

REVIEWS OF SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

Thomas L. Friedman, *The World is Flat* (Farrar, Straus, and Giroux, New York, 2005). ISBN 0-374-29288-4. \$27.50. 488 pp.

Several circumstances led me to read this book. More generally, it was being invoked in many arguments on behalf of the need for science education reform. More specifically, it came highly recommended by one of my students and one of my fellow teachers. One morning, in fact, I saw the fellow teacher reading it on the subway, and I asked to take a look at the table of contents. In an instant I could see what Friedman meant by a "flat" world -- a world whose playing field had been leveled so that everyone has an equal opportunity to access its technology. Friedman explains this more specifically in terms of "The Ten Forces That Flattened the World," but he does much more. He talks about how these "ten flatteners" are part of a "Triple Convergence" that is changing the way the world does business. He then goes on to talk about ways the America, developing countries, and companies can cope with the flattened world and concludes with a discussion of geopolitics and the flat world and the role of imagination.

The key to the "flattening" of the world, Friedman notes, is digitization: "Any activity where we can digitize and decompose the value chain, and move the work around, will get moved around." (p. 15) Only direct services need be performed on site. Friedman casts his ten flatteners in terms of technological developments that are usually associated with one particular company:

- 1) the advent of Windows (and the concurrent fall of the Berlin wall, on 11/9/89), which enabled a single global economic system
- 2) the advent of accessibility to the Internet for all, first enabled by Netscape
- 3) the advent of workflow software, which enabled applications to communicate with each other (data transcription language XML and its related transport protocol SOAP)
- 4) "open sourcing" brought about by self-organizing collaborative communities (examples: the Linux operating system, the Apache web server, the Firefox browser, and the Wikipedia)
- 5) outsourcing, sparked by the need to "fix" the "Y2K" problem, bringing the first economic benefits to India of the seven institutes of technology and six institutes of management set up by Nehru
- 6) offshoring, exemplified by cheap manufacturing by a skilled workforce in China
- 7) supply-chaining, exemplified by the way Wal-Mart both picks up its goods from its vendors and delivers them to its stores
- 8) insourcing, supply chains run for other companies by UPS
- 9) in-forming, enabled by searches of an ever-growing Internet by the likes of Google, Yahoo, and MSN Web Search
- 10) technologies which facilitate the other flatteners by enabling things to be digital, mobile, virtual, and personal.

"The convergence of the ten flatteners begat the convergence of a set of

business practices and skills that would get the most out of the flat world." (p. 178) Add to this three billion workers from previously closed economies (largely Russia, Eastern Europe, China, and India) -- all ready to leap into twenty-first century technology with nothing to unlearn from the twentieth -- and you have what Friedman calls "the triple convergence." Though these workers may drain jobs from the West, he notes, the consequent improvement of their standard of living will eventually make them a market for the products they are designing for the West, so even the West will benefit. ". . . everyone is going to have to improve themselves and be able to compete. It is just going to be one global market." (p. 191) ". . . as the world has gone flat . . . and so many people can now plug and play from anywhere, natural talent has started to trump geography." (p. 194)

"When the world starts to move from a primarily vertical (command and control) value-creation model to an increasingly horizontal (connect and collaborate) creation model, it doesn't affect just how business gets done," Friedman continues (on p. 201). "It affects everything -- how communities and companies define themselves, where companies and communities stop and start, how individuals balance their different identities as consumers, employees, shareholders, and citizens, and what role government has to play. . . . The most common disease of the flat world is going to be multiple identity disorder. . . ." Friedman then goes on to credit Michael Sandel with citing Marx as identifying "the inexorable march of technology and capital to remove all barriers, boundaries, frictions and restraints to global commerce" (p. 202), noting that we may decide to preserve some of the barriers, which amount to "lumps" in the "flat" world. In general, though, he counsels companies not to build barriers, to realize the benefits of collaboration, and to look at outsourcing as an investment in both innovation and in the economic well-being of the developing world.

Anticipating his closing comments about imagination, Friedman observes that an economically flattened world provides a bigger market for idea-based products but not for physical goods or physical labor. Citing Google and Starbuck's as new idea-based products that have become new wants and eventual needs, he writes that "America, as a whole, will do fine in a flat world with free trade -- provided that it continues to churn out knowledge workers who are able to produce idea-based goods that can be sold globally and who are able to fill the knowledge jobs that will be created as we not only expand the global economy but connect all the knowledge pods in the world." (p. 230) For those Americans, however, whose jobs are not "untouchable" -- by virtue of being "special," "specialized," "anchored," or "really adaptable" -- he sees the need for improved knowledge skills and advocates portable pensions and health care as the emphasis on "employment" shifts to "employability."

But, in spite of America's present commanding position -- 4000 of the world's 11,768 institutions of higher education, and a capital market duplicated elsewhere only in London, Frankfurt, and Tokyo -- Friedman cautions his readers that America is not preparing for the future. Finding an analogy with the declining standing of America's men's Olympic basketball teams, he describes what Rensselaer Polytechnic Institute President Shirley Ann Jackson calls a "quiet crisis" of American science and engineering, which he attributes to three "Dirty Little Secrets": 1) "the numbers gap" (not training enough new American scientists and engineers to keep pace with demand, while more foreign students are now being educated in their homeland

and finding it more attractive to work there), 2) "the ambition gap" (instead of basking in feelings of entitlement, workers in other countries are more motivated and productive), and 3) "the education gap" (continuing despondency about TIMSS and PISA scores).

