Last April 23 was the 40th anniversary of the first Earth Day celebration in 1970. Some attention was paid to a book that was a catalyst for the environmental movement, which was emerging at the time and spurred the creation of Earth Day. The book is, of course, Rachel Carson's *Silent Spring*, published in 1962. Her vivid descriptions of the effect of DDT on songbird populations led to an increased awareness of environmental issues in general, and ultimately to the creation of the Environmental Protection Agency, also in 1970. The prominence of *Silent Spring* has tended to put Carson's other writings into the shadows, but *Under the Sea-Wind* (1941), *The Sea Around Us* (1951), and *The Edge of the Sea* (1955) are all worth reading, and they did a great deal to inspire research on underwater life. While it is a fictional example, I feel compelled to mention one of my favorite novels, *The Highest Tide*, by Jim Lynch (2005). It's about an adolescent living on the Washington state coast and moved by *The Edge of the Sea* to study the ocean life he finds there. It has absolutely everything a biologist would want in a novel: romance, adventure, species names, poignancy, and humor.

Obviously, *Silent Spring* wasn't the only trigger for the environmental movement. As with any large-scale social change, there were many factors involved, including the whole social ferment of the time, with everything, including how we use the natural world around us, being called into question. In addition, there was the increasing evidence of the effects of pollution, and the example of how London, a city that had been choked by deadly fogs, had made real progress in improving air quality. There were also other books besides *Silent Spring* that were influential, including *A Sand County Almanac* by Aldo Leopold, which was published in 1949. This is a deceptively simple book that begins with short essays on observations Leopold made around his farm in Salk County, Wisconsin. In the second part, he digs into some environmental problems, drawn from his experiences not only in Wisconsin but in the Southwest, where he worked for a number of years in the U.S. Forest Service. It was out west that he developed his awareness of the complexities of ecological webs and the unanticipated consequences of human interference in them. These are the ideas that he later brought to his teaching of wildlife management at the University of Wisconsin, Madison, and that he presents more fully, and with more theoretical grounding, in the last third of his book. There he lays out moral arguments for the necessity of husbanding lands and the organisms living there.

Leopold died a week after his manuscript was accepted for publication and probably would have been somewhat disappointed by the positive but not terribly enthusiastic reception his book received when it was first published. But in the 1960s it was resurrected and became one of the founding documents of the environmental movement. When I first read *Sand County*, I had a similar response to those of its first readers: it was a nice nature book, like many others. Years later I read an essay (Vukelich, 1987) praising Leopold's description of the value of the dead and dying trees in his woodlot ("A Mighty Fortress"). This drew me back to the book, and the scales fell from my eyes. First of all, the writing borders on poetry in its beauty, while maintaining an exquisite clarity. I use Leopold's essay "Prairie Birthday" in class because he does such a wonderful job of describing how simple things like mowing a graveyard can lead to the loss of endemic species. And when I got interested in the aesthetics of biology, his "Conservation Esthetic" became one of my most important sources.

○ Memorable Books

If you haven't read Carson and Leopold, please do. They are just too good for any biologist to miss. Of course, I know that many of you have already met their writings and know them better than I do. But there might be other books published some time ago that you haven't read, or haven't read recently. I'm thinking of, for example, Lewis Thomas's (1974) *The Lives of a Cell*; even someone who is not as cell-obsessed as I am will be dazzled by his ideas and his prose. It is rather unpleasant for a person of my generation, who read this book when it first came out, to consider that it could now be called a classic, but it definitely deserves that designation – at least I think so. It struck me, when I thought about Carson's writings and then Leopold's, that while there are many good biology writers producing great books right now, we shouldn't forget the greats of the past. So I've decided to resurrect a few of my favorites. In fact, I've decided to dedicate this column to books that I consider classics.

Among biology writers, Lewis Thomas was one of my first loves. *The Lives of a Cell* came out during my first years of teaching and got me hooked. It was a compilation of essays he had written for *The New England Journal of Medicine*. This is hardly a literary journal, but back in the 1960s and 1970s its editor was a physician with a writer's eye, Franz Ingelfinger, who prevailed upon Thomas to produce essays for the *Journal*. The first collection was followed by two others, *The Medusa and the Snail* (1979) and *Late Night Thoughts on Listening to Mahler's Ninth Symphony* (1983). Thomas also wrote a wonderful autobiography called *The Youngest Science* (1983), which is how he describes medicine.

