THE PROMISE AND PERILS OF THE NEW ECONOMY

Today's dazzling information technologies are often described as tsunamis or tectonic shifts, forces of nature driving us inevitably toward a glittering "new economy." Our contributors question the easy optimism. They point to many difficult political and business choices ahead—about the division of public- and private-sector responsibilities, about security and privacy, about international cooperation, standards, and regulation. And they wonder whether the "new economy" is even all that new.

What 'New' Economy?

by J. Bradford De Long

As the 20th century ends, legions of the powerful—politicians, intellectuals, journalists, business leaders, and visionaries—are embarking on what can only be called pilgrimages. They are traveling to an arid promised land between San Francisco Bay and the Pacific Ocean, some 40 miles south of San Francisco: Silicon Valley. They invariably return with visions of a technological and economic future full of endless promise. Their exuberance should give us pause.

There have been similar pilgrimages in the past. In the 1830s and 1840s, Alexis de Tocqueville, Benjamin Disraeli, and Friedrich Engels journeyed to Manchester, England, to see the shape of the future emerging from the factories (and the smog and the slums) of the rising British cotton textile industry. In the 1920s, another generation's seekers

traveled to Detroit to see Henry Ford's assembly lines, which had unleashed such an extraordinary surge in productivity that automobiles, once luxuries available only to the rich, had become commodities that most Americans could afford. The mass production revolution that began in Detroit may have sparked a bigger improvement in the material conditions of life than the original Industrial Revolution in Manchester. In *Brave New World* (1932), Aldous Huxley wrote of a future in which people dated years from the production of the first Model T Ford, and in which the major problem facing governments was how to brainwash people into consuming enough of the bounty created by the miracle of mass production to keep the economy growing.

Today's pilgrims are very much like those of the past, convinced that new technologies are creating a fundamentally different future—a new society, a new culture, and a new economy. But what, exactly, is new about the "new economy" rising today from Silicon Valley?

Each of today's pilgrims seems to bring back a slightly different report. Some, lacking historical perspective, see patterns of entrepreneurship and enterprise that are in fact quite old. Others fail to understand the most important fact about economic growth: that ever since the Industrial Revolution there have always been dazzling new industries, inventions, and commodities. Still others misinterpret what our economic statistics are telling us about the impact of information technology.

Nevertheless, there is something to the idea that we live in a "new economy." What is new about it is not the rapid pace of invention and innovation nor the rise of living standards beneath the radar of official statistics. What is new is the potential of information goods to defy the very principles of scarcity and control over commodities that have convinced economists that the market is the one best system for guiding the production and distribution of goods. If that challenge materializes, we will indeed be confronted with a new economy, but one very different from the promised land of the pilgrims' dreams.

I

The first dimension of "newness" that the pilgrims hail—the one that strikes almost all observers immediately, and leads to breathless descriptions of technological revolution—is the sheer speed of technological progress in the semiconductor and semiconductor-derived industries. From his post at *Wired* magazine, executive editor Kevin Kelly writes of the new economy as a "tectonic upheaval . . . [driven by] two stellar bangs: the collapsing microcosm of chips and the exploding telecosm of connections. . . . tearing the old laws of wealth apart." *Business Week* editor-in-chief Stephen Shepard declares that information technology and the computer- and network-driven international integration of business constitute "the magic bullet—a way to return to the high-growth, low-inflation conditions of the 1950s and 1960s. Forget 2 percent real growth. We're talking 3 percent, or even 4 percent." Computers and telecommunications are "undermining . . . the old order" and triggering a "radical restructuring"

that leaves traditional analysts of the economy "unable to explain what's going on . . . wedded to deeply flawed statistics and models."

Since the invention of the transistor in the 1950s, the onrush of invention, innovation, and industrial expansion in information technology has been constant and rapid: transistors, integrated circuits, microprocessors, and now entire computers on a single chip and a high-speed worldwide network with the potential to link every computer within reach of a regular or cell phone. Year after year, Moore's Law (named for Intel Corporation cofounder Gordon Moore) continues to prove itself: the density of silicon on a single chip doubles (and thus the cost of silicon circuits to consumers is halved) roughly every 18 months. Moore's law has been at work since the early 1960s. It will continue until—at least—the middle of the next decade.

Observers note the enormous fortunes made on the stock market by founders of start-up corporations that have never turned a profit: how Internet bookseller Amazon.com is seen by Wall Street as worth as much as established bookseller Barnes and Noble. They see how last year's high-end products become this year's mass-market products and then are sold for scrap two years later.

Hence this vision of this "new economy": a future of never-ending cost reductions driven by technological innovation, "learning curves," "economies of scale," "network externalities," and "tipping points." In the old economy, you made money by selling goods for more than they cost. In the new economy, you make money by selling goods for less than they cost—and relying on the learning curve to lower your costs next year. In the old economy, you boosted your company's stock price by selling valuable goods to customers. In the new economy, you boost your company's stock price by giving away your product (e.g., a Web browser) to customers—and relying on network externalities to boost the price you can charge for what you have to sell next year to people who are now committed to your product. In the old economy, the first entrant often made big mistakes that followers could learn from and avoid: it was dangerous to be first into a market. In the new economy, the first entrant to pass a "tipping point" of market share gains a nearly unassailable position in the market.

There are pieces of the world that fit this vision of the new economy very well. Think of the fortune Bill Gates made by beating Apple past the tipping point with Windows. Think of the rapid price declines of silicon chips. Think of the rocketlike Wall Street trajectory of new companies that did not exist a decade ago. Think of the rise of companies that did not exist three decades ago—such as Intel—to industrial prominence.

Yet, somewhat paradoxically, it is along this marveled-at dimension that our economy today is perhaps the least new. For what this particular set of returning pilgrims to the future are describing are the standard

> J. Bradford De Long, *a professor of economics at the University of California, Berkeley, served as deputy assistant secretary of the U.S. Treasury Department during 1993–95. He is currently working on an economic history of the 20th century.*

Silicon Valley—the promised land?

economic dynamics of a "leading sector," of a relatively narrow set of industries that happen to be at the center of a particular decade's or a particular generation's technological advance. There have been such leading sectors for well over a hundred years. Manchester was the home of the leading sectors of the 1830s. It was the Silicon Valley of its day—and saw the same creation of large fortunes, the same plummeting product prices, and the same sudden growth of large enterprises. Every leading sector goes through a similar process. Consider the automobile. The average car purchased in 1906 cost perhaps $52,640 in 1993 dollars. By 1910 the price had dropped to $39,860, even as technical improvements had pushed the quality up by at least 31 percent. By the time the heroic, entrepreneurial age of the American automobile came to an end during World War I, an average car cost 53 percent less in inflation-adjusted dollars than a 1906-vintage vehicle, and its quality had doubled. Consumers were getting more than four times as much car for their (inflation-adjusted) dollar than a mere decade before.

The development of the automobile does not match the pace of innovation in semiconductors under Moore's Law, which generates at least a 32-fold, not a fourfold, increase in value over a decade. But it is in the same ballpark, especially if one allows for the fact that the tremendous improvements in semiconductors have not been matched by changes in the other components used in making microelectronics products.

Thus, a citizen of the late 19th century would not have had to wait for the arrival of our age in order to see the "new economy." A trip to

Detroit would have done the job. During the 1920s, authors writing articles in popular magazines such as the *Atlantic Monthly* confidently declared that mass production made not just for greater efficiency or higher productivity but "a better world," and demanded the rapid creation of a "Fordized America."

The automobile industry is not alone: other industries have had similar transformations during their times as leading sectors. In our dining room, my wife and I have a four-bulb chandelier. If we go to Monterey for the weekend and leave the light on, we will have consumed as much in the way of artificial illumination as an average pre-1850 American household consumed in a year. Such consumption would have cost that household about five percent of its income in candles, tapers, and matches. But because of the technological revolutions that made possible the cheap generation and transmission of electricity, it makes no perceptible difference in our Pacific Gas and Electric bill.

Some of the Silicon pilgrims make an elementary mistake. Seeing autos and other goods of the Industrial Revolution in much the same form today as they existed in their own childhood decades ago, they assume that such "industrial" goods must have emerged almost fully formed, that the pace at which they changed must have always been glacial. But we have had a succession of productivity revolutions in leading sectors since the start of the Industrial Revolution, sweeping through everything from textiles to medical care. That's why we call it a *revolution*—it kicked off the process of staggered sector-by-sector economic transformation of which Silicon Valley is the most recent instance.

With a dose of realism and historical perspective, the pilgrims returning from Silicon Valley might change their vision in several ways.

First, they would recognize that in microelectionics, as in every leading sector, the "heroic" period of rapid technological progress will come to an end. Henry Ford perfects the Model T. Britain's Cable and Wireless company figures out how to properly insulate submarine telegraph cables. The first easy-to-find antibiotics, such as penicillin, are all discovered. Moore's Law exhausts itself. Thereafter, computers and communications will become a much more mature industry, with different focuses for research and development, different types of firms, and different types of competition.

Second, in every leading sector the true productivity revolution occurs before the heroic period has come to an end. The first railroads connected key points between which lots of bulky, heavy, expensive materials needed to move. Later railroads provided slightly cheaper substitutes for canals, or added redundant capacity to the system in the name of marginal economic advantages. The first three TV networks came amazingly close to sating Americans' taste for audiovisual entertainment. The first uses of modern telecommunications and computers—telephone service, music and news via radio, the first TV networks, Blockbuster Video, scientific and financial calculations, and large database searches—had the highest value. Thus, it is unwise to extrapolate the economic value added by semiconductors, computers, and telecom-

munications far into the future. Later uses will have lower value: if they were the most fruitful uses, with big payoffs, someone would have applied technology to them already. This is a version of the standard economist's argument that the $1,000 bill you think you see on the sidewalk can't really be a $1,000 bill: if it were, someone would have already picked it up. But this economist's argument is rarely false: there aren't many $1,000 bills to be found lying on sidewalks.

Third, after the heroic age, the form of competition changes. During the heroic age, technology alone is the driving force. After the heroic age, what matters is figuring out exactly what customers want and giving it to them. As long as automobile prices were falling and quality was rising rapidly, Henry Ford could do very, very well by making a leading-edge car and letting customers choose whatever color they wanted, in the famous phrase, as long as it was black. As long as computer prices are falling and quality is rising rapidly, Bill Gates likewise can do very, very well even if his software programs crash and show their users the Blue Screen of Death twice a day.