"This Is Not a Test," Friedman titles one of his chapters, to let us know that he is describing "the real thing." While his parents told him that people in China are starving when he toyed with his food, Friedman describes how he tells his daughters that people in China are starving for our jobs. "The sense of entitlement, the sense that because we once dominated global commerce and geopolitics -- and Olympic basketball -- we always will, the sense that delayed gratification is worse than a spanking, the sense that our kids have to be swaddled in cotton wool so that nothing bad or disappointing or stressful ever happens to them at school is, quite simply, a growing cancer on American society. And if we don't reverse it, our kids are going to be in for a huge and socially disruptive shock from the flat world." (p. 303) Rather, they should be reading an African proverb posted in a Chinese factory (see box).

Friedman also points out how effective leadership could make an important difference. Alluding to President John F. Kennedy's rallying the American people during the Cold War to be the first nation to land men on the Moon, he writes that "If President Bush made energy independence his moon shot, in one fell swoop he would dry up revenue for terrorism, force Iran, Russia, Venezuela, and Saudi Arabia onto the path of reform -- which they will never do with \$50-a-barrel oil -- strengthen the dollar, and improve his own standing in Europe by doing something huge to reduce global warming." (p. 283)

For Friedman, "the line between those who are in the flat world and those who are not is [the] line of hope." (p. 376) He also acknowledges many barriers to achieving this hope, particularly illness and disempowerment. He lauds the Bill and Melinda Gates Foundation for their program to eradicate illness in the developing world, and he faults the Arab Muslim world for disempowering its people. That the GDP of the 21 Arab states is just below that of once-Muslim Spain has fostered humiliation, which, in turn, has led to terror in the name of what Friedman calls "Islam-Leninism," because he considers it "a global phenomenon more than a religious one." (p. 394) This humiliation has been felt by Arab Muslims growing up in the West (including many of the 9/11 terrorists) as well as those under illegitimate Arab rulers. and their terrorist action has abrogated the trust needed for a flat world to function. Although the Arab Muslim world, by and large, does not condone the specific destruction caused by this terrorism, they passively support the slap at America that it signifies.

Yet the "mother of all unflatteners" (p. 436) is the threat of nuclear terrorism, which Friedman argues must be prevented at all costs. To deal with this, he invokes what he calls "The Dell Theory of Conflict Prevention," that membership of a nation in a supply chain deters them from initiating a war. But more than world peace is needed to enable a flat world to operate. Friedman observes that already the Triple Convergence has China eclipsing Japan as the world's second largest oil importer, and meeting China's oil needs in 2012 will require another Saudi Arabia. Thus the world cannot provide the energy resources needed to sustain the economic flattening of the world, unless the US can join with China to practice more efficient use of energy and the development of alternative energy strategies -- Friedman's idea is for China to be the "laboratory" to try them out.

Although 9/11/01 undid many of the positive consequences of 9/11/89, Friedman pleads that we must pattern our lives more after the latter than the former. The difference lies in how we apply our imagination -- "one thing that has not and can never be commoditized." (p. 443) In order to do this, "we have to make sure that we get the best of our own imaginations -- and never let our imaginations get the best of us." (p. 448) He closes with three examples that harmonize with the economic flattening of the world:

- 1) eBay, an open cybercommunity which enables all to compete on an equal basis, with an openness intended to validate behavior that enhances the community.
- 2) Abraham George's Shanti Craven elementary school technology-rich education to untouchable students near Bangalore.
- 3) the 150 million Muslims in India, more than in any Muslim country except Indonesia. Benefiting from the "Triple Convergence" in India, they have advanced economically beyond their counterparts in Pakistan and other Muslim countries. Given the political as well as the economic opportunities available to them, "They usually don't want to blow up the world They usually want to be part of it." (p. 459)

In contrast with the Muslims in India, Friedman points out that oil is, in effect, a curse to other Muslim countries. Although oil revenues eliminate the need to tax these Muslims, their rulers also do not have to be accountable to their people. "Without taxation, there is no representation," he emphasizes (p. 460). Because Bahrain ran out of oil, he observes, it was forced to develop the skills of its people and is now consequently much better off.

- John L. Roeder

Every morning in Africa, a gazelle wakes up
It knows it must run faster than the fastest lion or it will be killed.
Every morning a lion wakes up.
It knows it must outrun the slowest gazelle or it will starve to death.
It doesn't matter whether you are a lion or a gazelle.
When the sun comes up, but better start running.

- African proverb in a Chinese factory

James Howard Kunstler, *The Long Emergency: Surviving the End of Oil, Climate Change, and Other Converging Catastrophes of the Twenty-first Century* (Grove, New York, 2005, 2006). 324 pp. \$14. ISBN 0-8021-4249-4 (paper).

One of the responses to my circulating my review of Friedman's *The World is Flat* was that I follow it up with Kunstler's *The Long Emergency*. Having received a copy from a former student as a birthday present and having heard the author speak at STS-12 nine years ago (see our Spring 1997 issue), that's what I did. Having heard Kunstler speak about how suburban sprawl -- and the automobiles needed to navigate it -- had deprived us of our sense of community, I needed little time to get the sense of his thesis in this book. It is basically his earlier thesis overlaid with

the dependence of automobiles on what he refers to as "cheap oil," coupled with the idea that the era of cheap oil is coming to an end.