One of Thomas's recurring themes is that there is much we don't know about the living world. This is what makes its study so wonderful: we are always uncovering amazing things. Our ignorance is particularly profound as far as the human body is concerned, and medicine has so far only scratched the surface. Thomas could remember when the first sulfa drugs – and, following them, antibiotics – were introduced, so he had some perspective. This is one reason for reading the classics: they broaden our time horizon and remind us that conditions today are in some cases very different from those of the past. Thomas's experience of seeing the beginning of infectious disease control with antibiotics and its mixed consequences reminded him of all the other areas of medicine where we are still in the dark.

I wrote not long ago (Flannery, 2009) about another of my favorite classics on this subject, *Mirage of Health* by Rene Dubos (1959).

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Dubos, who was involved in the early work on antibiotics, argued that health is a constantly receding mirage, because as one dreadful disease is conquered, this doesn't lead to a healthful utopia, but to another disease rearing its ugly head. Controlling the 19th-century scourge of tuberculosis didn't bring perfect health, but it brought better health, which means that people in the Western world live long enough to develop cancer or atherosclerosis. In the 1950s we worried about polio, in the 1980s HIV. Dubos couldn't predict the health problems of the future, but he knew that they definitely would exist.

Mirage is only one of several books by Dubos that deserve to be read today. Another is *So Human an Animal* (1968), for which he won the Pulitzer Prize. In his later years, Dubos became an advocate for environmentalism and is one of several people to whom the phrase "Think globally, act locally" has been attributed. In 1980, he published his views in *Wooing the Earth*. He also wrote a number of other books, too many to list here, but my husband would want me to mention Dubos's (1950) biography of Louis Pasteur. Obviously, there has been a lot of research done on Pasteur's life since then, but this book remains a classic, in part because it was written by one of his scientific descendents, and a fellow Frenchman.

○ Philosophical Classics

There are many people I know only through their books, but their personalities and passions come through so clearly that I feel I know them well – and love them. I've mentioned British botanist Agnes Arber many times in these columns. Her *The Mind and the Eye: A Study of the Biologist's Standpoint* (1954) is a great introduction to the philosophy of biology. There is something about Arber's prose, its clarity and poise, that make reading her work a literary as well as a scientific pleasure. I also have a few other philosophical favorites. The first such book I read, as I was beginning my teaching career, was William Beveridge's (1950) *The Art of Scientific Investigation*. One of my major criteria in reading a book on the philosophy of science is that I want it to be understandable without spending an hour per page. Beveridge's book fits that bill, as does Peter Medawar's (1982) *Pluto's Republic*, where, among other things, the author explains the hypothetico-deductive method. The only problem with the latter book is the title; I hesitate to put it in a bibliography because editors feel compelled to change Pluto to Plato. I'll let you read the book to find out how Medawar came up with that title.

Another of my personal classics in philosophy is Ludwik Fleck's (1979) *Genesis and Development of a Scientific Fact*. Fleck originally published it in Polish in 1935. Thomas Kuhn, author of another classic, *The Structure of Scientific Revolutions* (1962), found Fleck's work when he was researching his own book; Kuhn even learned Polish to translate it. Years later, he pushed for a proper English translation, which is why it is available to us today. It looks at science as a communal activity – in Fleck's case, the community being that of European researchers attempting to develop an accurate test for syphilis early in the 20th century. The book has in nascent form many of the ideas Kuhn later developed in his work on what a major change in scientific thinking, a revolution, involves. It is almost 30 years since the translation of Fleck's work appeared, so even in English it has aged enough, and well enough, to be considered a classic.

Before I leave philosophy, I just thought of another author who is "accessible" – the present-day term for "understandable by mortals." That's Jacob Bronowski, who is known to my generation as author of *The Ascent of Man* (1974), a tour of the history of science written as a companion to a PBS series of the same name. But an earlier generation knew him as the creator of *Science and Human Values* (1956), written in the aftermath of the development of the hydrogen bomb, which caused an outcry against science for having wrought such a tool of destruction. Bronowski argues that the bomb is a work of technology more than of science, and that in general science has done a great deal to improve rather than destroy the culture's moral fiber. He illustrates his point by describing the values important to science: honesty, tolerance, and freedom.