Americans in the 1930s thought they *were experiencing a global telecommunications revolution, as this 1933 advertisement by AT&T suggests.*

After the 1920s, however, the Ford Motor Company was overwhelmed by Alfred P. Sloan's General Motors, which figured out how to retain most of Ford's economies of scale while offering consumers a wide variety of brands, models, styles, and colors—a worthwhile undertaking, but not the stuff of economic revolution. Before GM, no one knew what kind of options car buyers really wanted. Today, no one knows what kind of options computer and Internet access purchasers really want, but they know that there are fortunes to be made by the new GMs of the information age. The company that plays GM to Microsoft's Ford likely will succeed by providing access—to computing power, to research materials, to the yet-to-be-built high-bandwidth successor to the Internet, to *information* uniquely valuable to *you*. But no one yet knows exactly how to do this.

Finally, each leading sector does produce a technological revolution. It does leave us with previously unimagined capabilities. The railroad gave us the ability to cross the continent in a week instead of months. Electric power gave us the ability to light our houses and power appliances (and computers). Microelectronics has given us extraordinary intellectual vision. More than a generation ago, when econ-

omists William Sharpe, Merton Miller, and Harry Markowitz did the work on how a rational investor should diversify an asset portfolio that won them the 1990 Nobel Prize in economics, they assumed that their labors were of purely theoretical interest. The calculations required to implement their formulas were beyond the reach of humanity. Today, however, the computing power to carry out calculations many times more complicated resides on every desk on Wall Street.

But a technological revolution is not an economic revolution. Just because microelectronics revolutionizes our capability to process information doesn't mean that it will dominate our economy. The economy, after all, focuses its attention on what is expensive—not on what is cheap. In every leading sector, the story has been the same. Once the exciting new product is squeezed into a relatively inexpensive commodity, economic energy flows elsewhere. *Business Week* does not run cover stories hailing electric lighting and exulting in its vast superiority over whale-oil lamps. Thus, as our capability grows, the salience of our expanded capability to the economy—which is, after all, the realm of things that are scarce—does not.

II

A second group of pilgrims, overlapping somewhat with the first, returns from Silicon Valley proclaiming that the American economy is poised to grow much faster than it has in a generation. They believe that the revolutions in microelectronics and telecommunications are producing a surge of productivity growth that could dramatically lift the American standard of living—if only the Federal Reserve and other government economic authorities would recognize what is going on.

These pilgrims hearken back to the postwar golden era of 1945-73. The drastic productivity slowdown that began in 1973 was a shock to America. It caused a deep slump in the stock market in the mid-1970s. It meant that government promises of future benefits that had been based on assumptions of steadily rising tax revenues (without rising tax rates) could not be fulfilled. It made false the basic American assumption that each generation would live significantly better than its parents' generation, with bigger houses, better jobs, and markedly easier lives. But all of that is behind us now, today's advocates of the new economy announce, or will be if policymakers recognize the potential not yet reflected in productivity statistics and other data. *Business Week*'s Stephen Shepard writes that information technology is a "transcendent technology" that affects everything: it "boosts productivity, reduces costs, cuts inventories, facilitates electronic commerce." The "statistics are simply not capturing what's going on" because "we don't know how to measure output in a high-tech service economy."

Speaker of the House Newt Gingrich opines that technological progress should give us an economy capable of measured annual economic growth of four or five percent without rising inflation, instead of the 2.5 percent deemed possible by the tightfisted central bankers at the Federal

The Chairman Speaks

No less a skeptic than Federal Reserve Board chairman Alan Greenspan allowed, in a speech on September 4, that there may be something to the idea of a new economy.

Some of those who advocate a "new economy" attribute it generally to technological innovations and breakthroughs in globalization that raise productivity and proffer new capacity on demand and that have, accordingly, removed pricing power from the world's producers on a more lasting basis.

There is, clearly, an element of truth in this proposition. . . . But, although there doubtless have been profound changes in the way we organize our capital facilities, engage in just-in-time inventory regimes, and intertwine our newly sophisticated risk-sensitive financial system into this process, there is one important caveat to the notion that we live in a new economy, and that is human psychology.

The same enthusiasms and fears that gripped our forebears, are, in every way, visible in the generations now actively participating in the American economy. Human actions are always rooted in a forecast of the consequences of those actions. When the future becomes sufficiently clouded, people eschew actions and disengage from previous commitments. . . . The way we evaluate assets, and the way changes in those values affect our economy, do not appear to be coming out of a set of rules that is different from the one that governed the actions of our forebears.

Hence, as the first cut at the question "Is there a new economy?" the answer in a more profound sense is no. As in the past, our advanced economy is primarily driven by how human psychology molds the value system that drives a competitive market economy. And that process is inextricably linked to human nature, which appears essentially immutable and, thus, anchors the future to the past.

But . . . important technological changes have been emerging in recent years that are altering, in ways with few precedents, the manner in which we organize production, trade across countries, and deliver value to consumers. . . .

Thus, one key to the question of whether there is a new economy is whether current expectations of future stability, which are distinctly more positive than, say a decade ago, are justified by actual changes in the economy. For if expectations of greater stability are borne out, risk and equity premiums will remain low. In that case, the cost of capital will also remain low, leading, at least for a time, to higher investment and faster economic growth. . . .

The future of technology advance may be difficult to predict, but for the period ahead there is the possibility that already proven technologies may not as yet have been fully exploited. Company after company reports that, when confronted with cost increases in a competitive environment that precludes price increases, they are able to offset those costs, seemingly at will, by installing the newer technologies. . . .

Such stories seem odd. . . . . But if cost-cutting at will is, in fact, currently available, it suggests that a backlog of unexploited capital projects has been built up in recent years, which, if true, implies the potential for continued gains in productivity close to the elevated rates of the last couple of years. . . .

We should not become complacent, however. To be sure, the sharp increases in the stock market have boosted household net worth. But while capital gains increase the value of existing assets, they do not directly create the resources needed for investment in new physical facilities. Only saving out of income can do that.

In summary, whether over the past five to seven years, what has been, without question, one of the best economic performances in our history is a harbinger of a new economy or just a hyped-up version of the old, will be answered only with the inexorable passage of time. And I suspect our grandchildren, and theirs, will be periodically debating whether they are in a new economy.

Reserve. Many good things will follow: real wages and living standards will rise rapidly, the Federal Reserve will be able to cut interest rates and expand the money supply more quickly without boosting inflation, and the stock market will boom unto eternity.

As best as I can tell, this group of returning pilgrims seems to have failed to recognize the importance of the word *measured* in the phrase "measured economic growth." They insist that true economic growth is greater than measured economic growth. And they are right: thanks to a large number of statistical and measurement problems that are built into our official economic statistics, "measured" economic growth understates real growth by one percentage point per year or so.

But these pilgrims overlook a crucial fact: official data have *always* understated growth. For more than 50 years, the national-income accountants at the Commerce Department have known that their numbers don't capture all the economic benefits flowing from inventions and innovations in the economy's leading sectors. Yet they have continued to follow their established procedures, partly because they lack the information to do a better job and partly because they prefer to report numbers they can count reliably rather than numbers that are based on guesswork. The problems of measurement today are probably bigger than in the past, but not vastly bigger.

This means that the numbers we use in steering the economy have not suddenly developed huge distortions that require a change in navigation. The data have always been distorted, yet have supplied adequate guidance. How would we tell if they were not reasonably accurate? How would we tell if economic growth were too slow? One guide would be the rate of investment: are bad economic policies stealing capital that should be going to expand the productive capacity of the economy? While one can argue that the budget deficits of the 1980s hobbled economic growth by crowding out investment, the budget deficits of the Reagan and Bush administrations are now gone. But if, as the new economy enthusiasts insist, productive capacity were growing faster than production, businesses would be firing workers on a large scale: unemployment would be increasing as firms used technology to economize on labor. Yet nothing like that is happening. The unem-

ployment rate is low and steady—a good indicator that the economy, now expanding at a measured rate of about 2.5 percent annually, is growing at the sustainable rate of its productive potential.

III

Nevertheless, despite the hype, delusion, and misunderstandings that surround the "new economy," it would be unwise to completely dismiss the concept. The pilgrims are not mad. They have seen something.

While it is true, for example, that the economic drama of the rising microelectronics and telecommunications industries resembles the stories of other leading sectors, the pace of productivity improvement today does appear to be faster than in most, if not all, cases in the past. And this productivity edge often does escape measurement.

For an example from telecommunications, look at the spread of network television throughout America, which began in the 1950s. In its heyday, network television dominated American culture—as, in some ways, it still does—occupying perhaps a fifth of the average American's leisure hours. But nobody ever paid a cent to receive network television. So its product received—and still receives—a value of zero in the national income and product accounts used to calculate the nation's gross domestic product (GDP).

The salaries and profits of the networks, of the production studios, of the actors, and of the advertising managers do appear—but they appear as a cost of the production of the goods being advertised, not as an increase in the economic value produced. In other words, the growth of broadcast television increased the size of the denominator in productivity calculations, but not the size of the numerator. Each worker who moved into the network television industry (broadly defined) thus decreased officially measured productivity.

For a contemporary example, look at the Internet: a source of entertainment and information that does not (or does not yet) rival network television, yet is assessed the same way. Consumers pay a toll to telephone companies and to Internet service providers in order to access the network. But then the overwhelming bulk of information is free (and is likely to remain so in the future). Once again the national income accountants at the Department of Commerce are, when they estimate real GDP, subtracting one-tenth of a percent from American productivity for each one-tenth of a percent of the labor force employed in creating and maintaining the World Wide Web.

The pilgrims are also right insofar as this particular leading sector may indeed have broader consequences for the economy, at least over the very long run, than other leading sectors of the past. Other leading sectors have revolutionized conditions for relatively small groups of people. In the 19th century, the automatic loom bankrupted handloom weavers, who wove cloth in their homes, and transformed the weaving business from one in which lone entrepreneurs rode from village to village dropping off yarn and collecting cloth to an industry dominated by

large factories and powered by steam engines. But it left the conditions of life of others largely unchanged, save for the significant fact that clothing became much cheaper. Today's leading sectors, however, might—but might not—radically change the conditions of life of nearly everyone: those who use information to direct enterprises (managers), who process information in their jobs (white-collar workers), and who use information to decide what to buy (consumers).