"Even after the terrorist attacks of September 11, 2001," he writes, "America is still sleepwalking into the future." (p. 1) He continues, ". . . the wonders of steady technological progress under the reign of oil have tricked us . . . to believe that anything we wish for hard enough can come true . . . wishing ardently that a smooth, seamless transition from fossil fuels to their putative replacements -- hydrogen, solar power, whatever -- lies just a few years ahead A more likely scenario is that new fuels and technologies may *never* replace fossil fuels at the scale, rate, and manner at which the world currently consumes them." (p. 3)

"It is possible that the fossil fuel efflorescence was a one-shot deal for the human race," he writes. (p. 5) ". . . an unprecedented orgy of nonrenewable condensed solar energy accumulated over eons of prehistory . . . created an artificial bubble of plentitude for a period not much longer than a human lifetime. . . .," he continues. ". . . as oil ceases to be cheap and world reserves arc toward depletion, we will . . . suddenly be left with an enormous surplus population . . . that the ecology of the earth will not support." (p. 7) However, ". . . humankind will survive . . . though not without taking some severe losses in the meantime, in population, in standards of living, in the retention of knowledge and technology, and in decent behavior . . . a dramatic die-back, but not a die-off." (p. 5)

Thus, in his first chapter, he essentially lays out the book and beckons the reader to continue on for more details. The next two chapters consider the geological and political factors determining oil supplies in recent history and the prognosis for the future. In the latter case he cites the work of both Al Bartlett and Matthew Simmons in seeking to establish the year of peak global oil production. (Al Bartlett reviewed Matthew Simmons' *Twilight in the Desert* in our Fall 2005 issue.)

But I was especially interested in the following chapter, "Beyond Oil: Why Alternative Fuels Won't Rescue Us," because I felt that Kunstler's denying a future based on alternative fuels was the key to his forecast of a dismal post-oil future. In that chapter he considers the following alternatives to oil: "natural gas, coal and tar sands, shale oils, ethanol, nuclear fission, solar, wind, water, tidal power, and methane hydrates." (p. 100) Kunstler rightly notes that fossil-based alternatives to oil all produce global warming, though he recognizes that they can be used more cleanly as fuels for generating electricity than as fuels for transportation. He also rightly evaluates energy sources by the ratio of the energy released to the energy invested in producing them. For oil when it was first discovered, this ratio was 20, and for Canadian tar sands it is 1.5. But for hydrogen, which he correctly calls a "pseudo-fuel," it is less than 1.

Kunstler writes, though, that "all of the non-fossil fuel energy sources . . . depend on an underlying fossil fuel economy" and adds that ". . . without the petroleum 'platform' to work off, we may lack the tools to get beyond the current level of fossil-fuel based technology . . . we have an extremely narrow window of opportunity to make that happen." (pp. 100, 102) He seems less dismissive of nuclear fission than of solar and wind energy, but even here he is quick to recognize that nuclear fission (like photovoltaics and wind) is limited to making electricity (which represents only 36% of our energy use).

"It means we can have the lights on at night and refrigerate our food, but without the benefit of artificial fertilizers made out of natural gas, and diesel-powered machinery to till the soil at industrial scale, we will have to completely reorganize agriculture." (p. 146)

After a further chapter discussing the further insults to the post-oil world which we can expect from global warming and further medical dangers, he comes to his penultimate chapter on "Running on Fumes: The Hallucinated Economy." Just as the stock market crashed in 1929 when the expected increase in the value of stocks bought on margin failed to materialize, so also have the "dot-com bubble," the Savings and Loan Association fiasco, and "creative" schemes "in a world of money so abstracted from any real activity besides the trading of abstractions" (p. 228) continued to characterize the "hallucinated economy," which Kunstler attempts to describe in a thermodynamic context with a questionable use of the concept of entropy. Most recently, according to Kunstler, this economy has invested its money unwittingly in real estate under the assumption that its value, too, will only continue to appreciate.

The same considerations, too, apply to energy sources. "Economists would rationalize," he writes, "by declaring that ninety-nine years from now we will have colonies on the moon or Mars or under the Sea of Cortez. Or that technology coupled with human ingenuity will solve the problem some other way, perhaps by genetically reengineering human beings to be one inch tall, or booting all our consciousnesses into computer servers where unlimited numbers of virtual people could dwell in unlimited virtual environments of endless cyberspace." (p. 193) "More likely, we will remain confined to the planet Earth," Kunstler rejoins, where the carbon dioxide resulting from burning half the world's supply of oil "is now ratcheting up global warming and climate change, which might well put the industrial adventure out of business before human ingenuity can come up with a substitute for oil." (p. 194)

This, of course, brings us to "Living in the Long Emergency," the final chapter. ". . . life in the decades ahead . . . will become increasingly and intensely local and smaller in scale . . . as the amount of available cheap energy decreases. . . .," he writes. "All other activities will be secondary to food production, which will require much more human labor." (p. 239) With oil the resource in most immediate shortage, Kunstler turns to transportation needed both to produce food and to market it, even to the point of tracking the world horse population, which peaked at 21 million in 1915 but has now rebounded to 7 million from a low of half a million in the mid-1950s (although almost three quarters of a million of our present horses are used for racing). He sees in the Amish and small-scale organic farmers -- and the craftsmen and women who support them -- the maintenance of agricultural knowledge that will be needed in the Long Emergency.

