversity. Examples include a primary focus on human disease and our interactions with bacteria in "The Evolutionary Arms Race"; and most of "The Mind's Big Bang" centers on the development of the human brain and especially the language, tools, and culture it engenders. The humancentric theme also emphasizes our relationship with the environment and how we change it. For a series that purports to cover 3 billion years or so of evolution, a remarkable portion of the program is devoted to just the last 100 to 1000 years. Whether in driving development of milder disease-causing bacteria or questioning the rate at which our habitat destruction has spurred extinctions, we humans clearly stand in the center of this evolutionary universe. And we are often painted as evildoers. In segment three, "Extinction!" a scientist notes that he studies extinction "basically because I am just tired of watching animals die." While this may be a noble and sympathetic sentiment, it may not reflect a fair assessment of the natural world where, as the series well documents, species have been dying for billions of years.

Viewers familiar with the broad landscape of evolution might be frustrated by this focus on humans. One wishes that the intrinsic beauty of the many fascinating tales to be told across the panoramic expanse of species could attract viewers. But viewers have to be met on their turf, and *Evolution* does an excellent job of that. And this may explain why many biologists may find the series falling short. There just is not enough time to cover all of what we would like to cover, whether it is the chronology of Darwin's life or the mechanisms of speciation.

For me, the biggest frustration is the series' focus on the "what" of evolution as opposed to the "how." My frustration is that there is so little emphasis on mechanism. How does evolution occur? What drives speciation? How do genes work to get from egg to organism and back, allowing for change? Both micro- and macroevolution suffer from insufficient attention to process. The series uses descriptive rather than mechanistic terms to discuss development of antibiotic resistance; human movement from trees to upright walking, tool use, and language; and the great Cambrian explosion. We do not get nearly as much information on genetics as I would like. Both because of my inherent interests and because of the crises facing evolutionary teaching these days, a greater emphasis on how evolution can and does take place would have been very helpful.

The series can provide some excellent models for how science progresses. The very day I viewed the segment "Great Transformations," wherein P. D. Gingerich firmly stated that whales evolved from wolf-like carnivores, he and several colleagues published a paper in *Science* (293: 2239) showing that, in fact, whales evolved from ancestral artiodactyls. Such lovely stories of the evolution of the science can teach us much about the nature of the science—in the right hands.

Also, much of *Evolution*'s focus is on micro-, not macro-, evolution. After the second show, there is little talk of speciation or mechanisms of speciation. For example, in "Why Sex?" we are presented with wonderful stories and explanations of sexual selection from peacock tails to human dating (amply illustrated with many clips from classic movies), but we are not given any further explanation of how this sexual selection can lead to new species. Similarly, "The Evolutionary Arms Race" (segment four) spins wonderful tales of escalating toxin production in newts to counter snake predation and development of a balance between fe-

line immunodeficiency virus and wildcat species, yet it does not explore how any of these pressures can promote speciation.

Why am I concerned about speciation and macroevolution? Because of the final segment in the series, "What about God?" This hour is the only one, beyond a brief introduction to Ken Miller in "Darwin's Dangerous Idea," that discusses creationism and the challenges to teaching evolution in our schools. This is also the segment that I found most troubling, troubling not because of what it presents but because of what it does not present. The entire focus of this segment is on "young earth" creationists, who adhere to a strict interpretation of the first chapters of Genesis and believe that the world is of recent vintage and that God controls all events. This belief in a "young earth," and efforts to promote it, is illustrated by three stories: Ken Ham and Answers in Genesis (a Kentucky-based organization founded by Ham to promote creationism); the attempt to balance religious and scientific teaching at conservative, Christian Wheaton College; and the efforts of students in Lafayette, Indiana, to introduce special creation into their biology curriculum. I admit to the bias of a sore loser—I have been trying for years to get on Ken Ham's Top Ten List of Most (Least?) Wanted Opponents of Creationism, but I haven't made it yet. But the real problem is not the relatively small, though vocal, group of fundamentalist young earth creationists.