But why should the fact that today's leading sectors revolutionize the production and distribution of information make a difference? Why is information special? The new economy's advocates give a number of answers emphasizing the limitless possibilities of an economy dominated by goods that are almost impossibly cheap to produce and distribute. But there is one answer they don't give: it is special because the invisible hand of the market may do a much poorer job of arranging and controlling the economy when most of the value produced is in the form of information goods.

For the past 200 years, relying on competitive markets to produce economic growth and prosperity has, by and large, proven a good bet. But the invisible hand of the market does a good job only if the typical commodity meets three preconditions. The commodity must be *excludable*, so that its owner can easily and cheaply keep others from using or enjoying it without his or her permission. It must be *rival*, so that if I am using it now, you cannot be. And it must be *transparent*, so that purchasers know what they are buying.

Commodities that are not "information goods" take the form of a single physical object—hammers, cars, steaks—and are rival and excludable by nature. If I am using my hammer, you are not. Their transparency is straightforward: if I am buying this car at this showroom, I can see it, touch it, drive it, and kick it before writing a check.

But if a commodity is not excludable—if I, the owner, cannot block you from using it if you have not paid for it—then my relationship to you is not the relationship of seller to buyer, but much more that of a participant in a gift exchange: I give you something, and out of gratitude and reciprocity you give something back to me. Think of an economy run like a public radio pledge drive. It doesn't work very well—the revenue raised is a small fraction of the value gained by consumers—and the process of collecting the revenue is very annoying.

If a commodity is not rival, then the market will not set its price correctly. If my using it does not keep you from doing so, as is the case with software and other information goods, then there is a sense in which its price should be zero. But no producer can make a profit selling a commodity at a price of zero. Only a producer with substantial market power can keep the price up. So in a world of nonrival commodities, we could expect monopoly to become the rule rather than the exception.

The logic of nonrival goods provides a large part of the explanation for the rise of Microsoft. Only firms that establish a dominant position in their markets can charge enough to make even normal profits. Firms that don't do so plunge into a downward spiral: with low sales volume and costs of writing software code that remain the same no matter whether they sell

one copy or one million, their cost per program shipped is high.

If a commodity is not transparent, then markets may fail completely. If you don't know what's in that used car or health insurance policy you are considering, you don't know how much it is really worth. Sellers also need transparency. An insurer required to sell health insurance policies without knowing anything about its customers would face a nightmarish prospect. Worrying that all potential customers would already have costly illnesses, it would raise prices—until in fact only those who had costly illnesses would want to try to buy insurance. The market would break down. Yet information goods are highly nontransparent: in the case of many or most information goods, the entire point of buying something is to learn or see something new—and so you cannot know exactly what you are buying or how much you will like it until after the fact.

The wave of the future? The U.S. Department of Justice filed a major antitrust lawsuit against Microsoft earlier this year when the company bundled Windows 98 with its own Web browser.

All three of these conditions—goods must be excludable, rival, and transparent—must be met if the invisible hand is to work well, and there are many reasons to be concerned that the new economy won't meet them.

Words distributed in electronic form (and, with improvements in scanner technology, words distributed in books and magazines as well) are becoming nonexcludable. Information goods are by definition nontransparent: if you know what the piece of information is that you are buying, you don't need to buy it. Software is becoming non-transparent as well: when you purchased Microsoft Word or WordPerfect for the first time did you realize that you were committing yourself to a long-run path of upgrades and file-format revisions? Finally, computerized words, images, and programs are nonrival: a file doesn't know whether it is the second or the two-thousandth copy of itself.

How far will the breakdown of these preconditions of viable profit-making markets extend? Will it be confined to a relatively small set of e-goods, or will it expand to embrace the rest of the economy as well? We do not really know. But it is possible that we are moving toward an information age economy in which the gap between what our technologies could deliver and what our market economy produces will grow increasingly large as companies devote themselves increasingly to securing monopolies. It is possible—although how likely we do not know—that in an information age economy the businesses that enjoy the most success will not be those that focus on making better products but those that strive to find ways to induce consumers to pay for what they use. Some may succeed through superior advertising campaigns, others by persuading consumers to enter into a gift-exchange relationship: the public radio syndrome. Recently, after downloading a demonstration version of a software maker's flagship product, I received an e-mail from the company's marketing department. It said that while the program was billed as a time-limited demonstration version that would stop working after 60 days, it was in fact a complete and unencumbered working program. The company hoped that I would find it valuable enough to pay for and register. But even if I didn't, the message said, the company would be pleased if I would tell my friends how wonderful its program was.

Other companies will follow a different strategy. Rather than giving their product away in hopes of receiving payment in return, they will try to make money by suing everybody in sight. They will seek to use the law to create stronger legal controls over intellectual property—everything from software to films—and spend freely to track down those who are using their products without paying for them. From society's point of view, this is a wasteful path—driving up profits, dampening demand, and reducing consumer welfare.

If the information age economy winds up looking much like the one sketched here, the role of government, far from shrinking into near irrelevance, as many of today's pilgrims airily assume, might grow in importance. In such a world, the tasks of government regulators would become infinitely more difficult. The very nature of the commodities produced would be constantly undermining the supports the market economy needs in order to function well. It would then be the job of government to shore up these supports: to do whatever it could to create a simulacrum of market competition and to restore the profitability of useful innovation. The Antitrust Division of the Justice Department might become the most important branch of the federal government.

This vision of the future information age economy—if it should become reality—would certainly qualify as a new economy. But it would be a dark mirror image of the new economy we hear so much about today.

Chronologically Incorrect

by Edward Tenner

Seventy years ago, W. I. Thomas and Dorothy Swaine Thomas proclaimed one of sociology's most influential ideas: "If men define situations as real, they are real in their consequences." Their case in point was a prisoner who attacked people he heard mumbling absent-mindedly to themselves. To the deranged inmate, these lip movements were curses or insults. No matter that they weren't; the results were the same.

The Thomas Theorem, as it is called, now has a corollary. In a microprocessor-controlled society, if machines register a disordered state, they are likely to create it. For example, if an automatic railroad switching system mistakenly detects another train stalled on the tracks ahead and halts the engine, there really will be a train stalled on the tracks.

Today, the corollary threatens billions of lines of computer code and millions of pieces of hardware. Because they were written with years encoded as two digits (treating 1998 as 98), many of world's software programs and microchips will treat January 1, 2000, as the first day of the year 1900. Like the insane convict, they will act on an absurd inference. For purposes of payment, a person with a negative age may cease

to exist. An elevator or an automobile engine judged by an embedded microprocessor to be overdue for inspection may be shut down. All of our vital technological and social systems are vulnerable to crippling errors. Correcting programs requires time-consuming close inspection by skilled programmers, custom-crafted solutions for virtually every computer system, and arduous testing—and time is running out.

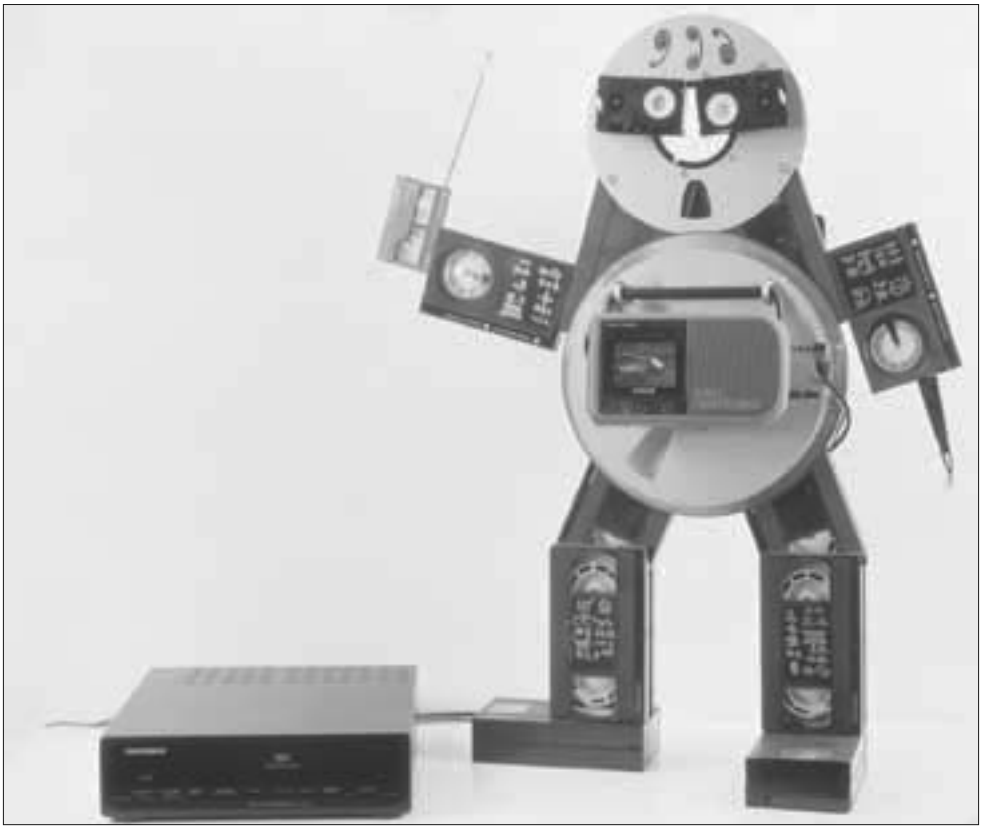
Nobody denies the hazards. And as we will see, if only because of the original Thomas Theorem, the Year 2000 Problem is already upon us. The unsettling question is just how serious it will remain after more billions of dollars are spent between now and then correcting and testing affected systems—fully 1,898 in the U.S. Department of Defense alone, and hundreds of thousands of smaller computer networks if those of small businesses are included. Will the first days of the year 2000 be just a spike in the already substantial baseline of system failures recorded in professional forums such as the Risks site on the Internet? That might be called the fine mess scenario. Or will it be a chain reaction of self-amplifying failures—the deluge scenario?