Kunstler surveys and rates the different parts of the U.S. in their ability to adapt to the Long Emergency and concludes that the most adaptable parts are small cities and towns in the northeast, surrounded by fertile farmland. The key criteria for buildings are 1) ability to walk (or bicycle) to them, 2) ability to heat them, and 3) ability to keep their roofs repaired. This requires sufficiently dense urban living, but not so dense that energy-consuming elevators are needed -- Kunstler settles on two-to-five stories as most ideal. He feels the northeast is most adaptable because it has a greater pride in sense of community, also plentiful fertile soil and rainfall.

Air and auto transportation, both of which depend on oil, could be afforded only by the wealthy, and neither to a sufficient extent to maintain public highways or commercial airlines. More realistic modes of transportation, Kunstler argues, are water and electrified rail (provided that nuclear electric plants can be built soon enough) -- he recalls the once widespread network of interurban light rail systems, which, he says, can now be rebuilt on the roadbeds of abandoned highways.

As one of the few present occupations that will continue to be viable, teaching, Kunstler writes, will likely become a more respected profession. But it will become more limited in scope, preparing the rest of the population for more useful "hands-on" employment ("... most nonmanual-labor jobs ... do not require anything more than the ability to write a coherent paragraph or perform a few rudimentary operations of arithmetic -- which is asking a lot, by the way. . . .") (p. 217). Though "falling standards of living, loss of amenity, shrinking life expectancy, resource scarcity, political disorder [and] military strife will . . . shatter many of our cherished beliefs" (p. 302), Kunstler would like to preserve some of our contemporary ideas, such as "due process of law, separation of church and state, social equality, the secret ballot, and compound interest." (p. 302)

What especially concerns Kunstler is the emerging feeling that something can be gotten for nothing, which he attributes to the emerging respectability of gambling from the proliferation of casinos -- "from students who expect to be given automatic As just for showing up . . . to ordinary citizens living wildly beyond their means on credit cards." (p. 302) Instead, "there will be hunger instead of plenty, cold where there was once warmth, effort where there was once leisure, sickness where there was health, and violence where there was peace. We will have to adjust our attitudes, values, and ideas to accommodate these new circumstances and we may not recognize the people we will soon become or the people we once were. . . . Irony, hipness, cutting-edge coolness will seem quaint or utterly inexplicable to people struggling to produce enough food to get through the winter. In the Long Emergency, nobody will get anything for nothing." (p. 303)

"We will be uninterested in the 'root causes' of misbehavior and expeditious in dealing with the sheer fact of it, meaning justice is likely to be harsh and swift," he concludes. "We will be a lot less inclined to entertain excuses for anything. Personal responsibility will be unavoidable, perhaps excessive. Adolescence as we have known it could disappear and childhood will afford fewer special protections." (pp. 303-304)

After adding his own personal Long Emergency, Kunstler appends an Epilogue freshly written for his paperback edition that focuses on events through February 2006. One of the things that concerns him is that Americans have been distracted from their energy crises by other overriding events -- Watergate during the Arab Oil Embargo, the Iran hostage crisis during the Iranian oil embargo. He is equally concerned that political improprieties will likewise distract Americans from the energy crises we face at present -- and that this time it won't be followed by the two decades of plentiful oil and relative peace which characterized the last two decades of the twentieth century. That era gave rise to the globalism that Friedman writes about in his book, but Kunstler maintains that globalism will end with the era of cheap oil. In effect, cheap oil has been a "flattener," and without it the world will cease being flat.

- John L. Roeder

"The most significant characteristic of modern civilization is the sacrifice of the future for the present, and all the power of science has been prostituted to this purpose."

- William James, quoted by James Howard Kunstler at the beginning of Chapter 6

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There is a group in the US that believes we are entering the end times. War, famine, pestilence, and death are on the march. A virtuous few will be saved, but the masses will be left in a living hell. If you are one of the virtuous, now is the time to get your friends and loved ones to come with you, and if you aren't, now is the time to convert.

Sorry, I'm not talking about evangelicals and the rapture. I'm talking about James Howard Kunstler's writings about the coming societal collapse, which have been getting so much attention in the alternative press recently.

In the end, the bad guys get their due: "I doubt that the WalMarts and K-Marts of the land will survive..." On the way to the end, the economy slips into depression: "the aggregate economic effect of these failures will be a worldwide deflationary depression. I will not be surprised if it is as bad in terms of unemployment and hardship as the 1930s."

We also go through hell on earth: "...places like Long Island, Northern New Jersey, the San Fernando Valley, Atlanta, Phoenix, Miami, Las Vegas and hundreds of places like them are apt to become uninhabitable." Finally, we settle into the pattern Kunstler believes will be the salvation of humanity: "I believe it will deeply affect the economies-of-scale of virtually all activities in the United States, essentially requiring us to downsize and localize everything from government to retail merchandising to farming."

Oh wait, I'm so sorry again. Those are direct quotes from an article Kunstler wrote in 1999 for his website about how the coming *Y2K computer bug* was going to destroy Wal-Mart, render cities uninhabitable, cause a depression, and make us all downsize to smaller communities. This review is supposed to be about *The Long Emergency*, Kunstler's latest book. The new book is about how *crossing peak oil* will destroy Wal-Mart, render cities uninhabitable, cause a depression, and make us all downsize to smaller communities. (Kunstler has conveniently erased all references to the Y2K article from his website, but it still exists on the Internet archive sites at http://web.archive.org/web/20010211165926/kunstler.com/mags_y2k.html)

Since Kunstler clearly decided long ago what was going to happen, regardless of the actual facts, it is not surprising that his chain of logic is based on mistaken facts that could be corrected with a few moments of research. For example, he claims doom and gloom will be upon us because our manufacturing is being "hollowed" out and exported to low wage countries. Since

everybody works in services now, when trade disappears we will have no ability left to make things for ourselves.

