Special Book Article

Books to remember

A look at a few of the twentieth century’s classic mainstream biology texts

A scientist who writes a book for a popular audience is engaging in risky business. Merely by trying to crack a predominantly nonscientific audience, the scientist invites the accusation of trivializing his or her field of expertise. One scientist who took this risk and rendered a classic is James D. Watson, author of The Double Helix.

In telling the story of the discovery of DNA’s molecular structure, Watson wrote a book that breaks complex ideas into simple concepts and attracts even readers whose interest in genetics may be marginal. The story turns biochemistry into adventure, pitting Watson and Crick as errant, youthful geniuses against a brilliant, seasoned adversary, Linus Pauling. It also puts obstacles in their path in the form of their own superiors, who fail to understand the significance of what the two biologists are trying to do. After all, in the early 1950s, geneticists did not even agree that DNA was generically significant. Watson and Crick were on the cutting edge of research, virtual renegades. In writing his book, Watson used these elements to create great dramatic tension.

Part of the charm of the book is Watson’s openness in discussing the vagaries of scientific research and the personalities of his colleagues, which is to say that the book is just a shade gossipy. However, Watson did not spare even himself from the razor slashes of his insights. He cast himself as a young man who would rather slouch toward the local movie theater than knuckle down with the books he was supposed to be studying. In a sense, he adopted the role of Every-student, easy for the reader to identify with and capable of carrying the story on his own dramatic shoulders.

Watson was just as blunt, however, in portraying other people. For example, on the opening page of chapter one, he characterized Crick as quick and penetrating of mind but went on to show him as loud and garrulous, a pain to be around. Watson also made some provocative blanket statements that did not endear him to colleagues, such as “One could not be a successful scientist without realizing that...a goodly number of scientists are not only narrow-minded and dull, but also just stupid.”

Some critics thought he went too far. Wrote John Lear in Saturday Review: “The Double Helix is shallow and shrill...a bleak recitation of bickering and personal ambition too intense to leave room for caring about the larger concerns.... What worries me about The Double Helix is the effect it may have on immature minds.”

Other critics were more positive. The Christian Science Monitor reported, “It’s fascinating reading for it captures the flavor of first-rate science.” The Nation said it “expresses the open adventure of science.”

Watson, who recently headed the federal Human Genome Project, also wrote a more technical classic, The Molecular Biology of the Gene. According to Robert Cook-Deegan, author of The Gene Wars, “Almost to a person, molecular biologists over the age of forty-five anywhere in the world can recall where they were when they first read the book.... The book earned him the admiration of a generation of scientists, the first to grow up in thrall to molecular biology.” In scoring this double victory, Watson joined the ranks of some other skillful scientist-writers.

Two such authors were Theodosius Dobzhansky and George Gaylord Simpson, who respectively wrote Genetics and the Origin of Species and Tempo and Mode in Evolution. Both books were published by the Columbia University Press, Dobzhansky’s in 1937 and Simpson’s in 1944. Both are lucid accounts of how evolution and genetics work.

But both men also wrote more popular accounts on the same subjects. Simpson’s book was The Meaning of Evolution, published in 1949. Anyone who has read that marvelous account of the workings of evolution quite likely remembers it with excitement. Simpson, without the turgidity or obscurity that mars so many academic books, does not so much explain evolution as put it on exhibit, showing the reader how this powerful force performs its secret deeds.

Dobzhansky showed the same talent for dualistic writing when he penned Mankind Evolving, based on lectures he delivered at Yale University in 1959 and published in 1962. A critic writing in American Society Review said, “Dobzhansky’s synthesis of what we know and can guess of the past and continuing evolution of man is lucid, well-knit, and thoroughly absorbing.... Read it for pleasure.” A critic writing in American Anthropologist called it “a great book.”

Mankind Evolving covers a wide range of subjects under the topic of genetics, including racism, inherited diseases, how genes work, intelligence, and personality. The book’s status as a classic, however, depends not so much on the topics it covered as on the way in which Dobzhansky wrote—simply, directly, and clearly, yielding a book that, like Watson’s, revealed science as an adventure.

Arguments everyone finds unconvincing

One scientist who quite likely outscored all others in reaching a wide, popular audience with a scien-

by Roger L. DiSilvestro

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A scientific message within the context of a classic book was a forester who was born in Iowa in 1886 and died fighting a grassfire on his farm in Wisconsin in 1948. When he died, he left behind a manuscript of essays that synthesized a new way of looking at land and wilderness. His name was Aldo Leopold, and he is known today as the father of wildlife management in part because he wrote the first textbook on that applied biological science.