Warning, diagnosing, correcting, testing, certifying, and testifying about the Year 2000 Problem, increasingly abbreviated as Y2K, is the mission of a new computer specialty that might be called Y2Kology. Few of today's Y2Kologists were familiar to readers of the consumer computer press even five years ago, though Edward Yourdon had written influential books on programming and Capers Jones was a leading network management consultant. Few teach in the largest and oldest academic computer science departments or business schools. The hardware and software establishments regarded the problem as tedious housekeeping in the emerging frictionless networked economy. All that is changing as Y2Kologists begin to make headlines.

Because Y2Kology mixes evangelism, prophecy, and entrepreneurship, its message has not won easy acceptance. The financial news magnate Michael Bloomberg called the Year 2000 Problem "one of the greatest frauds of all time" at a meeting of securities traders last year. As late as last spring, the Bank of Montreal predicted only a "mild blip," and a mid-1998 survey of chief financial officers of companies with more than 20 employees revealed that only 17 percent were very concerned, and 48 percent were unconcerned.

Read closely, Y2Kologists share no consensus on how severe the Y2K dislocations are likely to be. Edward Yardeni, chief economist of the Deutsche Morgan Grenfell investment bank, now estimates that the odds are strongly in favor of an economic recession as serious as the one triggered by the 1973–74 oil shock. But an acknowledged aim of alarming predictions, as in George Orwell's *1984*, is to galvanize people into action that will prevent the worst. As of mid-1998, many leading

> Edward Tenner, *a former Wilson Center Fellow, is a visitor in the Department of Geosciences at Princeton University. He is the author of* Tech Speak *(1986) and* Why Things Bite Back: Technology and the Revenge of Unintended Consequences *(1996).*



Fin de Siècle Man *(1992), by Nam June Paik*

Y2Kologists, including the Canadian consultant Peter de Jager and the American academic Leon Kappelman, were arguing that if organizations concentrated on their essential systems and deferred other work, massive failure could still be averted. Edward Yourdon and his daughter Jennifer Yourdon have written a guide for coping with a variety of plausible scenarios, which in their view range from a two-to-three-day disruption to a 10-year depression. And a few panicky Y2K programmers are retreating to the western deserts—the very area most dependent on electronically controlled federal water distribution systems.

One thing is certain: the apprehension is real, and will have real consequences. Just as the fear of nuclear war and terrorism has transformed the world over the last two generations, so the mere possibility of massive system failure will cast a shadow over its political, military, business, and scientific rulers for years to come. Year 2000 is less a crisis of technology than a crisis of authority.

For at least a century the West has expected, and received, orderly technological transitions. Our vital systems have grown faster, safer, and more flexible. Boiler explosions, for example, killed as many as 30,000 Americans a year around 1900; today, only a handful die in such accidents. The reduction was the result of cooperation among engineers, state legislators, and industries to establish uniform codes and inspection procedures in

place of patchwork regulations and spotty supervision. Well before the sinking of the *Titanic* in 1912, national and international bodies had made transatlantic travel much safer than it had been in the age of sail. Railroads long ago arrived at standards for compatible air brake systems that allowed passenger and freight cars to be safely interchanged. And evolving engineering standards have helped reduce accident levels on the nation's interstate highways. But no comparable effort has been made to cope with the Y2K problem.

Most consumers pay little attention to the hundreds of national and international standards-setting bodies. Only when major commercial interests are at stake, as when specifications are established for high-definition television or for sound and video recording, do the news media report on debates. Laypeople are rarely present at standards-setting deliberations. Before the early 1980s, many conventions were handled mainly as internal corporate matters. AT&T established exchange numbers and area codes, and IBM and a handful of other manufacturers upgraded operating systems of their mainframe computers. And why should people worry? The record of these organizations was unmatched in the world. A Henry Dreyfuss-designed, Western Electric-manufactured rotary telephone could work for a generation without repair. The future seemed to be in good hands.

The breakup of AT&T, the explosion of utilities competition, the globalization of manufacturing, and the rise of personal computing have all helped diffuse authority over standards. And freedom from regulatory entanglement has brought immense benefits to manufacturers, consumers, and the economy. But it has had an unintended consequence. The diversity of systems and the fierceness of business rivalries discourage public and private technological authorities—from the Defense Department to Microsoft—from taking firm and early action to cope with emerging problems. (A fear of antitrust prosecutions has also inhibited Year 2000 cooperation among corporations, enough so that President Bill Clinton felt compelled in July to propose special legislation to clear the way.) Governments have avoided interference in commercial decisions, and businesses have succeeded more by following market shifts than by staking out ambitious new standards. As the Thomas Theorem implies, if people do not believe they can exert power or influence, then they cannot. Which brings us to "the millennium bug," which is no bug at all.

Over the last four decades, the Year 2000 Problem has passed through three phases, each bringing its own challenges for authorities. The first age, the Time of Constraint, lasted from the origins of electronic computing to the early 1980s. The managers and programmers of the time knew that programs using only two-digit years had limits. Many must have been aware of the master programmer Robert Bemer's early-1970s article in the industry journal *Datamation*, describing the Year 2000 Problem in the COBOL programming language he had codeveloped. These electronic pioneers could have used four-digit dates, but there was a strong economic case for two. In fact, the U.S. Air Force

used single-digit dates in some 1970s programs and had to have them rewritten in 1979.

Leon Kappelman and the consultant Phil Scott have pointed out that the high price of memory in the decades before personal computing made early compliance a poor choice. In the early days of computing, memory was luxury real estate. A megabyte of mainframe hard disk storage (usually rented) cost $36 a month in 1972, as compared with 10 cents in 1996. For typical business applications, using four digits for dates would have raised storage costs by only one percent, but the cumulative costs would have been enormous. Kappelman and Scott calculate that the two-digit approach saved business at least $16–$24 million (in 1995 dollars) for every 1,000 megabytes of storage it used between 1973 and '92. The total savings are impossible to calculate, but they surely dwarf most estimated costs of correcting the Year 2000 problem. (One leading research group, the International Data Corporation, estimates a correction cost of $122 billion out of more than $2 trillion in total information technology spending in the six years from 1995 through 2000.)

Sometimes linked to apocalyptic anxieties about the millennium, the Y2K problem is beginning to produce a crop of alarmist pop-culture products.

Even where Year 2000 compliance was feasible and economical, it wasn't always in demand. In the 1980s, a number of applications programs were available with four-digit dates, such as the statistical programs and other software systems produced by the SAS Institute, one of computing's most respected corporations. SAS does not appear to have promoted it competitively as a major feature. The UNIX operating system, originally developed at Bell Laboratories, does not face a rollover problem until 2038, yet this too did not seem to be a selling point. Even Apple Computer did not promote its delayed rollover date of 2019. The year 2000 still seemed too far away.

By the mid-1980s, the Time of Choice was beginning. The economic balance—initially higher storage and processing costs versus long-term savings in possible century-end conversion costs—would have still been an open question, had it been openly raised. The great majority of

crucial government and business applications were still running on mainframe computers and facing memory shortages. But the trend to cheaper memory was unmistakable. The introduction of the IBM PC XT in 1983, with up to 640 kilobytes of random access memory (RAM) and its then-vast fixed hard drive of 10 megabytes, was already signaling a new age in information processing.

Yet the possibilities presented by the new age remained an abstraction to most computer systems managers and corporate and government executives. Then as now, most of their software expenses went not to create new code but to repair, enhance, and expand existing custom programs—what are now called "legacy systems." A date change standard would initially increase errors, delay vital projects, and above all inflate budgets. And it was not a propitious time to face this kind of long-term problem. The American industrial and commercial landscape during the 1980s was in the midst of a painful transformation, and investors appeared to regard most management teams as only as good as their last quarter's results. Only the mortgage industry, working as it did on 30-year cycles, had recognized the problem (in the 1970s) and begun to work on it.

In 1983, a Detroit COBOL programmer named William Schoen tried to market a Year 2000 conversion program he had created. A sympathetic column about his warnings in a leading trade weekly, *Computer World*, went unheeded. Schoen went out of business after selling two copies.

Not that government was much more prescient. The Federal Information Processing Standard of the National Institute of Standards and Technology (NIST) for interchange of information among units of the federal government specified a six-digit (YYMMDD) format in 1968 and did not fully change to an eight-digit (YYYYMMDD) format until 1996. The Social Security Administration was the first major agency to begin Year 2000 conversion, in 1990. Despite the impressive military budget increases of the 1980s and the Pentagon's tradition of meticulous technical specifications for hardware, many vital Defense Department systems still require extensive work today.

The computing world of the 1990s recalls a multimedia trade show display decorated at great expense and stocked with the best equipment money can buy, yet still dependent on a hideous, half-concealed tangle of cables and power lines, with chunky transformer blocks jutting awkwardly from maxed-out surge protectors. Our apparently seamless electronic systems turn out to be patched together from old and new code in a variety of programming languages of different vintages. The original source code has not always survived. Year 2000 projects can turn into organizational archaeology.

The German philosopher Ernst Bloch popularized the phrase *Gleichzeitigkeit des Ungleichzeitigen*, literally "simultaneity of the nonsimultaneous," to express the coexistence of old and new values. Far from being dead, the past (in William Faulkner's even more celebrated words) sometimes is not even past. Indeed, in Faulkner's native South, much of the

cotton trade is said to rely on ancient IBM punch card systems now maintained by arcane specialty vendors. In the United Kingdom, the Royal Air Force's supersonic Tornado fighters, costing £20 million each, are still equipped with 256 kilobytes of core memory, with processing data recorded on standard audiocassettes. This seemingly obsolete system not only performed magnificently in the Persian Gulf War but is considered impervious to conventional electronic jamming techniques. Year 2000 repair confronts us with many such examples of coexistence.

The Time of Choice ended in the early 1990s, when leading computer industry publications prominently recognized Year 2000 conversion as a problem and warned of the consequences of neglecting it. Peter de Jager's September 1993 *Computerworld* article, "Doomsday 2000," may not have been the *Silent Spring* of Y2Kology, but it was fair warning. Writing in *Forbes* in July 1996, Caspar W. Weinberger, chairman of Forbes, was probably the first prominent business figure to underscore the seriousness of the problem (though, curiously, the former secretary of defense said nothing about the Y2K dilemmas confronting the public sector).