That might support his thesis, except that it isn't true. With a few minutes of research, you can find that US-based manufacturing plants are producing more than twice as much 35 years after this supposed "hollowing" began, and output continues to grow. A simple online search yields the Federal Reserve's time-series manufacturing index: <http://www.economagic.com/em-cgi/data.exe/blsin/inu0002us0>. Clearly, he's confusing manufacturing employment (which is dropping, due to increased productivity) with manufacturing output (which is increasing strongly). Kunstler should have known this already — his fellow columnist at *Rolling Stone* magazine, William Greider, made the same mistake in his book, *One World, Ready Or Not*, and was taken to task by Princeton economist Paul Krugman for it.

Or what about this complete societal collapse due to lack of oil? Physicist Richard Tarara at St. Mary's College regularly has his class calculate the costs of weaning ourselves from oil. That cost is truly huge, measured in tens of trillions of dollars over a century. Over that time period, however, absorbing the cost would be approximately the equivalent of a mild (at the optimistic end) to a severe (at the pessimistic end) recession. Kunstler's collapse thesis requires that we hit a wall suddenly and run out of oil with no warning.

In fact, Kunstler claims in his epilogue that we already hit peak last year. But if extraction costs were rising in line with oil prices, Exxon, BP, and Shell would not be reaping record profits. Their profits come from the fact that extraction costs are still low. Exxon won't even invest in a project unless it will be profitable at \$20 a barrel.

The peak oil thesis is a truism; at some point we will start extracting less oil yearly. It's not the physics he gets wrong, it's his notion that the timing is somehow hidden from the world and we will run out without warning. For us to suddenly run out of oil requires that financiers Kunstler takes to task for their greed don't want to profit from the coming oil crisis. If they did want to make money, why wouldn't they buy oil now and hoard it to sell at astronomical prices later? If financiers are as greedy as he expects — and I agree with him that they are — we will see a drawn out transition as prices rise decades in advance of shortages.

Clearly, these inconvenient facts don't support Kunstler's predetermined conclusion that society will collapse and be reconstituted as smaller communities. After reality proved him wrong in 2000, he's substituted the evils of technology with the evils of oil. Making the same shocking predictions for peak oil doesn't make them any more likely. I suppose he could have corrected his conclusions to fit the actual facts, but a book devoid of apocalypse called "The Long Adjustment" would have taken much more actual work and research.

That is too bad — a well-reasoned analysis of how society would change given the changing nature of energy costs would be both fascinating and welcome. Unfortunately, *The Long Emergency* is neither.

- Kevin Laws

(*Editor's Note:* Kevin Laws also wrote the guest editorial in this issue.)

Malcolm Gladwell, *The Tipping Point: How Little Things Can Make a Big Difference* (Back Bay Books/Little, Brown and Company, New York, 2002). 280 pp. plus endnotes. ISBN 0-316-34662-4 (paper).

This is "A fascinating book that makes you see the world in a different way," according to a review in *Fortune* magazine, cited on the cover. Here is one breakout challenge near the beginning:

Consider, for example, the following puzzle. I give you a large piece of paper, and I ask you to fold it over once, and then take that folded paper and fold it over again, and then again, and again, until you have refolded the original paper 50 times. How tall do you think the final stack is going to be? In answer to the question, most people will fold the sheet in their mind's eye, and guess that the pile would be as thick as a phone book, or if they are really courageous, they'll say that it would be as tall as a refrigerator. But the real answer is that the height of the stack would approximate the distance to the sun. And if you folded it over one more time the stack would be as high as the distance to the sun and back. This is an example of what in mathematics is called a geometric progression. Epidemics are another example of geographic progression. . . . (p. 11)

The subtitle of the book refers to quite a range, from unintended consequences to research-based and manipulated strategies. In this work Gladwell follows the classical Speech 101 instructions: [1] Tell'em what you're going to tell'em. [2] Tell'em. [3] Tell'em what you told'em. [4] Stop and sit down.

With the analogy of a large, balanced object toppling or being pushed over to a very different position -- "tipping" -- Gladwell offers both amusing and ominous examples. Since the hardback edition was first published in 2000, advertisers, auto designers, politicians, and fashion designers have, without subtlety, attempted to employ the three principles of epidemics in their work. To understand them it is necessary, of course, to read the book, but the eight chapters supply quite engaging text that analyzes and explains the processes at work.