But his real claim to fame is the posthumous book of essays that was published in 1949 as A Sand County Almanac. In Almanac, Leopold offers a series of essays about his experiences in the field as a forester and wildlife biologist, creating an atmosphere and background for his closing discussion of wilderness, wildlife, and humanity.

His theme lies in that closing discussion, in which he makes a plea for the development of a land ethic. Humanity, he says, has followed through history a series of ethical developments, learning first to respect the rights that exist between individuals. An example is the Mosaic Decalogue and its many don’ts—don’t kill one another, don’t covet another’s spouse, don’t steal, and so on. Subsequent developments set the relationship between individual and society. “The Golden Rule,” Leopold wrote, “tries to integrate the individual to society; democracy to integrate social organization to the individual.”

Missing, however, was an ethic “dealing with man’s relationship to land and to the animals and plants which grow upon it.... The land-relation is still strictly economic, entailing privileges but not obligations.” Leopold called for an ethic that enlarges the boundaries of community to include soil, water, plants, animals—what he collectively called “the land.”

To initiate the process of social evolution leading to a land ethic, Leopold wrote, we must “quit thinking about decent land-use as solely an economic problem. Examine each question in terms of what is ethically and esthetically right, as well as what is economically expedient.” He then boiled down his concept into two sentences that are often quoted today: An action “is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.”

The Almanac became an instant success and is still available in a multitude of printings. It is perhaps the most quoted book in the conservation field outside of Thoreau’s works. Ironically, publishing house Alfred A. Knopf turned down the book in 1947 with a letter to Leopold that said, “The ecological argument everyone finds unconvincing.... In short, the book seems unlikely to win approval from readers or to be a successful publication as it now stands.”

In his suggestion that ecological science could change the way in which society views its relationship to land and wilderness, Leopold was seeking a major shift in thinking. Achieving such shifts was the subject of another classic work: Thomas Kuhn’s The Structure of Scientific Revolutions. This book goes beyond the field of biology. Its arguments fit any science as well as many other human endeavors, from art and architecture to philosophy and psychology.

As a graduate student in physics, Kuhn took a class that dealt with physical science for nonscientists. The class exposed him for the first time to the history of science and so entranced him that he shifted his career into history and philosophy. Later, while studying at the Center for Advanced Studies in Behavioral Sciences in 1958 and 1959, Kuhn wrote the first draft of an essay from which the book sprang.

Kuhn contends that scientists within any given field adhere to common viewpoints or systems that he called paradigms. He defined paradigms as fundamental theories or hypotheses (he calls them “achievements”) that “some particular scientific community acknowledges for a time as supplying the foundation for its further practice.” The hypothesis or theory must be sufficiently unprecedented to attract adherents away from “competing modes of scientific activity.” Examples of paradigms include Ptolemaic astronomy and Darwinian evolution. Kuhn observed that paradigms are occasionally overturned in the face of new data. Through such revolutions, science advances, or at least changes.

Paradigms, Kuhn pointed out, can lead to stultification of intellectual inquiry by setting limits on what constitutes acceptable research. “A paradigm can, for that matter, even insulate the community from those socially important problems that are not reducible to the puzzle form, because they cannot be stated in terms of the conceptual and instrumental tools the paradigm supplies.” Or, as he put it more eloquently later in the book, “In science...novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation.”

You are the lady who started all this

Books from the realm of popular science can lead to paradigm shifts across a broad social spectrum. A classic case is Rachel Carson’s Silent Spring, which led a powerful attack on the pesticide industry in 1962. By then, Carson, who spent 20 years as a staff biologist and editor with the US Department of the Interior, was already the widely recognized author of books about the ocean, including The Sea Around Us, which stood on the bestseller list for 86 weeks and won Carson international acclaim.
Although educated as a biologist, Carson had a life-long interest in writing. She won her first writing award when only ten years old. As a graduate student, she focused on marine biology at Johns Hopkins University in Baltimore, Maryland, and at the Marine Biological Laboratory in Woods Hole, Massachusetts, where the Pennsylvania native saw the ocean for the first time. In 1936, she became one of only two women hired by the federal Bureau of Fisheries to fill professional jobs. A year later, the Atlantic Monthly launched her literary career by publishing "Undersea," an essay that combined scientific information with literary eloquence.