The Time of Trial began in the mid-1990s, as conversion programs began in earnest and Y2K issues were increasingly aired in the computer press. It will probably last until around 2005. A few annoyances are already apparent. Credit cards with 2000 expiration dates, for example, have been rejected by some authorization systems. Many critical points will arrive in 1999, with the need to reset some older Global Positioning System (GPS) equipment, for example, and especially with the beginning of fiscal year 2000 for many governments and private-sector organizations.

During the Time of Choice, the problem was recognized but deferred for two reasons. First, there was the chance that entire computer systems would be replaced before 2000. Second, future software tools might reduce conversion costs sharply. In 1988, a senior Defense Department computer systems official told the *Chicago Tribune*: "Our projections for the development of artificial intelligence systems suggest that by 1994 and 1995, they may be able to handle most of this relatively easily." Yet 10 years later, a congressional committee heard one expert give the Pentagon an "F" for its Year 2000 readiness. In the civilian sector, too, older hardware and software is far more pervasive than many experts anticipated. It may also be too late for most businesses to replace their vulnerable systems; programmers are scarce and expensive, and conversion can take years to complete.

Speaker of the House Newt Gingrich (R.-Ga.), publisher and likely Republican presidential contender Steve Forbes, and other prominent Republicans are exploiting the Clinton administration's failure to address the problem earlier. How could self-styled technology advocates such as Vice President Al Gore have turned a blind eye to a threat of such magnitude? Embarrassed as Gore might turn out to be by a series of government computer failures in early 2000, and shy of the Year 2000 issue as he has lately appeared, congressional Republicans have no better track record. For example, during hearings about the Internal Revenue Service's computer

system woes in 1996, Senator Ted Stevens (R.-Alaska) cited "advice from a very distinguished thinker" to the effect that problematic computer systems would be replaced by 2000. Only in early 1997 did the Republican-controlled Congress's own auditing arm, the General Accounting Office, upgrade Year 2000 to its most serious category of issues. The other organization that might have dealt with the issue, the Office of Technology Assessment, was abolished by Congress in 1995. In fact, the legislators with an interest in the problem are a small group that includes members of both parties, among them senators Robert Bennett (R.-Utah) and Daniel Patrick Moynihan (D.-New York).

Computer industry executives, from Microsoft's William Gates on down, also missed opportunities. When Microsoft introduced Windows 95—a two-digit name—in the summer of that year, it required developers to meet a variety of compatibility standards before they could display the Win95 logo. (For example, the procedures for removing a program and its associated files from a hard drive had to be simplified.) Continued functionality after four and a half years was not one of these requirements. Even in mid-1998, some of Microsoft's own software products may have at least minor problems associated with the date change. Microsoft has been at least as responsible as most other companies, probably more so. Yet Gates published his book *The Road Ahead* (1996) without a discussion of the Year 2000 Problem; in a July 1996 column, he appeared unaware that a number of popular current personal computer programs were affected. (Most problems with programs on non-networked personal computers can be solved relatively easily, often with a simple upgrade.)

If the coexistence of past, present, and future was the discovery of the Time of Choice, *triage* is becoming the watchword of the Time of Trial. Fortunately, information technologies are not created equal. Some organizations have hundreds or even thousands of computer systems, but only a minority are vital and only a few may be critical. In 1998 it is too late to fix everything, even with emergency budgets and the mobilization of computer-skilled employees from other departments. As the project management guru Frederick P. Brooks pointed out in his classic *Mythical Man Month* (1982), adding programmers to a late project can actually delay it further. In a complex interconnected system, more things can go wrong.

In the Time of Trial, triage will not be the only military metaphor. Many other information technology projects will be suspended or canceled as programmers are called up for the front. Careers will be damaged and entire organizations will be set back. Well-prepared companies will gain strategic advantages. Yet so far, financial markets have not been able to identify Year 2000 winners and losers. A study by Triaxys Research showed that as of June 1998 many companies had not completed Year 2000 assessments, much less undertaken efforts to correct their problems. Investors still do not have adequate information.

Despite these gaps, there is reason to hope for a fine mess rather than a deluge. Some banks and investment houses have reported mak-

Moon, Antares, Earth, Sun *(1990), by Nam June Paik*

ing good progress on their systems. A Wall Street dry run of Year 2000 trading last July seemed to go well. Improvements of Year 2000 software tools may shorten the time needed to make repairs. Indeed, the military metaphor provides a measure of reassurance. For all the shortcomings of British and American policy and planning during the years between the world wars, for example, Allied scientists and engineers performed miracles once war broke out.

Some dangers will persist despite the efforts of even the most resourceful managers. Realization of any one of the five most ominous threats could validate the doomsayers' predictions. These risks might be abbreviated as SMILE: second-order effects, malicious code, interdependencies, litigation, and embedded processors.

Thomas's Theorem suggests that the expectation of a Year 2000 crisis may be enough to create a real one no matter how effective the efforts to repair the underlying code. Our social and technological systems are more efficient than ever, but because, for example, information technologies now allow vendors and manufacturers to maintain lean warehouse inventories, slight disruptions can have more serious repercussions. Running the gamut from shifts of investment funds based on Internet-transmitted rumors about the Year 2000 readiness of particular companies, to depletion of bank and automatic teller machine currency supplies, to runs on bread and toilet paper, a late 1999 panic might be comical but also potentially deadly.

Add potential sabotage to the equation. The Pentagon already wor-

ries about information warfare and terrorism. Hostile states, criminal organizations, and domestic and foreign radical movements can already attack vital networks. The beginning of the year 2000 is a perfect cover. Do not forget embezzlers and vengeful staff. An apparently Year 2000-related incident could mask electronic robbery, and a continuing shortage of skilled personnel could delay diagnoses for priceless months. Computer security experts also fear fly-by-night Y2K consultants who may collude with corrupt managers to offer bogus certification, or plant Trojan horse programs in the systems of honest but desperate ones.

Thanks to decades of global thinking, North America and Europe are also linked to nations whose Year 2000 readiness makes many Western nations look like paragons. The Asian financial crisis that began last year has surely delayed the compliance programs of some major trading partners of the United States and Europe. International interchange of data may send a failure in one country rippling through the most rigorously Year 2000-ready systems: the sociologist Charles Perrow calls this "tight coupling." Major corporations are already pressing their trading partners for certification of their Year 2000 compliance. Domestically, this may make or break some firms, but it will not bring down the economy. Internationally, it may trigger local crises that might lead to mass migrations or insurrections.

The courts have only begun to consider legal liability for Year 2000 failures. The cases already on the docket will test one of the law's principles: to decree retroactively but to create predictability. Because Year 2000 cases will raise new questions and provoke immense claims, the litigation will be prolonged and sometimes ruinous.

The most serious wild card of all, though, is a hardware issue. Most discussions of the Year 2000 Problem focus on the difficulty of repairing and testing software, but that is a cinch compared to dealing with the thousands of embedded microchips that control critical systems. The Gartner Group estimates that 50 million embedded devices may malfunction. Traffic signals and freeway entrance metering lights will fail. Elevators will shut down if their electronic hardware tells them they have not been inspected for nearly a hundred years. (The largest elevator manufacturers deny their products are vulnerable to Y2K failure.) Electric power distribution switches and pipeline controls will interrupt energy flow. Medical x-ray machines will not turn on—or far worse, off—at the proper times.

(There is an alternative final E in SMILE: the euro, the new European currency scheduled for introduction in 1999. Conversion of existing financial programs and historical data for euro compatibility competes for scarce programming time with Year 2000 conversion projects, and bugs in new and revised financial software may compound Year 2000 errors.)

No matter what its outcome, the Year 2000 Problem will stamp a cohort of managers, private and public, as it will put some of their predecessors on trial. Generation X will become Generation YY. Like other powerful events, Year 2000 will alter culture. But we don't know how, because it will have many surprises, positive and negative, for even today's most informed analysts.

The Year 2000 Problem shows that neither military nor civilian authority, neither social democracies nor authoritarian regimes nor market economies, neither big business nor small business, took fully adequate steps in planning for the future. And now, those seeking to discredit all established elites are coming into their own. Gary North, a Ph.D. historian and founder of the Institute for Christian Economics, not long ago was a prolific but obscure lay theologian criticized by some mainstream evangelical conservatives for his mix of radical theocracy and financial doomsaying. Now enjoying the survivalist good life on an Arkansas property with a private natural-gas well, he runs the Internet's scariest Y2K Web site, deftly collating the most frightening speculation available from establishment sources.

The future prestige of technological leaders is as problematic as the fate of political elites. Bill Gates apparently has never responded publicly to Peter de Jager's impassioned plea in the August 1997 issue of *Datamation* for a formal declaration of the urgency of action on Year 2000. A surprising number of nontechnical people still expect that Gates will find a way to fix the problem. Paradoxically, surveys of public opinion, independent of the millennium issue, have shown least public confidence in the insurance industry and greatest confidence in executives in the technology industries, yet insurers may well emerge less damaged in the early 2000s than some of the software producers. Prudential is often cited as an exemplary pioneer of conversion management.

Supposedly insulated from market pressures and encouraged to take the long view, universities seem to be as badly exposed to Year 2000 troubles as other organizations. Nor did any of the leading engineering, scientific, or business associations, or the best-funded think tanks, sound any early warning that I have been able to find. A few journalists did bring the issue to their readers' attention as early as the 1980s.

If centralized technological planning is discredited, if the discipline of markets (such as securities analysts' reports and insurance underwriters' risk assessments) has failed to give timely warning that cannot be ignored, what is left? Perhaps it is the realization that technology is not just a radiant future but a messy present, that the age of transition never ends, and that rapid novelty and massive legacy can interact to create lethal assumptions. The first of January 2000 will not be the first danger point, and it will be far from the last. Nobody can predict just what lessons will be learned, what concepts introduced, which individuals acclaimed. The outcome of Y2K will change everything, but if we already knew what will be changed, there would have been no Year 2000 crisis, only a problem.