If scientists don't report their findings honestly, then obviously the whole fabric of science will deteriorate. While scientists may hold views that are contrary to those of others, they have to be tolerant of diverse views and keep an open mind about them, because often the way ahead is not on either side of the argument but on some middle ground between them. The deterioration of Soviet science that Bronowski described was proof enough that intellectual freedom is essential for progress in science. He argues that as science becomes more important in our society, scientific values become more prominent and can infuse the rest of the culture. Instead of undermining values, science actually strengthens them. As in the 1950s, this point is debatable, but Bronowski's book still makes an important contribution to the discussion.

I'm not sure James Conant's (1947) *On Understanding Science* counts as philosophy of science; it is more an argument for why the general public needs a firm grounding in science. If this cry sounds familiar, it's because it is still being heard throughout the land; the average American's level of scientific literacy, or lack thereof, is forever being bemoaned (see http://www.calacademy.org/newsroom/releases/2009/scientific_literacy.php). So maybe it would be a good idea to go back to an earlier view of the subject, one that isn't laden with today's rhetorical baggage. Conant was president of Harvard University at the time he wrote this book and during World War II had served as chair of the National Defense Research Committee, the high-level scientific body that oversaw the Manhattan Project, among others. Conant found in speaking to nonscientists – politicians, administrators, and military men involved in the war effort – that they had no sense of what he termed "the tactics and strategies of science" (p. 30), in other words, how science is done. That is what he thought people needed to appreciate about science – more than just the facts. It's discouraging that Conant's words sound so awfully familiar, but that doesn't mean that his book isn't worth reading. Maybe we just have to be more conscientious about putting his ideas – which include the use of historical case studies – into action.

○ Excellence

I've noticed as I've searched for books to include here that many of them are very small; that is, they are in the true pocketbook format that's now reserved for crime and romance fiction. One book that I found among the littles was *So Excellent a Fishe* by Archie Carr (1967). This book on sea turtles came to mind recently because of the Gulf oil spill. In this and other works, Carr wrote of the troubles facing these creatures, problems that have only been compounded over the years. Though when I originally read this book in the 1970s I had no real interest in sea turtles, Carr made me love them, and him. His prose is so captivating and yet low-keyed, his passion comes through subtly but clearly. He also wrote *The Windward Road* (1956), for which he won the John Burroughs Award for excellence in natural history writing. That book too is about sea turtles, but in addition he wrote more broadly, of Central America in *High Jungles and Low* (1953) and of the state where he taught in *A Naturalist in Florida* (1994). There are obviously a great many fine nature writers, some of whose works are indeed classics. I cannot begin to mention them all, but Carr is one for whom I have a special affection; he is a person I only know through his writings, but that's still a great gift.

○ Parasites and Mayonnaise

Sometimes a book's title is just too good *not* to pick it up. That was the case for me with Robert Desowitz's (1981) *New Guinea Tapeworms and Jewish Grandmothers*. Such titles are usually just a combination of different topics in a book of essays, but in this case, the tapeworms and the grandmothers are connected, if tenuously. Among the Ekari people

in New Guinea, eating undercooked pork is an important part of their culture, and it leads to transmission of the pork tapeworm, *Taenia solium*. Scandinavian fishermen who immigrated to the lake regions of Michigan and Wisconsin in the 1800s brought the fish tapeworm, *Diphyllobothrium latum*, with them. In the first third of the 20th century, there was commerce in live fish between the Midwest and New York City, where fish markets had holding tanks filled with live pike, pickerel, and carp, perfect for making one of a Jewish grandmother's specialties, gefilte fish, balls of minced fish boiled until cooked. Since the fish was prepared shortly after killing, the tapeworm larvae remained alive until the fish was thoroughly cooked. But the grandmothers kept tasting the cooking balls, and in the early stages the larvae were still alive – thus, tapeworms in Jewish grandmothers.

