complexification—from physical order to chemistry, then biology, and then mind and culture.

This new way of understanding the world—non-mechanistic, non-reductionist—reconnects the technological and biological by showing that both are manifestations of spontaneous order. In this way, it can support a new kind of idealism about technology's possibilities. The ongoing creation of a man-made world can be seen, in this view, as part of the larger aspiration of mankind's continuing complexification: the development, through free institutions, of the best of human nature in all its variety and richness.

Every boy knows what it's like to stare wide-eyed at a fire engine or a fighter jet. This is what has moved men to make bigger and more majestic bridges, buildings, and then machines. That sheer glory of force, of size and power and muscularity is what made the film *Top Gun* such a hit.

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David Link

I begin with "The Dynamo and the Virgin," a chapter from *The Education of Henry Adams* (1905). In it, Henry Adams visits the Great Exposition of 1900 and, viewing the incredible, towering power sources on display, begins to contemplate the awesomeness of the developing technologies. The only precedent he can think of is the inspiring and miraculous power the Virgin held in the history of art.

Adams was on to something about why technology has been so compelling in the 20th century. Men are every bit as moved by the might of the machines they can build as they are in thrall to the power of sexual beauty. Every little boy knows what it's like to stare wide-eyed at a fire engine or a fighter jet or a bulldozer. This is a large part of what has moved men to make bigger and more majestic bridges, buildings, and then machines. That sheer glory of force, of size and power and muscularity, is a large part of what made the film *Top Gun* such a hit. Sure, there was a perfunctory love story in the movie, but what it's about, what you can't forget, is the roar of those jets, the fire and the blaring sound of them, and the thrill and fun the pilots have in actually being in charge of all that force.

As our control over technology developed, though, a necessary and inevitable lesson accompanied our progress: humility. The second book on my list is Walter Lord's *A Night to Remember* (1956), on which the 1958 film was based. The story of the sinking of the *Titanic* is the stuff of pure myth—if it had not actually happened, someone would have had to make it up. The sinking of the *Titanic* is most useful as a story about hubris. Our technology is the manifestation of our dreams, and nothing in the story suggests we should stop trying to make our marvelous, outsized visions real. On the other hand, we ought to keep in mind that while we are godlike, we are not gods. Glorious luxury liners are well worth the effort and the cost, but that's no reason not to have enough lifeboats on board.

My third choice is *The Dancing Wu Li Masters* (1979), by Gary Zukav. The goal of the book was to make the obscure field of quantum mechanics comprehensible to non-scientists, and, surprisingly, it succeeds in illuminating what the attraction of all that heady stuff is. Like Adams, these men (and they're pretty much all men) experience real awe, this time around, not at size and force, but at the enigmatic elegance of the physical world. *The Dancing Wu Li Masters* helps explain why modern scientists are driven to explore particles so infinitesimally small that they are (sometimes quite literally) nothing but ideas.

This move from Adams to Zukav is summed up in Stanley Kubrick's *2001: A Space Odyssey*. The film begins with man's fascination with the first tool; in one brilliant edit it moves dazzlingly to the end of our century, where the idea and execution of tools has been all but perfected. What is left is the realm of pure mystery. Which, in a way, brings everything back to where Adams found it in 1900—the point of wonder.

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Paul Lukas

Most of us tend to think of technology in terms of the macro rather than the micro. I refer here not to sheer physical size—surely Silicon Valley has taught us that the mightiest technological achievements can come in the tiniest of processing chips. I refer instead to our notions of technological complexity and, especially, technological power, whether measured in horsepower, kilowatts, megatons, or gigabytes. For the most part, our cultural mindset goes, bigger is better and biggest is best.

But technological power, not to mention technological utility, comes in many sizes. For every supercomputer, digital camera, and electronics laboratory, there's a host of products that may seem far more mundane yet are no less remarkable: office supplies, kitchen gadgets, canned goods, children's toys. Don't mistake these items' ubiquity for technological simplicity. Our tendency to take them for granted is in fact a testament to an immensely sophisticated production system, a system so vast and efficient that it can provide these things without most of us even stopping to ponder how it all gets accomplished. The mechanical engineering and industrial design processes that produce these items may be less glamorous than, say, software design, but they're no less important or impressive. Think of them collectively as *inconspicuous technology*.