Present at the Creation

by Leslie D. Simon

The new very broadband high capacity networks . . . ought to be built by the federal government and then transitioned into private industry.
—Vice President-elect Al Gore, at the December 1992 postelection economic summit in Little Rock

Private sector leadership accounts for the explosive growth of the Internet today, and the success of electronic commerce will depend on continued private sector leadership.
—"A Framework for Electronic Commerce" (July 1997), a White House policy paper written by Ira Magaziner with advice from Vice President Gore's staff

It was an extraordinary turnabout. In the space of the four and a half years between these two statements, the most technology-literate administration in American history reversed itself on one of the century's more important technological questions. It wasn't a political change of heart that turned Bill Clinton and Al Gore around but a recognition that they were dealing with something vastly greater than

they had imagined only a few years earlier. And that "something greater" now urgently confronts the United States and other countries with important choices.

During his years in Congress, Vice President Gore had championed critical advanced research by the government in new information and communications technologies. He liked to remind people that his father, as a senator from Tennessee, had played a key role in the construction of the interstate highway system during the 1950s and '60s—a new national transportation infrastructure that transformed the American economic and physical landscape, creating millions of jobs in road and housing construction, shopping malls, and countless other enterprises. The vice president would go on to say that now the government needed to create an infrastructure for the next century—an information infrastructure built on the foundation of government programs such as the multibillion-dollar High Performance Computing and Communications Initiative.

The World Wide Web still lay over the horizon when Vice President-elect Al Gore spoke of a government-backed "information superhighway" at Little Rock in 1992.

Government efforts had played an enormous role in the birth of the Internet and its underlying technologies, from packet switching to integrated circuits. ARPANET, the original backbone of the Internet, and NSFNET, which later superseded it, were designed chiefly for the defense community and scientific researchers. Both were creatures of the federal government. But the logic of governmental leadership was overtaken by events. By 1994, in the digital equivalent of the Big Bang, cyberspace was exploding out of its original narrow confines. Suddenly, the Internet was alive with commerce, business, entertainment, education, art, and, yes, pornography.

The spark was provided by the creation of the World Wide Web, an Internet graphic tool that greatly simplified the task of retrieving and viewing information. Invented by Tim Berners-Lee at CERN, the European high-energy physics research laboratory, the Web came to life in 1993 when a University of Illinois student named Marc Andriessen released a software program called Mosaic, the parent of Netscape Navigator. Now,

instead of entering obscure instructions by keyboard and staring at screens full of monotone type, users were able to steer through a universe of words, images, and sounds with the click of a mouse button. Within an amazingly short time of perhaps eight "Web years" (Silicon Valley denizens measure time in Web years—there are four in each chronological year), office workers, high school students, retirees, physicians, and even a few politicians were sending e-mail, setting up Web sites, and surfing the Web. Suddenly, every television and magazine advertisement boasted a URL (universal record locator), or Web site address.

With efforts such as Gore's Reinventing Government program, the Clinton administration moved quickly to capitalize on the new technology, launching Web sites, for example, that eased citizens' access to government agencies. It also tried to keep government in the forefront of research. When a consortium of universities and high-technology companies in 1997 announced a joint effort to create Internet 2, a faster, advanced version of the Internet with enough bandwidth to carry the huge data files involved in scientific research, videoconferencing, and other specialized undertakings, the administration announced its Next Generation Internet program, offering researchers federal grants and underwriting research projects by government agencies.

But the Internet tsunami moved too quickly for the government to stay in front. In July 1997, the administration's "Framework for Electronic Commerce" announced the new policy: the private sector would lead the development of electronic commerce.

At the time, few saw the document as remarkable. We live, after all, in a time when the virtues of market-led development seem increasingly self-evident in the United States and abroad. But imagine the reaction if Theodore Roosevelt had called for the oil or sugar industries to be self-regulating. Or even if Ronald Reagan had called for industry to regulate cyberspace.

What the administration (and others) correctly realized, however, is that creating cyberspace is an undertaking almost without precedent. We are in effect creating a new world, a world that is virtually unbounded by physical laws, legal jurisdictions, and international borders. To leave the shaping of that world primarily to government agencies would have been folly.

Cyberspace offers industry opportunities of a kind never seen before. The modern oil industry, for example, grew out of the aggressive entrepreneurship of industry titans such as John D. Rockefeller and the intervention of governments concerned about monopoly and national security. A wrong turn—say, government policies that drove the price of gasoline sky-high or created scarcity—would have given us a very different world from today's highly mobile car culture, with its suburbs, interstates, shopping malls, and McDonald's drive-throughs. Yet, physical

> Leslie D. Simon, *a Wilson Center Public Policy Scholar, is a retired IBM senior executive who has worked with governments around the world on high-technology issues. A member of the State Department's Advisory Committee on International Communications and Information Policy, he is currently working on a book about the digital age.*

The death of distance: videoconferencing allows doctors in Canada and India to consult. Bandwidth limitations and other barriers must be overcome before such technologies become widely available.

facts limited the power of industrialists and politicians alike to determine the oil industry's future: petroleum deposits exist only in certain places and in certain quantities, and crude oil can be refined into gasoline only through chemical processes that obey physical laws. The supply would never be endless.

Today, in creating cyberspace, the physical limitations are far fewer. Cyberspace is almost entirely a creation of the mind—a vast and still largely blank slate awaiting the spark of human ingenuity. That is not to say that there is no role for government. Indeed, the choices that governments and the private sector make will almost alone determine what gets written on the slate. Those choices must be made soon. The very freedom of cyberspace from physical laws, its borderless nature, and its frenetic growth all mean that profoundly important choices must be made over the next decade. If we fail to make them in time, they will be made for us, by default.

The physical constraints on cyberspace are shrinking all the time. True, one must still view the data, graphics, or video on a flat panel or cathode-ray tube; type on a keyboard or wield a mouse; and make contact with others through webs of copper wire, optical fiber, coaxial cable, satellite dishes, and electronic switches. Yet while these physical artifacts make cyberspace possible, they do not define it, and, increasingly, do not limit its potential. High-tech companies today are racing to reduce even further our physical connections to the digital world, using techniques such as voice recognition and hand signaling. The growing global network of computers and other hardware is opening up a vast array of uses. The Internet can take the place of a post office, a telephone, a broadcast

studio, an insurance agent, a sound recording, a movie theater, an automobile dealership—almost anything anybody can imagine.

As the physical infrastructure of cyberspace fades into the background, what is important is what you see and hear and how you use it. The medium is no longer the message. In cyberspace, media can take on any form—video, print, graphics, or sound—at the whim of the user. As media converge, they become fungible background elements. Their distinctiveness is rapidly disappearing. The sharp line that existed between television and print media when Marshall McLuhan examined them earlier this century is fading rapidly. Content is now king.

National boundaries also fade into near irrelevance in the digital universe. An image or article or video created in one country can be viewed elsewhere at any time or as many times as users wish. Banking, shopping, schooling—all can be performed across national boundaries. The only services that are not transnational—at least not yet—are government services. While a Malaysian can buy delicacies from a virtual French shop, or take college-level courses from a Canadian school, he or she cannot apply for French or Canadian social security benefits. In the future, growing demand for just such opportunities may change the very notion of citizenship.

Even the Internet's physical communications web is amorphous and mutable, creating itself without regard to national borders but according to the traffic patterns that packet-switched networks are designed to optimize. These virtual and ever-changing connections are proving too sublime for government regulation. Every frame viewed or service rendered in cyberspace raises questions no nation can deal with in isolation. What if an image is not considered pornographic in one country but is in another? What if a physician in one country diagnoses a patient in another where the physician is not licensed? What if the patient wants to sue the physician for malpractice? And what if the physician's services are taxable in both countries?

A final unique characteristic of cyberspace is the speed of its development. Traffic on the Internet doubles every 100 days. It is estimated that the number of people using the Internet worldwide will grow from 100 million today to more than one billion by 2005. In 1997, there were about 2.7 trillion e-mail messages—many times more than the amount of mail delivered by the world's post offices! The volume of electronic commerce is expected to grow from about $2 billion in 1997 to more than $300 billion in 2002, to more than $1 trillion in 2010.

In the United States and other industrial countries, a good bipartisan start has been made in agreeing on some fundamental principles governing the future of cyberspace, but translating them into specific policies has been more difficult. Even after the Clinton administration announced its new emphasis on private-sector leadership last year, for example, government and industry at first were lost in mutual incom-

prehension. To industry, self-regulation and private-sector leadership initially meant only that it should continue to do what it does best—develop and sell innovative products. It would help Washington clear away policy obstacles to growth in areas such as taxation and commercial law. But that was about it.

To government, self-regulation meant that industry would take the initiative in areas such as protecting the privacy of Internet users and monitoring pornography and other objectionable content (e.g., bomb-manufacturing instructions). There are precedents for this. In the 1960s, when the nation was flooded with dubious advertising claims, the advertising industry, under pressure from the Federal Trade Commission, developed a code of self-regulation that has worked well. Now, the government, besieged by complaints about privacy violations and Internet pornography, was transferring the political heat to leading CEOs such as Intel's Andy Grove, IBM's Lou Gerstner, and Microsoft's Bill Gates. A bit unsure how to proceed—and perhaps a bit reluctant to assume such responsibilities—industry hesitated. Since then, it has begun to step up to the challenge. On the agenda for both government and the private sector are six major issues, with a host of others waiting in the wings:

Privacy: All kinds of personal information, from school records to patient medical data to local real estate and tax records, is now being digitized and made available on the Web. And vast quantities of fresh data are being used and collected through "cookies" (data about your preferences stored in your browser by a Web site you visit), "data mining" by powerful computers that allow merchants to track the buying habits of individual shoppers, and other new technologies. Privacy is now the number one Internet issue. Will individuals have control over how data about them are collected, disseminated, and used? Or will all data be public?

While the United States already has a complex system of privacy laws and regulations, industry could provide more protection tailored to the digital world, and will need to do so to avoid inviting broader government regulation. Indeed, some see government itself as the greatest threat to privacy, and past abuses by the Internal Revenue Service, as well as the Social Security Administration's handling of private information on its Web site recently, do not offer much encouragement to think otherwise.