The real challenge to teaching evolution today comes from members of the "intelligent design" community, who argue that their brand of creationism is really "creation science" and who have been fighting to get this very, very bad understanding of science into the curriculum. Unfortunately, as we have seen recently in Kansas and even in the US Congress, they represent a much larger, more politically savvy group—and they have been enjoying too much success in their efforts.

In sum, then, *Evolution* is an elegant and engaging, important contribution to our educational efforts to promote public understanding of where we come from and how we are connected to the larger biosphere. There is indeed, as Darwin said, "a grandeur in this view of life." If it falls short, it is because we simply cannot cover 3 billion years of evolution in 8 hours and get in all the details. One might describe *Evolution* in the terms of a recent commercial for light beer: While some of us may find it less filling than we would like, as public science education, it certainly tastes great.

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DARWIN'S TRIUMPH

Evolution: The Triumph of an Idea. Carl Zimmer (introduction by Stephen J. Gould, foreword by Richard Hutton). HarperCollins, New York, 2001. 364 pages, illus. $40.00 (ISBN 0-06-019906-7, hardcover).

In September 2001, the Public Broadcasting System aired a week-long series entitled *Evolution.* That acclaimed series, a coproduction of WGBH and NOVA Science Unit and Clear Blue Sky Productions, was supplemented by an excellent Web site containing numerous resources for biology teachers *(www.pbs.org/wgbh/evolution)*. The series' companion book, *Evolution: The Triumph of an Idea,* is an accessible and elegantly designed volume that most biologists will want to buy. Charles Darwin would have loved it.

Evolution: The Triumph of an Idea was written by Carl Zimmer, the author of *At the Water's Edge* and *Parasite Rex.* Zimmer, a former senior editor at *Discovery* magazine, has contributed articles to *Natural History, National Geographic, Audubon,* and *Science.* In *Evolution: The Triumph of an Idea,* his lively writing style dramatizes a sweeping and balanced story of the history, development, relevance, power, importance, and far-reaching implications of Charles Darwin's theory of evolution. Zimmer presents his rich and up-to-date view of evolution in four units that focus on Charles Darwin and the rise of Darwinism, the creation and extinction of species, "evolution's dance," and humanity's place in evolution. These units are informed by disciplines as diverse as primatology, paleontology, and genetics (from Mendel's peas to the human genome) and include fascinating stories about topics ranging from the mysteries of sex to the development of the human brain.

Evolution: The Triumph of an Idea begins with a discussion of Darwin's life and adventures aboard the *Beagle,* how he wrote *On the Origin of Species,* his fears of his own ideas, the development of our understanding of "deep time," and the rise of Darwinism. Although the characters in Zimmer's narrative are familiar (e.g., Darwin, Hutton, Cuvier, Paley, Lamarck, Lyell), his story is nevertheless compelling. Zimmer punctuates human interest narratives with information from sources as diverse as Mendel, Arizona's Meteor Crater, Dobzhansky, mutations, and isotopic clocks. When you finish this unit, you'll not only concede Zimmer's points but also feel that you *know* Charles Darwin. You'll also look forward to what's coming next. This unit is the best in the book; you'll be hard-pressed to find a better overview of the history of Charles Darwin and his ideas.

In the second unit of *Evolution: The Triumph of an Idea,* Zimmer expands his discussions of the evidence underlying the success and triumph of Darwin's idea. He addresses the tree of life, chance and constraint in animal evolution, and extinction. Zimmer again tells an intriguing story that includes an overview of master-control genes, Hox genes, gene duplication, and the evolution of eyes (photos of which adorn the cover). Unlike Darwin, who used overwhelming numbers of supportive examples to force readers to concede his points, Zimmer chooses his examples with restraint. Nevertheless, his examples are wonderfully effective, especially his discussions of *Pakicetus* (a terrestrial whale that lived 50 million years ago) and *Ambulocetus* (a

"walking whale" from 45 million years ago). In addition to exploring the mass extinction that occurred at the end of the Permian (when 90 percent of all species disappeared), Zimmer also discusses human extinctions. Thus, readers are given a good overview of the history of life, including evolution's many failed experiments.