There are a number of books that focus on inconspicuous technology. One of the best is Henry Petroski's *The Evolution of Use-*

ful Things (1992), a loving examination of such minor miracles as paper clips, tin cans, pins and needles, nuts and bolts, silverware, adhesive tape, pull tabs, and the like. You don't need to be a minutiae fetishist to appreciate Petroski's examination of the subtler aspects of our everyday world, and you don't need to be an engineer to understand his prose. (The book also devotes several pages to a discussion of the zipper, which is itself the subject of an excellent book: Robert Friedel's *Zipper: An Exploration in Novelty* [1994]).

Packaging is another key component of inconspicuous technology. Package-design elements like the Coca-Cola wave and the Wrigley's arrow have become subsumed into our collective cultural psyche. For a look at the history of packaging, including an examination of the formidable technological challenges packaging can present and the additional technological innovations it can facilitate, try Thomas Hine's *The Total Package* (1995), which examines everything from milk cartons to cereal boxes and will forever change your perceptions of your local supermarket.

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These books are wonderful and instructive, but they're also a bit scholarly; the best way to appreciate inconspicuous technology is in the context of the real world. Curiously, the best example of this is a work of fiction: Nicholson Baker's *The Mezzanine* (1986), in which the narrator enthusiastically pursues a series of obsessive intellectual tangents on such unlikely subjects as soda straws, men's-room urinals, shoelaces, doorknobs, tear-off perforations, cigarette butts, and vending machines, all in the course of a short escalator ride. To fully appreciate the wonders of the inconspicuous world, in theory *and* practice, start here.

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Henry Petroski

To understand technology fully, it is necessary to understand the nature of engineering. The formulation and solution of technical engineering problems is, of course, at the heart of every technological endeavor, whether it be the design and production of an automobile or the generation and distribution of electricity, but dealing with technical problems within the constraints of the laws of nature is only one aspect of the total engineering enterprise. Real engineering in the real world is inextricably complicated by cultural, social, political, economic, and aesthetic goals that shape and in turn are shaped by the technical objectives.

The full story of just about any ostensibly technical project will illustrate the complex interrelationships among competing goals and constraints that engineers must deal with in the course of producing a technological artifact. Among the best of such stories is that of the building of the Brooklyn Bridge, told by David McCullough in his 1972 book, *The Great Bridge*. The true story of the conception and realization of a bridge that has become a cultural treasure is also the very human story of how John Roebling, his son, Washington Roebling, and his wife, Emily Warren Roebling, dealt with accidents and death, not to mention political corruption and greed, along with the physical and technical challenges of constructing the largest bridge in the world. It is as gripping as any novel.

A more recent book, *The Innovators* (1996), by David P. Billington, tells the stories of engineering pioneers who shaped modern technology and thereby made America modern. Rather than weaving an extended narrative about a single artifact, however, Billington uses famous technological achievements such as the steam engine, the distribution of electricity, the telegraph, and steel making to show how even the most technical aspects of engineering—its equations and formulas—are influenced by such factors as social, economic, and aesthetic considerations. By explaining in simple terms how technical decisions must incorporate a wide range of seemingly nontechnical considerations, Billington's book shows more explicitly than any other the true nature of engineering as a social and cultural, as well as a technical, endeavor.

Engineering is done by engineers, of course, and the 1976 book by Samuel C. Florman, *The Existential Pleasures of Engineering*, has become a classic for understanding the passion and enthusiasm individual engineers can feel for their work and the satisfaction they can experience as they make tangible contributions to society and culture. Florman's book has recently been reissued in a second edition (1994), which includes a new preface and chapters from some of his other books, and it is considered by many to be required reading for those wishing a full understanding of the engineer and engineering in modern society.

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John J. Pitney Jr.

Foundation (1951), by Isaac Asimov: In this classic of science fiction, a "psychohistorian" uses computers and advanced mathematics to predict the decline and fall of the Galactic Empire,