Industry has begun to respond. The American Bankers Association, for example, has developed a privacy code for member banks, and the Information Technology Industry Council, a high-technology trade association that includes large corporations such as Xerox, Compaq, and IBM, has adopted a code for its members. These codes generally restrict what member companies can do with data they gather about their customers—such as information supplied when consumers fill out loan applications or warranty forms for their new computers—and spell out requirements for notifying the public about their policies. It is even more encouraging that an initial group of 39 companies and 12 trade associa-

tions has formed an umbrella group, the Online Privacy Alliance, to attempt to meld the activities of different industry groups. But these efforts, laudable as they are, just scratch the surface. A more comprehensive private-sector code, international in scope, together with an enforcement mechanism to punish malefactors, will certainly be needed.

Security: People will not make extensive use of the Internet to buy, sell, and borrow unless they can be assured that their credit card numbers and other details of the transaction are secure. Cryptography—coding all transmitted messages—is the principal answer, but it leads to a public-policy question: Cryptography under what terms? That question has stymied Congress and the administration. Business and civil liberties groups want no limits on cryptography, hoping to maximize the security and privacy of online communications. But the Federal Bureau of Investigation and other government agencies, legitimately worried about the uses criminals, terrorists, and others may make of encryption, favor various controls, such as limits on exports of encryption software, or even domestic controls, such as the use of a "back door" in all codes to allow government agencies to decode information under certain circumstances. Congress must end the uncertainty soon or risk greatly retarding the growth of electronic commerce.

Objectionable Content: In 1996, responding to parents alarmed by the ease with which children can find pornography on the Internet, Congress passed the Communications Decency Act, making it a crime to transmit "obscene or indecent" material over the Internet. But the Internet is a more complex place than the legislators realized. In some cases, it resembles television broadcasting, and thus is more susceptible to regulation, while chat rooms and other forms of Internet communication are more like private conversations and thus enjoy the strongest First Amendment protection. In 1997, after the American Civil Liberties Union, the Center for Democracy and Technology, and other organizations challenged the act, the Supreme Court struck it down as unconstitutional. Congress seems uncertain about what, if anything, to do next, and is currently considering laws that prohibit materials that are "harmful to minors," and that require schools and libraries to block children's access to "inappropriate materials." The private sector may hold the solution to this problem. High-tech companies have already written software programs such as Net Nanny and SurfWatch that allow parents to bar access to pornography, and a consortium of companies working with the Massachusetts Institute of Technology has created a standardized tool for achieving the same end, the Platform for Internet Content Selection. Now industry should make a bigger effort to educate parents about what their more technologically nimble children may be doing during all those hours of Web surfing and what they as parents can do to regulate it.

Access: How can we avoid becoming a nation of information haves and have-nots? Computers and Internet connections come with big price tags, and without help, inner-city and rural children, for example, may be shut out. With the advent of telephones earlier in the century, we used regula-

tion to achieve universal service. When television broadcasting arrived in midcentury, we let the market decide who got to watch. Both methods produced near-universal access. Which course should we follow now?

There seems to be agreement in Congress on the need for universal access, but not yet on the means to achieve it. This year, Congress has been trying to force the Federal Communications Commission to stop its program of subsidizing Internet hookups for schools, libraries, and hospitals, after hearing loud complaints from consumers who spotted on their long-distance phone bills a new charge to pay for the $1.2 billion subsidy. Congress, of course, had created the program in the first place. While competition and market forces will play the main role in spreading access by driving prices down, industry and government should both experiment with new ways of opening doors to the Internet—for example, by setting up cyberkiosks in libraries, community centers, and post offices.

Taxation: As more economic activity migrates on-line, politicians and tax collectors are worrying about losing tax revenues—especially those from state sales taxes and, in Europe, national value-added taxes. Who collects the tax when an on-line buyer in Iowa orders a lamp from a computer server in California that is shipped from a warehouse in Holland? How is the tax collected? How do the authorities even know about the sale? The states are beginning to stir—Florida, Connecticut, Texas, and Nebraska are among those examining taxes on Internet service providers. The Clinton administration has called for a moratorium on new Internet taxes, but Congress and the states have yet to agree.

Infrastructure: If the Internet is to reach its full potential, telephone, cable TV, and other companies will need to invest vast sums in switch-

Peering into the future

ing equipment, cable, optical fiber, and satellite networks, along with their underlying software. But the archaic laws restricting competition among such companies has discouraged investment. The Communications Reform Act of 1996, which was meant to spur telecommunications competition and innovation in advanced high-bandwidth services, has so far resulted chiefly in a tangle of court cases and a series of high-profile mergers—among them Bell Atlantic and Nynex, and AT&T and TCI—that may or may not produce the desired results. Congress and the administration need to find new means to separate the advanced technologies of the Internet from the regulatory tangle of the old world of telephony.

Beyond these six key issues are numerous others of a more technical and legal nature: intellectual property, especially copyright, digital contracts and signatures, the future governance of the Internet, and the ownership and value of government information, to name a few. Abroad, uncertainty also reigns on these crucial issues. It was only in February 1995, at a Group of Seven ministerial meeting, that Europe officially accepted the notion that, on balance, cyberspace would create new jobs. Under the forceful leadership of Martin Bangemann, the European Union (EU) Commissioner for Industry, the Europeans, along with Japan and Canada, have also embraced the fundamental premise that Internet development should be driven by the market and the private sector. As in the United States, however, the effort to implement specific policies has been slow.

Elsewhere in the world, there is less cause for encouragement. Singapore, for example, has made an exemplary push to exploit the economic potential of cyberspace, attempting to wire every home in the country with broadband coaxial or fiber-optic cable by 2000. At the same time, however, Singapore censors on-line material and registers Singaporean Web site operators. Governments everywhere feel a strong temptation to closely regulate the on-line world. Some, notably Canada and France, fret about perils they perceive to their language and culture. Autocratic and totalitarian regimes see the borderless Internet as a threat, and some, such as China, would like to limit their citizens' participation to something like a giant private network, with all content and services filtered by government.

Because cyberspace is borderless, trying to draw up laws and regulations in a national vacuum is increasingly an exercise in futility. In 1995, for example, an EU directive required member nations to create national authorities to regulate private-sector privacy policies. But European companies and citizens do business on line in other countries that lack such broad national authorities. Were these international transactions to be prohibited? The EU offered to certify that other countries provide an "adequate level of protection." But who is to say what is adequate? Some countries have no privacy protection at all, including China and some of Europe's other important trading partners. Oddly, the Europeans have chosen to aim their sights at the United States, which has its own sophisticated but confusing

legal system to regulate privacy: a mix of federal, state, and private-sector protections, including the broad consumer protection powers of the Federal Trade Commission.

Ultimately, many emerging cyberspace issues will have to be resolved by international organizations, such as the new World Trade Organization (WTO) and the United Nations Conference on International Trade Law. A good example of what such organizations can do is the 1997 WTO agreement on basic telecommunications, under which more than 60 countries committed themselves to deregulation and to increase international competition in the industry. This agreement should help strengthen the physical infrastructure needed to support the digital world. But the international road is a tortuous one. International organizations tend to move glacially, and toward the lowest common denominator. That is the bad news. The good news is that a number of them, such as the Organization for Economic Cooperation and Development, have officially embraced the emerging digital universe, leaving behind the old Luddite arguments against progress.

Now the United States and its partners must push for a quick resolution of a few key issues. A broader international consensus on the potential economic and social benefits of cyberspace is one objective, along with agreement on the need to foster new skills and schooling better suited to an information economy. An emphasis on private-sector leadership in the development and use of cyberspace is another important goal. Business must also be encouraged to develop its own rules and enforcement systems for managing privacy, objectionable content, and other challenges. A final priority is a blueprint for approaching policy issues internationally, specifying what issues need to be tackled, in what order, and in what international forum. And public officials at all levels of government in every nation and international organization must take on the personal responsibility of educating themselves so that choices can be made quickly and intelligently.

Yet all of this would represent only a beginning of our efforts to shape the emerging world of cyberspace. More and more institutions are being drawn into the digital universe every day—banking and financial services, the retail industry, elementary education, state government, and many others. It will change all of them in ways so profound as to render totally useless their current statutory, regulatory, and historical underpinnings. Digital cash and other innovations lie before us, many of them not even imagined. So do challenges such as Internet crime and information warfare. We have the opportunity to make the most of the economic and social advantages that this revolution has to offer—or, by failing to act, to waste some of its potential and do ourselves harm. We have ample warning, but do we have the will and skill to act?

The Digital Rights War

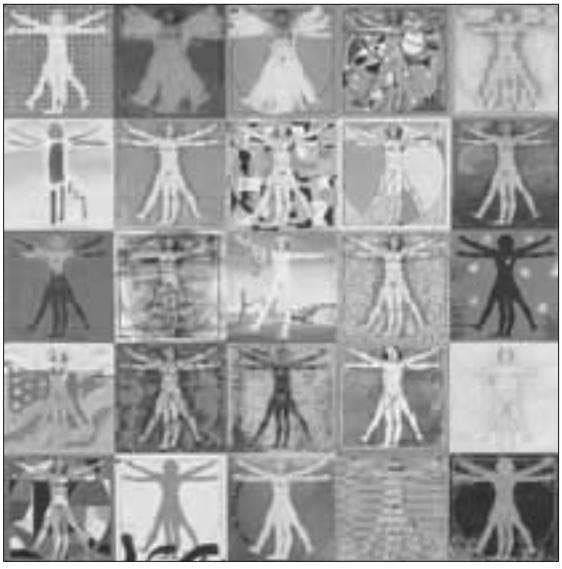
by Pamela Samuelson

Digital technology is opening up new worlds of potential, few more enticing than the emerging global marketplace for information products and services. Imagine being able to call up news articles, short stories, photographs, motion pictures, sound recordings, and other information any time, day or night, almost anywhere in the world. This is the vision that until recently sent the stocks of obscure Internet enterprises soaring and propelled relatively new companies such as Microsoft to the front ranks of American industry.