The tenets he points to emerge in both familiar and little-known examples. In the rich, dense introduction the author tells the reader where will take us:

The *Tipping Point* is the biography of an idea, and the idea is very simple. It is that the best way to understand the emergence of fashion trends, the ebb and flow of crime waves, or, for that matter, the transformation of unknown books into best sellers, or the rise of teenage smoking, or the phenomena of word of mouth, or any number of the other mysterious changes that mark everyday life is to think of them as epidemics. Ideas and products and messages and behaviors spread just like viruses do. The rise of Hush Puppies and the fall of New York's crime rate are textbook examples of epidemics in action. Although they may sound as if they don't have very much in common, they share a basic, underlying pattern. First of all, they are clear examples of contagious behavior. (p. 7)

Human social behavior (think "fads") often imitates the cycles of epidemics. The sudden popularity of the *Ya-Ya Sisterhood* or the rap music genre provide commercial examples. Clichés often appear and spread, then vanish like the 1918 flu: "at the end of the day," "it's not a matter of if but when," and "let's not play the blame game" arose recently and already appear to be on the decline. Yet, the ubiquitous "like" and "you know" serve no useful communication purpose but have persisted longer than most verbal epidemics. Gladwell employs numerous

examples with just enough detail to establish his points. In some cases he offers didactic lessons for successful campaigns to sell ideas or products. An especially valuable section comments on failed and successful ways to reduce teenage smoking.

To illustrate such contagious action, he cites yawning ("I made some of you reading this yawn simply by writing the word 'yawn.'") as well to the anti-crime trend in New York City illustrate patterns of evolution in the decline of epidemics. The former is simple, familiar, and verifiable at once. The latter was not foreseen: From 200,000 crimes a year in the mid-1960s a sharp rise to 650,000 in the mid-1970s preceded a plummeting to its previous levels by 1992. By 2005 New York's crime rate had dropped so that it did not qualify it for the highest 200 US cities. In an opposite example, a syphilis epidemic descended on Baltimore in one year. Newborns afflicted with the disease rose 500% in the year from 1995 to 1996. The particulars of these urban trends clarify the themes he sets forth throughout the book.

After successful, prolonged sale for some nonfiction books, their influence suddenly expands delta-fashion when paperback sales create a secondary readership. Two examples include *Guns, Germs, and Steel*, by Jared Diamond (reviewed here the Fall 2001 issue of this *Newsletter*) and the present book under review. These seminal works, required reading for many college students, will surely extend their key impacts over years, even decades, into future classrooms. Such successes build an automatic clientele for the later publications by the same authors. Gladwell's *Blink* and Diamond's *Collapse* (reviewed in the Winter/Spring 2006 issue) created enormous paperback sales.

The Three Principles or characteristics can be stated so simply their profundity may be overlooked: [1] contagiousness, [2] the fact that little causes can have big effects and [3] change happens not gradually but at one dramatic moment, the tipping point. There are also The Three Rules: The Law of the Few, the Stickiness Factor, and the Power of Context. To absorb the lessons, I recommend skipping the five pages of commendations and then reading the introduction and first chapter, The Three Rules of Epidemics. Afterward, skip around in any order through the seven other sections, concluding with the revised Afterword in the 2002 paperback. Detailed endnotes point the reader to additional resources. I am about a third of the way through *Collapse* and then plan to read *Blink* as soon as my son lends me his copy.

- John D. White

Philip Dray, *Stealing God's Thunder: Benjamin Franklin's Lightning Rod and the Invention of America* (Random House, New York, 2005). xviii + 229 pp. \$25.95. ISBN 1-4000-6032-X.

In his introduction, Dray characterizes Benjamin Franklin by "his interest in investigating that which had not yet been adequately explained, and the urge to fix what could bear improvement. . ." (p. xiii) On a grander scale, he states that "Through Franklin's lightning rod and his leading role in fostering American independence, mankind found in him both a philosopher who banished superstition [some deemed lightning rods sinful, because they diverted God's wrathful action] and a revolutionary who humbled kings." (p. xvi)

In making these statements, Dray appears to be formulating a thesis that Franklin's scientific contributions should be viewed in the same light as his other contributions toward the betterment of humankind. To communicate his thesis he has written what might be considered a scientific biography of Franklin. It turns out to be a description of Franklin's scientific achievements within the context of his life story.

After a first chapter on Franklin's youth in Boston that seems like the first chapter from any Franklin biography, Dray shifts into "scientific gear" with his chronology of observations and theories about static electricity, beginning with Pliny and ending with Archibald Spencer, an itinerant lecturer whose electrical apparatus Franklin bought after Spencer completed his tour. One is left to wonder, in fact, whether Franklin would have made his imprint on the theory of electricity had he not met Spencer.

Dray also notes that Franklin bemoaned the lack of a practical use of electricity, though the need to control it did have a practical use in the form of the lightning rod. Of all of Franklin's contributions to science and technology, it is the lightning rod that is singled out by Dray. In fact, he devotes only two pages to Franklin's celebrated measurement of the Gulf Stream (in conjunction with his last trip across the Atlantic), and no mention at all is made of Franklin's investigation of the calming effect of oil on rough water (see reference #7, Winter/Spring 2006 issue).

In the chapter on Franklin's sojourn in England, Dray relates the debate between blunt and pointed lightning rods, which was decided (incorrectly from a scientific point of view) in favor of blunt rods, simply because Franklin, in disfavor in England after 1775, preferred pointed ones. In the chapter on Franklin as Ambassador to France, Dray tells the story of Robespierre's defense of the right of Vissery's right to install a lightning rod on his home.

In fact, Dray is at his best in telling stories -- my favorite is one in which a committee of Franklin, Bailly, Guillotin, and Lavoisier found there to be no medical efficacy in the treatments of Mesmer. I found myself wondering whether these stories might stand alone better as magazine articles than being strung together on the larger framework of everything else that Franklin did. Of course, that would thwart Dray's thesis of looking at all of Franklin's contributions to humanity in the same light. In fact, he comes back to this thesis in his final chapter, "The Science of Freedom," suggesting that Franklin looked at the United States Constitution as an experiment in self government.