Desowitz was a parasitologist who was discouraged from going into this specialty in the 1950s because practitioners thought that the field was winding down. After all, malaria was being brought under control through the decimation of mosquitoes with DDT. This is a classic example of scientific hubris. Desowitz had a long career in the field, and malaria, Chagas disease, and a long list of other parasitical afflictions are still with us. As *New Guinea Tapeworms* indicates, he was not only able to contribute to the research and clinical aspects of the field, but also to make this medical specialty better known to the general public. He also wrote a number of other books, including another of my picks, *The Malaria Capers* (1991).

When it comes to great titles, the books of Harold Morowitz are hard to beat. I'm having a difficult time picking a favorite. *Mayonnaise and the Origin of Life* (1985) is a wonderful title, but is it better than *The Thermodynamics of Pizza* (1991) or *Entropy and the Magic Flute* (1993) or the much longer *The Wine of Life and Other Essays on Societies, Energy and Living Things* (1979)? This last book was the first one I read, and it sold me on Morowitz. He covers everything from what the chemicals in the human body are worth in dollars to how bacteria are classified. As the titles of his books indicate, Morowitz is passionate about energy, and about the energy-producing reactions in the cell, his research field. He makes even the more difficult concepts in thermodynamics understandable, and does it all with wit. The "About the Author" note in *The Wine of Life* states that "he has been on the faculty of Yale since 1955 and reports that he is now covered with ivy up to his sternum."

○ Further Back

It's debatable when a book becomes a classic: does it have to be out of print, does it have to be published at least 50 years ago, does it have to be published over 50 years ago and still be in print? Obviously I have no set criteria for my hall of fame, but so far I haven't gone very far back; I am more interested in books from my own history that I think are still worth reading. But I will stretch a little further into the past to mention a few great authors. There is Paul de Kruif, who wrote a true classic, *The Microbe Hunters* (1926). A microbiologist who left research for writing, he inspired many to pursue careers in medicine and biology. While his prose may seem flowery today, and his history dated, there is an excitement in his work that can't be beat. The same is true of the writing of Hans Zinsser, the author of *Rats, Lice and History* (1935), which he described as a "biography of typhus," the bacterial disease he spent his life studying. Zinsser was opinionated, to say the least, and the book presents his views on everything from modern poetry, which he despised, to lice, which fascinated him.

Another author I truly love is Homer Smith, who wrote a novel called *Kamongo, or The Lungfish and the Padre* (1932). Obviously he had a Morowitz-like gift for titles, and his prose is amazing as well. The book is really a dialogue between a scientist and an Anglican priest during a voyage through the Red Sea as they both head away from their work in Africa, as kidney researcher and missionary, respectively. The scientist is a thinly disguised version of Smith himself, who studied lungfish, which can aestivate in dried mud for years, as a way to find out how the kidney works under such extreme conditions. *Kamongo* is a philosophical exploration of the relationship between science and religion, and whether you agree with Smith's rather atheistic position or not, the ideas are presented so beautifully that it's a joy to read.

From the same era is the work of a science writer who is little known today but whose writings are still worth examining. He is John Sullivan, who was a science journalist back when this was a rather novel profession. His essays are collected in such books as *Aspects of Science* (1926). I discovered the latter in a used bookstore and for six dollars bought myself a treasure. I have other popular books on science from the early years of the 20th century, but I don't think many of them have aged as well as this one. Of course, the fact that Sullivan wrote essays on art and science endears him to me. He was also one of the first writers to popularize Einstein's work, so he definitely had a broad range.

○ Those I Haven't Mentioned

If you have stuck with me this far, I'm sure you've thought of writers that I haven't mentioned, and you think I should have. That's the great thing about the classics game – there is no correct list or perfect definition of the genre, if you want to call it that. I haven't mentioned Loren Eiseley, whom many consider one of the finest science writers of the 20th century. Yes, he is wonderful, and I've enjoyed such books as *The Immense Journey* (1957) and *The Night Country* (1971), but his prose is just a little too flowery for my taste. Then there are authors whose works are not far enough in the past to be dubbed classics, though they are definitely headed in that direction. One of the most prominent in this category is Stephen Jay Gould, whose death in 2002 ended a brilliant writing career. His books are, quite literally, too numerous to mention. But I will say that *Ever Since Darwin* (1977), his first book of essays, is my favorite, and with it I will end my ramblings and leave you to work on your own list.

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