The great advantage of digital information—and a key source of its potential—is that, once produced, it is easy and cheap to disseminate. There is, however, a threat as well as a promise in this unique quality. Digital information is the equivalent of what land, factories, and equipment are in the conventional economy: essential property. And the very same low costs of reproduction and dissemination that are its great virtue also make possible unauthorized uses—including everything from copying a page from a magazine to pirating thousands of copies of a Frank Sinatra CD—on an unparalleled scale. It is no longer just commercial pirates peddling mass-produced bootlegs that alarm the Hollywood movie studios and the publishing industries; it is also the ordinary Tom, Dick, or Harriet who may be inclined to share copies of

a favorite film or book with a thousand of his or her closest friends.

To guard against this possibility, some established copyright-based enterprises—including film studios, book and magazine publishers, software companies, and others that trade in intellectual property—have been spending hefty sums to create technological "locks" for their products. They are also seeking amendments to federal copyright law that would outlaw any tampering with these locks. But they are asking copyright law to perform tasks very different from those it has performed in the print world, tasks with alarming implications for our national life.



Universal Man III *(1992), by Paul Giovanopoulos*

The new future of technically protected information is so far from the ordinary person's experience that few of us have any clue about what is at stake. So comfortable are we with the way in which copyright law matches up with our everyday experience, practices, and expectations that we find it hard to imagine the dramatic changes the digital world may bring. If I buy a copy of *A Streetcar Named Desire* today, for example, I know I can read it, share it with a friend, and perform scenes in my home or in a classroom. I can also make a photocopy of a favorite passage to send to my sister. If I am short of cash, I can go to a library and borrow a copy, making the same uses of it as I would of a purchased copy. But I also know that I should not run off dozens of copies or stage a production unless I get the copyright owner's permission.

In the familiar world we take for granted, principles and practice seem to form a seamless whole. Virtually all private and noncommercial uses of information are lawful. Yet the underlying law is somewhat more complicated. From the standpoint of copyright law, it is permissible to read a play not so much because one has paid for a copy, but because the law does not confer on owners a right to control the reading of protected, or copyrighted, works. It is okay to borrow a copy of the play from a library or share a personal copy with a friend because the law treats the first sale of a copy to the public as *exhausting* the copyright owner's right to control further distribution of that copy. Photocopying a favorite passage from a play would generally be considered a "fair use." Performing the play among friends or in a classroom also passes muster thanks to special "carve-outs" for these activities. The main concern of the law has been to stop people from becoming alternative publishers of a work (by, say, making many photocopies) or

undercutting other commercial exploitations (such as controlling the licensing of theatrical performances of *A Streetcar Named Desire*).

But the rules that have served the print world so admirably do not carry over very well to the digital world. For one thing, it is impossible to use any work that exists in digital form without also making a number of temporary copies of it. When you visit the CNN Web site, for example, or look at entries in a CD-ROM encyclopedia, your computer has to make temporary copies so that you can see the material. This simple fact has profound implications for copyright. After all, the principal right of authors and publishers (as the term *copy-right* implies) is to control reproduction of their works.

In 1995, the Clinton administration issued a policy white paper, *Intellectual Property and the National Information Infrastructure*, that spelled out just how profound it thought these implications were. The white paper made the controversial assertion that because temporary copies do get made, copyright owners are entitled to control all browsing and reading of their works in digital form. Never mind that Congress, in writing the laws in an earlier era, probably never contemplated that the rights of copyright owners would extend so far.

The white paper also endorsed a view shared by many copyright owners—including big companies such as Disney, Time-Warner, and Microsoft—that "fair use" is going to wither away in the digital world, and by analogy in the print world. Why? Because it is now technically possible (or soon will be) for consumers to get a license from the publisher whenever they want to use a copyrighted work. These copyright owners contend that the real reason certain uses of such works were formerly considered *fair* is that it was simply too expensive and cumbersome to require a license for each use. Now that technology is curing this "market failure," they assert, fair use goes away. In the new order they envision, if a use can be licensed, it *must* be licensed, even a photocopied passage from *A Streetcar Named Desire*.

It is also contended in the white paper that the "first sale" principle is outmoded. The principle doesn't apply, according to this argument, because lending a digital copy of a work to a friend requires making a copy, not just passing along your copy. In addition, digital copies of works tend to be offered on *licensed* terms, not by sales of copies. When you buy a copy of word processing software, for example, the publisher includes a so-called license agreement—that often includes a prohibition on retransfer of the copy and other restrictions on sharing the content. Increasingly, other digital works, such as encyclopedias and CD-ROMs of telephone listings, also come with such licenses. If these "shrinkwrap" licenses are legally enforceable—an issue on which the courts are currently split—there is no reason why they could

> Pamela Samuelson *is a professor of information management and of law at the University of California, Berkeley. In 1997 she was named a Fellow of the John D. & Catherine T. MacArthur Foundation.*

not also be applied to the print world. Then it would be illegal to sell second-hand books, for example, or even to give them away—a prospect that must surely delight publishers of college textbooks. This is not just a theoretical prospect. The National Conference of Commissioners on Uniform State Laws will soon complete a new model commercial law, designed to serve as a template for state law (which governs these matters), that validates all mass-market licenses of information, whether in digital or print form.

The abolition of the "first sale" principle would have a powerful effect on libraries. In the past, when a library stopped subscribing to a particular journal, for example, it still had back issues available for patrons. But in a world of licensed information, canceling a subscription may mean losing all access. So all information in a particular database would become unavailable. Owning a licensed physical copy of the information, such as a CD-ROM of reference materials, might not make a difference. Publishers would be entitled to demand their return, or to trigger embedded technological locks to keep users out.

Some publishers envision an information future ruled by a pay-per-use system. Users would license from the publisher each and every access to and use of protected works, even those for private, noncommercial purposes. If you want to read an article in *Time* but don't have a subscription, these publishers argue, why shouldn't you have to pay 50 cents or a dollar to read it—even at a library—and twice as much if you want a printout? The Clinton administration's white paper, with its assertion that copyright owners are entitled to control all uses of works in digital form, strongly endorsed this vision.

The white paper also foresaw the use of technological "locks" and self-destructing copies to help copyright owners protect their works against unauthorized uses. Try to make a copy of a movie on one of the new digital videodisks (DVDs) available today, for example, and you will quickly find your path blocked by such a lock. In fact, you probably won't be able to play your disk on a DVD player purchased in Tokyo or London because the players contain built-in technical locking systems coded by geographical location. (This gives the studios greater control over the distribution and marketing of their goods.) The DivX format for movies is an example of a self-destructing copy system already in the marketplace. If you purchase a DivX disk, you can play it on your own player for 48 hours, but after that, the data on the disk is inaccessible unless you pay another license fee. There is no technical reason why this can't happen with other kinds of information as well. Why shouldn't recording companies issue CDs that are coded to self-destruct or lock up after 15 plays, forcing those who want to hear more to pay more?

But some copyright owners worry that what one technology can do, another technology can often undo. They have lobbied Congress to make it illegal to circumvent or bypass technical protection systems and to outlaw the manufacture or sale of software that make circumvention possible.

Chinese police heap pirated music CDs and other contraband for burning. One trade group estimates that pirates cost film studios, software makers, and other U.S. firms up to $20 billion annually.

Congress debated the issue earlier this year, pondering three options. One, pushed strongly by Hollywood, was a total ban on circumvention. The studios implausibly liken circumvention to burglary, insisting that it should never be allowed.* Libraries and educators were among those arguing for a second approach: banning circumvention only when the purpose is to infringe a copyright, which is, after all, the real evil that concerns the studios. Congress, however, chose a third option, a general ban on circumvention with specific exceptions in a number of cases, such as for law enforcement agencies.

What about the vitally important issue of circumvention to make fair use of a protected work? A friend of mine, for example, recently defeated the technical protection on a videocassette in order to get a film clip to demonstrate the negative connotation of the word *redskin* in a lawsuit. This seemed to him fair use. Alas, it might not be permitted under the new rules.

The Senate version of the bill makes no allowance for circumvention for fair use, a position that has won the legislation the backing of Hollywood and software giant Microsoft. The House bill, recognizing the stakes involved, calls for a two-year study of the fair use issue and carves out a temporary suspension of the ban for nonprofit institutions. (Delegates negotiating an international copyright treaty in Geneva in 1996 rejected a ban on circumvention sought by the Clinton administration for similar reasons, including concern about the implications for

*In practice, people frequently circumvent protection systems, and social custom often supports them. Some years ago, for example, when software publishers offered their products only on copy-protected disks, users frequently bypassed the protection in order to make backup copies. A federal court even upheld the legitimacy of selling a program that could bypass these systems, reasoning that making such backups is a legitimate, noninfringing use.

fair use.) A House-Senate conference committee should resolve the differences this year, but that will hardly end the debate. How the new provisions will be applied in the marketplace—where, for example, consumers may resist new controls—and how the new law will meld with existing law and constitutional principles, such as the right to free speech, will keep contention very much alive.

In this year's debate over the new law, as in others surrounding the seemingly less than scintillating subject of intellectual property, the general public has not had a strong voice. The American Library Association, the Electronic Frontier Foundation, and a handful of other groups have sought to speak for the ordinary Americans whose lives will be profoundly influenced by what Congress decides, but without an aware and aroused public, these advocates' effectiveness will remain limited.

Americans need to have a broader public conversation about the kind of information future they want to create, a conversation that must include the role of copyright. The loudest answer to the copyright industries today comes from technological optimists such as Nicholas Negroponte, the director of the Media Lab at the Massachusetts Institute of Technology and a columnist for *Wired*. The optimists stake out the opposite extreme of the argument, insisting that because the economics of bits is so different from that of atoms, copyright is, or soon will be, dead. Good riddance, they add. All information must ultimately be free.

But Negroponte and his allies do not explain how creators will be able to make a living if they have no right at all to charge for the use of their works. If they are to thrive, authors, moviemakers, painters, software creators, and others do need a way to control commercial uses of their work. Preserving copyright looks to be the best way to achieve this goal. But copyright works well in part because creators can also make fair uses of the work of others and because people have reasonable freedom to privately share information. These values, too, need to be preserved.

An "information society" in which all information is kept under high-tech lock and key, available only under terms and conditions dictated by a licenser, would not be worthy of the name. We need to work instead toward a new status quo that preserves the values that are already built into copyright law, allowing authors and publishers to thrive while also promoting the widest possible use of their creations.