In his epilogue, Dray wonders whether Franklin today would find society *too dependent* on the "electrical fluid" which had no practical use in his day.

- John L. Roeder

Art Hobson, *Physics: Concepts & Connections* (4th ed.) (Pearson/Prentice Hall, Upper Saddle River (NJ), 2007). xvii + 470 pp. plus answers, glossary, and index. ISBN 0-13-187946-4.

As reported in our coverage in this issue of this author's Millikan lecture at the Syracuse meeting of the American Association of Physics Teachers, Art Hobson believes that physics education should be intended for all, that it should be conveyed in a conceptual rather than technical manner, that it should reflect the way physicists view the world today, and that it must be taught in a social context. Since the first edition of this book in 1995 (reviewed in our Winter 1995 issue), this book has been the fruition of Hobson's vision of what physics education should be about. Indeed, a flow chart showing the interrelationships among topics which he calls the "Newtonian core" and topics classified as "societal" and "modern, philosophical" has been a trademark of every edition (except that in this edition the topics are indexed by chapter and section, and the box previously labeled as "high energy physics" has been replaced by two more specific boxes -- on "quantum fields and standard model" and "quantum gravity"). That this text is now in its fourth edition twelve years later suggests that Hobson's vision of physics education for all, through the eyes of physicists today and in a social context, has acquired a following.

In fact, the constancy of the organization of this text through its four editions suggests that the author may have "gotten it right" from the beginning. There remain 18 chapters, broken into five parts that continue to be headed as follows: 1) "Prelude: Of Stars and Atoms"; 2) "The Newtonian Universe: A Clockwork Kingdom"; 3) "Transition to the New Physics"; 4) "The Post-Newtonian Universe: The Observer Intrudes"; and 5) "Within the Atom: Fire of the Nucleus, Fire of the Sun." But when one penetrates more finely into the structure of the book, changes become readily apparent. The chapters on electromagnetic radiation are restructured to provide more emphasis on global climate change. The chapters on relativity have been restructured to provide more focus on cosmology. The chapters on quantum physics and its implications have been largely rewritten. A section on "Nuclear Terrorism" has been added to the chapter on fission and fusion. Our "Energy Future" is now referred to as our "Energy Challenge," and the last two sections of the final chapter on quantum fields have been rewritten. But, according to Hobson's preface, he has "wordsmithed" the entire text to make it "20,000 words shorter despite several new additions." Indeed, the last chapter of the first edition ends on page 520; this makes the fourth edition a full 50 pages shorter!

The refocused second relativity chapter acknowledges a "golden age of cosmology," which "began in 1992 when an observing satellite charted the first detailed map of the early universe." While "the keys to the new cosmological discoveries are the wonderful new observing instruments," Hobson also acknowledges that "the key to understanding these discoveries is the general theory of relativity." He goes on to connect all the new considerations about cosmology -- the big bang, the cosmic inflation that followed it, the emission of the cosmic wave background, and the roles of dark matter and dark energy, the latter causing the universe to accelerate. ". . . the big bang *created* time and space," Hobson writes on p. 256; elsewhere, on p. 267, he notes that the combination of positive kinetic and radiant energy in the universe add to its negative gravitational energy to give a nearly zero result, thus obviating any need to account for a large amount of energy in that big bang. In a diagram on p. 259 he shows how the angle subtended by a typical disturbance remaining from the big bang, which would have the measure of the distance traveled by a disturbance during the 400,000 years following the big bang, indicates that the geometry of the universe is flat (rather than positively or negatively curved). He pictures dark matter as a spherical cloud surrounding a galaxy. He likens the role of dark energy to causing an object thrown upward to continue to accelerate higher. In a chapter marked

by many pauses for "How do we know?" because of the large amount of evidence for these ideas, he concludes that "the flatness of the universe, dark matter, the acceleration of the universe, and dark energy all fit together in a beautifully consistent but totally unexpected picture of the universe." (p. 263) And on p. 267 he maps it all out on a logarithmic time line -- from 10⁻⁴² s to 10¹⁸ s (now).

In rewriting his chapters on quantum physics, Hobson has replaced his previous discussion of wave-particle duality with the consideration of radiation and matter as being composed of quantized fields. He opens by characterizing quantum physics by probability rather than certainty, interconnectedness, discontinuous changes, and dependence on the observer. Omitting his previous discussion of the photoelectric effect and its quantum implications (the traditional basis for establishing particle properties of light), he goes to the two-slit interference pattern for light cited five chapters earlier as Thomas Young's basis for concluding light to be a wave. Only now he asks what would happen if this pattern were "built up" from a long exposure of very dim light. In this case one sees a pattern of an increasing number of dots which suggest particulate properties of light. But these particulate properties would conflict with the model that "light is an extended wave in a spread-out EM field that comes through both slits." (p. 301) This conflict can be resolved, however, if we consider a "photon" (the erstwhile name for "light particle") to be "simply an energy increment of a spread-out EM field" (p. 303) and each dot appearing on a screen to be the result of an event in which "the entire space-filling EM field instantly loses one quantum of energy, and at the same instant that quantum of energy shows up at a particular point on the screen." (p. 304) Hobson also notes that "the precise impact point of any individual photon is unpredictable even though the emerging statistical pattern is predictable" (p. 305) and that "communication" between the EM field (which fills the entire slit-to-screen region) and the impact of each photon on the screen is a result of the nonlocality which causes an interconnectedness of quantum phenomena.

