Joseph Justus Scaliger (1540–1609). Working what Grafton describes as "bibliographical and philological miracles," this "most arrogant as well as the most learned of men" relied on his knowledge of ancient languages and astronomy to fix dates from the fall of Troy to the fall of Constantinople. He was the first to establish a "coherent, solid structure" of historical time, "basically the one that scholars still use."

Scaliger's greatest achievement may have been to reveal the painstaking discoveries of a third-century chronologer, Eusebius of Caesarea (in present-day Israel), compiled in two volumes. The first, Grafton reports, contained "a vast amount of information, some of it quite worrying to a Christian reader," including chronologies of ancient Egypt and Babylon. The second contained "something that seems to have been new: a comparative table of world history from the birth of Abraham onward"—showing no dates, but correlating events in the history of the world's great empires. St. Jerome had translated Eusebius's second book into Latin in the fourth century (ignoring the troubling first book). But until Scaliger came across the two volumes in 1602, no one seems to have wondered why Abraham's birth coincided with the 17th Egyptian dynasty. As Scaliger realized, tracing backward from this coincidence led to the inescapable conclusion that the kingdom of Egypt had existed before Creation.

Scaliger's revelations touched off debates that lasted for hundreds of years. Dissenters used the evidence to discredit the Bible, while other scholars got so bogged down in arguing about niggling details of Egyptian and Chinese chronology that Voltaire and the other philosophes centuries later came to see *chronology* as a "synonym for sterile pedantry." Time had finally passed chronology by.

Science, Technology & Environment

Hydrogen Hype

"Rethinking Hydrogen Cars" by David W. Keith and Alexander E. Farrell, in *Science* (July 18, 2003), American Assn. for the Advancement of Science, 1200 New York Ave., N.W., Washington, D.C. 20005.

Are hydrogen cars the next new thing? Hydrogen fuels, advocates say, could reduce air pollution, ward off global warming, and reduce dependence on foreign oil. President George W. Bush has proposed a $1.7 billion, five-year plan to develop hydrogen-fueled vehicles and supporting infrastructure. But Keith, a professor of engineering and public policy at Carnegie Mellon University, and Farrell, a professor of energy and resources at the University of California, Berkeley, say that, at this point, it's just so much gas.

"If hydrogen cars are ever to match the performance of current vehicles at a reasonable cost—particularly fueling convenience, range, and size—technological breakthroughs in hydrogen storage and energy conversion will be required," the authors say. Costs will be very high. Just setting up a new hydrogen-fuel distribution system would cost more than $5,000 per vehicle initially.

Hydrogen can be burned cleanly or used in fuel cells, thus virtually eliminating vehicular air pollution, Keith and Farrell acknowledge. But the improvement would come at a relatively high cost because "regulation-driven technological innovation" has already reduced emissions from gasoline-powered cars to low levels. It will cost less than $16,000 per metric ton to reduce nitrogen oxide emissions to meet the latest Environmental Protection Agency standards for gasoline vehicles. More gains can be had at relatively low cost. But the additional reductions achieved by hydrogen would cost roughly $1 million per metric ton.

And while hydrogen cars emit no carbon dioxide at the point of use, the production of hydrogen is likely to release that greenhouse gas. Why? Because it is much cheaper to make hydrogen from coal or natural gas than from non–fossil fuel sources. If reducing carbon dioxide emissions is the goal, the authors say, it would be far more cost effective

to replace today's fossil fuel–fired electric power plants with wind or nuclear plants.

Hydrogen cars are an attractive long-run possibility, Keith and Farrell conclude, but not the only one—and not one America should wholeheartedly embrace anytime soon.

Trapped in the Lab

"Patients Have Been Too Patient with Basic Research" by Ralph M. Steinman with Maia Szalavitz, in *Cerebrum* (Fall 2002), Dana Press, 900 15th St., N.W., Washington, D.C. 20005.

Biomedical researchers, working in laboratories with rats and mice and tissue cultures, have made great strides in the theoretical understanding of human diseases—but benefits to the people suffering from those diseases have not kept pace. The reason? Not enough physician-scientists, who both treat patients and use them in research, contend Steinman, a professor of immunology at Rockefeller University, and Szalavitz, a science writer.

"Historically, medical research was conducted by physicians, but the molecular and cell biology revolution changed that dramatically by the early 1960s," the authors observe. "Since then, even basic research on particular diseases has required specialized skills that most doctors never develop." And most specialized researchers, working at the cellular and molecular levels, are far removed from the bedsides of patients.

Of the 700,000 physicians in the United States today, only 14,000 are scientists working to apply lab discoveries to human disease. Their numbers have declined since 1980, for manifold reasons. It can take 12 to 14 years to become both a physician and a

EXCERPT

Let Us Age

The case for ageless bodies seems at first glance to look pretty good. The prevention of decay, decline, and disability, the avoidance of blindness, deafness, and debility, the elimination of feebleness, frailty, and fatigue, all seem to be conducive to living fully as a human being at the top of one's powers—of having, as they say, a "good quality of life" from beginning to end. We have come to expect organ transplantation for our worn-out parts. We will surely welcome stem cell–based therapies for regenerative medicine. It is hard to see any objection to obtaining a genetic enhancement of our muscles.

[But what] if everybody lived life to the hilt, even as they approached an ever-receding age of death in a body that looked and functioned—let's not be too greedy—like that of a 30-year-old? Would it be good if each and all of us lived like light bulbs, burning as brightly from beginning to end, then popping off without warning, leaving those around us suddenly in the dark? Or is it perhaps better that there be a shape to life, everything in its due season, the shape also written, as it were, into the wrinkles of our bodies that live it? What would the relations between the generations be like if there never came a point at which a son surpassed his father in strength or vigor? What incentive would there be for the old to make way for the young, if the old slowed down little and had no reason to think of retiring—if Michael could play until he were not 40 but 80? Might not even a moderate prolongation of life span with vigor lead to a prolongation in the young of functional immaturity—of the sort that has arguably already accompanied the great increase in average life expectancy experienced in the past century?

—Leon R. Kass, a fellow in social thought at the American Enterprise Institute, in *The New Atlantis* (Spring 2003)