Carson's interest in writing about pesticides dated to the dawn of the pesticide heyday. In 1943, she tried to interest Reader's Digest in a story on the dangers of DDT, but the editors turned her down. In 1958, she received a letter from a Massachusetts friend who complained that aerial spraying for mosquito control was killing birds and other animals on the friend's private wildlife sanctuary. Carson looked into the matter and found mounting evidence that pesticide use was threatening wildlife in general as well as human health. When several magazines rejected her proposals for pesticide stories, she decided to write a book on the subject.

Carson did not oppose all use of pesticides, just the indiscriminate use that her data indicated was a threat to human health and ecological integrity. She backed up her concerns with hard data, and when The New Yorker ran three excerpts from the book, she became an instant media celebrity and a chemical-industry villain. Mail deluged her desk and stacked up in the offices of government officials.

A typical attack by the chemical industry and its allies in agriculture is the review by William J. Darby, a biochemist, that appeared in the Chemical and Engineering Newsletter. Darby wrote that Silent Spring "adds no new factual material not already known to such serious scientists as those concerned with these developments...in view of her scientific qualifications in contrast to those of our distinguished scientific leaders and statesmen, this book should be ignored...." Darby added that heeding Carson’s words would mark “the end of all human progress.”

The onslaught continued as the chemical industry sought to besmirch Carson’s reputation. Then, in 1962, President Kennedy formed a special scientific panel to investigate Carson’s claims. The panel’s report, released in May 1963, vindicated her work.

Carson’s effort led directly to such landmark legislation as the ban on DDT, the Clean Air and Clean Water Acts, and the creation of the Environmental Protection Agency. She and Silent Spring in effect launched the modern environmental movement and its supporting sciences. When, in June 1963, Senator Abraham Ribicoff faced Carson at the opening of Senate hearings on environmental pollution, he recognized her achievement with the words, “You are the lady who started all this.” By then she was ill with cancer. The disease silenced her voice the following spring.

Children of Cain

The 1960s also saw the arrival of what constituted almost a subgenre of popular science, a subgenre that spawned a classic or two. These books include such titles as African

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Book list

Reviewing, or revisiting, a century's classic bioscience books is fraught with the concern that the reviewer knows what a classic book is. Yet “classic” is hard to define. For help in choosing books for this article, I resorted to ProfNet (Profnet@Profnet.com), sending out a plea for interested biologists to send in suggestions for books that should appear in this article. The books they proposed, along with some of my own choosing, are listed here.


"Where will I find the fine line between art and science?"

Genesis, by Robert Ardrey; The Naked Ape, by Desmond Morris; and On Aggression, by Konrad Lorenz. The titles alone reveal the general subject matter: behavioral studies of the human animal, with emphasis on the animal side.

Ardrey—trained as an anthropologist but a playwright by trade—could arguably be called the pioneer of this subject. Ardrey advanced the idea that humans evolved some 500,000 years ago from an African ape given to arming itself with stone weapons both for dicing up prey and braining conspecifics. Ardrey put the onus for persistent human violence on the hunting proclivities of our ape ancestors. His hypothesis drew on the previous three decades of research on human fossils.

Ardrey's ideas about the geographic origins of humans, coupled with the use of stone tools, were mainstream and respectable. The aspect of his book that attracted so much attention in the 1960s was Ardrey's apparent reveling in the idea of our species' violent roots and his argument that violence among humans is a genetically predisposed inevitability. Ardrey also highlighted the homicidal aspects of human nature: "We are Cain's children..." he wrote.

"Man is a predator whose natural instinct is to kill with a weapon."

Ardrey presented his case stylishly, as befitted a playwright, thus attracting a wide audience. "Ardrey draws every drop of dramatic blood not only from the story of man's emergence from the apes but also from the history of its discovery," wrote a critic in Kirkus "...he gets across in this personalised way a picture of the evolution of man measurably more vividly than the usual pallid popularisations of the academic...."

Some reviewers pointed out that Ardrey was too quick to attribute a generic homicidal impulse to human-kind. They cited, for example, Ardrey's persistence in calling the stone and bone utensils of prehistoric peoples "weapons" rather than "tools." Nevertheless, Ardrey captured many a 1960s imagination, and his ideas often dominated discussions about human behavior and evolution. He also made a conscious effort, as he put it, to effect "a revolution in the natural sciences." Those who read African Genesis in its halcyon years likely remember fondly the beauty of the writing and the book's compelling read.