The same arguments are then made for electrons. Photos of Tonomura's building up a two-slit electron interference experiment in 1989 show the same evolution as those for two-slit light interference. Again, the explanation is a quantized field -- this time a *matter* field. "Everything, all matter and all radiation," Hobson writes, "is made of spread-out fields, but these fields are quantized and this is why we have particles of light (photons) and particles of matter (such as electrons)." (p. 311) In two-slit interference experiments, neither photons nor electrons exist as separate particles until the instant of impact on the screen. (Hobson has described his field-theoretic approach to what others continue to refer to as the wave-particle duality of matter in the *American Journal of Physics*, **73**(7), 630-634 (July 2005).)

Having established the quantized field model of matter in the first of his two chapters on quantum physics, Hobson concludes this chapter by indicating that the next will consider the remainder of the characteristics he has cited of quantum physics -- uncertainty, interconnectedness, and dependence on the observer. And he notes that the matter waves are described by the solution to Schrödinger's equation and that the intensity of those waves indicates the probability of detecting a particle. Although Hobson has already alluded to quantum uncertainty in discussing the two-slit interference pattern, he begins his second quantum physics chapter with Heisenberg's *quantification* of quantum uncertainty, which he represents as a rectangle on a graph of speed versus position. The next section, titled "The Effect

of Observation" in this edition but "Quantum Jumps" in the first edition, is really about the work of John Bell, John Clauser, and Alain Aspect which showed that the criticism of quantum mechanics by Einstein, Podolsky, and Rosen (without mentioning the latter two by name) was unfounded, that what is referred to in the following section as "spooky action at a distance" is really observed. This "spooky action" is otherwise known as "entanglement"; it reflects the interconnectedness of quantum systems that results from the quantum phenomenon of *nonlocality*. "Two entangled particles do not coordinate their actions by communications between them; rather, their actions *must* be coordinated because they are a single object, but in two different places." Hobson writes (p. 333). Thus he addresses the role of the observer as well as the interconnectedness of quantum systems. He rounds out the chapter by a description of the hydrogen atom in terms of the electron's matter field.

In concluding the second quantum physics chapter in his first edition, Hobson wrote, "Despite nearly a century of post-Newtonian physics, a post-Newtonian worldview is still not in sight" (p. 385), but in the dozen years in which he has worked his way through four editions of this text, he now writes about a "quantum worldview," which "asserts that the universe is made of nonmaterial fields, the particles of the microscopic world are merely quantized increments of these fields, the future is inherently unpredictable, and nature is deeply interconnected and indivisible." Noting the contrast with the Newtonian worldview, he adds, "This is nothing like a machine." (p. 338)

Reformulating his two quantum physics chapters to consider radiation and matter as being composed of quantized fields sets Hobson up for a seamless transition to his final chapter (on quantum fields). "At the core of quantum field theory is the view that the universe is not made of material 'things' but is instead made only of fields," Hobson writes. (p. 440) "There is no truly solid or enduring 'thing.' In this sense, there is 'nothing': no thing. Only fields." New topics included in this final chapter include neutrino mass, the Higgs field (needed to account for particle mass as well as cosmic inflation), and the string hypothesis (he chooses the term "hypothesis" because the string idea is still tentative and observationally unconfirmed, whereas the word "theory" refers to a well-confirmed idea such as Darwin's theory of biological evolution).

In addition to updating his text to describe the way physicists view the world today, Hobson has also updated its social context. As noted above, he has added a section on "Nuclear Terrorism," and the chapter on our "Energy Future" is now referred to as our "Energy Challenge." His discussion of nuclear terrorism, which Thomas Friedman in *The World is Flat* calls "mother of all unflatteners," considers stealing an intact nuclear weapon, obtaining weapons-grade fissionable material and building a crude weapon, sabotaging nuclear facilities to release radioactivity, and obtaining radioactive material to build a "dirty bomb" energized by conventional explosives. In addressing "The Energy Challenge," Hobson introduces the concept of sustainability within the context of a 1996 statement from the American Physical Society. He specifically cites resource depletion and global warming as forcing reduced fossil-fuel use, which he sees "as a decarbonization of the energy supply" (p. 422), and he pauses on p. 414 to ask "How do we know when oil production will peak?" Other specific additions are references to compact fluorescent bulbs and the ITER project (though not by name) "to build an experimental fusion reactor in Cadarache, France." (p. 419)

The passage of Hobson's text through four editions also reflects changes in learning resources through those years. "Concept checks" in the fourth edition replace "Dialogues" in the first. End-of-chapter summaries of ideas and terms are now replaced by a list and page number references to look them up for review (but the student can also go to the glossary at the end of the book). Home projects and Discussion Questions, present in the first two editions, have been removed, but Problems were added, beginning in the second edition (remember that while Hobson eschewed algebra in his Millikan lecture, he emphasized the importance of "numeracy"). Remaining at the end of every chapter is a comprehensive set of Review Questions and Conceptual Exercises. And in this fourth edition is a "new Companion Website with GradeTracker," which "contains activities designed to reinforce students' conceptual understanding of chapter-specific content and practice their problem-solving skills."

- John L. Roeder