In the penultimate unit of *Evolution: The Triumph of an Idea,* Zimmer turns to coevolution, disease and evolution in medicine, and the evolution of sex. His examples, ideas, and presentation will again be familiar to most biologists (e.g., coevolution between ants and their fungi, biochemical warfare, the development of resistance to antibiotics and pesticides, and the evolution of HIV). The most convincing chapter of this unit focuses on sexual selection, in which Zimmer tells fascinating stories concerning female choice (e.g., combs on roosters, tails of peacocks), the manner in which some damselflies remove previous males' sperm from females with which they mate, infanticide, and a male lion's method for ensuring that a lioness will be sexually receptive and able to bear his offspring when he takes over a pride (he kills the resident cubs). The chapter concludes with a sobering comparison of the brutal, patriarchal societies of chimps with the calmer, matriarchal societies of bonobos (in which problems are often resolved with sex). Like all of the preceding units, this one is extremely well written, accurate, convincing, and entertaining.

The final unit of *Evolution: The Triumph of an Idea* focuses on the social roots of human evolution and "the God question." The first two chapters of the unit again present familiar information in a marvelously effective way—readers are given excellent insights into evolutionary psychology, language, the "out of Africa" hypothesis, and the development of art, technology, and culture. The unit ends with a highly personal story of Darwin's final years, and finally with his death. Like the rest of *Evolution: The Triumph of an Idea,* these chapters are entertaining, accurate, and compelling.

The only chapter of this remarkable book that disappointed me was the final one, entitled "What about God?" That chapter discusses the evolution–creationism controversy in the United States, the misuse of evolution to justify war and social inequalities, and the Scopes trial and its aftermath; it includes critiques of "creation science" and "intelligent design." Zimmer again uses interesting examples to make his points (e.g., how natural selection *can* produce complex systems such as blood clotting and antifreeze in cold-water fish). He also does a good job of explaining why many creationists insist on being made directly and specially by God, and why they reject Darwin's claim that humans were "created from animals." My disappointment in the chapter stems largely from its factual errors. Although some are relatively trivial—for example, Zimmer omits John Whitcomb Jr. as an author of *The Genesis Flood* and states that the Arkansas "equal time" law was challenged in 1982 (the challenge came in 1981)—others are more serious. For example, the Arkansas Supreme Court did not refuse to hear Susan Epperson's challenge to the state's law banning the teaching of evolution. Indeed, Epperson won her initial challenge of the law, and when the state appealed her victory, the Arkansas Supreme Court reversed the Chancery Court's decision. Similarly, it was the Arkansas Education Association, not the ACLU, that assisted Epperson with her challenge of the Arkansas antievolution law. The association's Eugene Warren refused the ACLU's offer of help at her initial trial (Susan Epperson, personal communication).

I was also disappointed by Zimmer's emphasis on Kansas's removal of evolution from its state educational standards in 1999. Although Kansas subsequently reinstated its proevolution standards, Zimmer overlooks the fact many other states continue to have educational standards that omit evolution. He also fails to note that a surprisingly large percentage of biology teachers want creationism to be taught in science classes of public schools.

Despite these concerns, *Evolution: The Triumph of an Idea* is one of the best and most thorough books about evolution available. Overall, it is very well written, entertaining, lively, and convincing, and it effectively mixes science with human interest to produce a fascinating saga of one of the greatest ideas in history. Many biologists will want to buy this book, and all biologists will want to read it.

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Editor's note: Professor Moore is editor of The American Biology Teacher. *His most recent book is* Evolution in the Courtroom: A Reference Guide, *published by ABC-CLIO.*