A book that drew an equal amount of controversy but nevertheless was not so far out on a limb as Ardrey's was The Naked Ape, which in the mid-1960s climbed the bestseller lists like King Kong scampering up the Empire State Building. Desmond Morris, a British zoologist, was professionally equipped to make a credible argument for tracing the roots of human behavior and anatomy to the world of nonhuman animals, showing that a good deal of ape still resides in the heart of humanity.

Morris also laced his book with a heavy dollop of sexual titillation in discussions of such matters as why humans have buttocks and how male humans rank among the great apes in terms of penis size. Like Ardrey's book, Morris's was entertaining as well as enlightening and doubtless brought biological concepts to new segments of the reading public. The Naked Ape helped to create, for many readers, a new way of thinking about human behavior and about human-kind's link to the larger biological world.

On a similar level came Konrad Lorenz's 1966 book, On Aggression, arriving at a time when America was wrestling with the Vietnam War and human violence seemed about to erupt into world destruction. Lorenz, a leading Austrian animal behaviorist, investigated aggression in species ranging from wolves to jackals and applied what he found to human behavior.

Other species, he wrote, have evolved behavioral means for bringing intraspecific violence to an end. Essentially, species in which individuals fight one another also display inherent behaviors for surrendering, and these behaviors inhibit the winner of a fight from continuing into mayhem and murder. One example Lorenz propounded at length was the gray wolf, in which a submissive animal turns its neck to a dominating opponent. This display of vulnerability, in which the winner could easily kill the opponent with a slashing bite, inhibits further action, and the fight ends.

Humans, Lorenz contended, also use an inherent submission display: cowering on the ground. However, the development of long-range weapons made such displays obsolete, because missiles and bombs do not respond to cowering. As the results
of violence become more and more remote and abstract, he wrote, they also become irrevocable.

To correct this situation, Lorenz suggested, nations should compete with one another not through violence but through such activities as scientific competition, like the race to the Moon that once electrified Russia and the United States. He also suggested that people could attend exhibits of ritualized violence, such as boxing matches and football games, to get violence out of their systems without actually engaging in it.

Subsequent research proved the latter idea wrong—observing violence apparently lowers the threshold for engaging in violence. The former idea seems naive now, too. Nations, after all, already compete constantly on myriad nonviolent levels, from the competition for markets to the Olympic Games. But such activities themselves can lead to violence, as when gunboat diplomacy becomes an expedient means for winning the contest for trade. To top it off, although submission displays work effectively between members of a wolf pack, fights among members of different packs are more fatal. On Aggression's status as a classic is sagging with the years, but its cogent analysis of animal and human behavior helps it to hang in there for now.

**Certain to become a classic**

Restrictions of space and time leave this list of classic bioscience books wildly incomplete. Behavioral biologists alone could complain justly of the absence of such works as Jane Goodall's *In the Shadow of Man* and George Schaller's works on gorillas, tigers, and lions. And what about Lorenz's *King Solomon's Ring*? And Niko Tinbergen's *The Herring Gull's World?* Many good works are missing.

And yet one title, consisting of a single word, cannot pass unannounced: *Sociobiology* by E. O. Wilson. Talk about a paradigm shift. This book hit the world of biology in the mid-1970s like a runaway train.

Wilson defined sociobiology as "the systematic study of the biological basis of all social behavior." The point of all behavior, Wilson suggested, is to ensure the survival of as many of an organism's genes as possible, but not necessarily on a simple survival-of-the-fittest basis. In some cases, the best means for ensuring the survival of your genes is not to reproduce but rather to help ensure the survival of your parents' or your siblings' offspring. Thus, even altruism is essentially selfish.

That last paragraph, in a nutshell, covers the whole book, which nevertheless ran to nearly 700 large pages of text supporting the theme. A review in *Library Journal* contended that the book was "definitive" and "certain to become a classic in its field." It also met Kuhn's criteria for revolutionary, because it changed fundamental thinking about the driving forces of evolution. It is a heavily technical book, but it was also widely reviewed in the popular press and has about it the aura of a popular book.

"There are books of which the backs and covers are by far the best parts," Charles Dickens said. Certainly that is not the case with the books presented here. These books come to us with a sense of certainty that, reading them for the first time or the umpteenth time, they will always reward us for visiting them. They bring to mind W. H. Auden's comment, "Some books are undeservedly forgotten; none are undeservedly remembered."

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