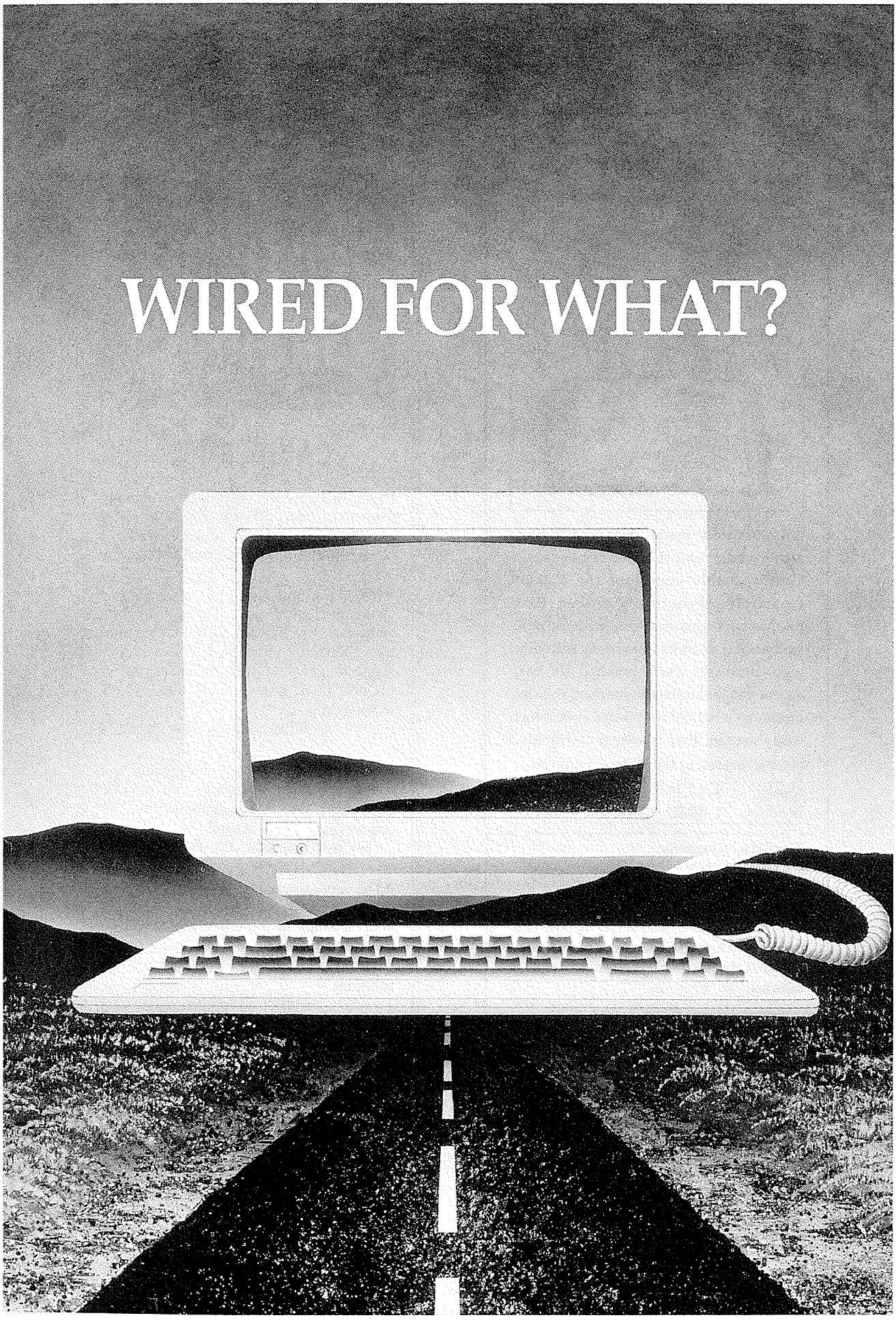
WIRED FOR WHAT?



The race is on to build the information superhighway. From "players" in business, government, and other realms comes promising talk of empowering individuals and launching a new age of digital democracy. From critics come warnings that the highway may only expand the empire of television, creating a "vaster wasteland" of 500 channels. Stepping back from the hubbub, our contributors ask what Americans might want from the information superhighway, what can be learned from recent experience with today's Internet, and what the history of other media suggests about the information highway of the future.

IN SEARCH OF THE CYBERMARKET

BY DOUGLAS GOMERY

That crashing noise you keep hearing in the distance is the sound of Big Deals collapsing on top of Big Hype about the information superhighway. Last fall, regional telephone company Bell Atlantic and cable giant Tele-Communications Incorporated (TCI) announced their $15 billion marriage, the largest corporate merger in history, and promised us all the moon and the stars—a new era of faster and better communication, international interactive bridges, more high-tech jobs, and an information-fueled economic expansion lasting into the next century. This was only the biggest and fanciest of a string of shotgun weddings that were announced as corporations scrambled to get in on the imminent arrival of the superhighway. The deals included a $4.9 billion union of Southwestern Bell and the Cox Enterprises cable company, and a $12.6 billion American Telephone and Telegraph takeover of McCaw Cellular Communications.

The hype approached the dimensions of hysteria. Several months before the Bell Atlantic-TCI merger was announced, John H. Gibbons, a science adviser to President Bill Clinton, declared, "Information highways will revolutionize the way Americans work, learn, shop, and live." Alan Kessler, head of 3Com Corporation, predicted that the infohighway "will collapse time and space, erase cultural boundaries and move continents and people closer together." In January, Vice President Al Gore promised that the National Information Infrastructure, as he calls it, will "educate, promote democracy, and save lives."

Now many of the deals have come undone, the fragility of the dreams—and especially the economics—underscored by the fact that the big Bell Atlantic-TCI deal was wrecked in part by federal regulators' decision to trim cable TV rates slightly. Some sort of information superhighway will certainly be built, skeptical dismissals of the "superhypeway" notwithstanding. But it now seems clear that a certain modesty about our expectations for when it will be built and what it will accomplish is in order.

A generation ago, futurists heralded the coming of cable TV in terms very similar to those being heard today. In 1971, the foundation-backed Sloan Commission on Cable Communications predicted: "Cable technology, in concert with other allied technologies, seems to promise a communications revolution. . . . The potential of cable television in the service of formal education—that is, as part of the school and higher educational system from kindergarten onwards—has been universally acclaimed." Our metaphors are as old our hype. In 1972, writer Ralph Lee Smith published a book called *The Wired Nation*, arguing that the United States should use cable TV as an "electronic communications highway." By the 1980s, Smith was predicting that Americans would be learning at home, corresponding by electronic mail (E-mail), and scanning far-off libraries in search of information.

Cable TV has arrived, but it is not very close to what was imagined or hoped for. A tiny minority of Americans are now doing the sorts of things that Smith and others talked about, but not through cable TV. Smith's wired nation is basically a one-way televised street, with plenty of mass entertainment, some new information, and little in the way of formal pedagogy. The big networks still dominate. Despite a few success stories (CNN and C-SPAN), there has been no flowering of "serious" TV programming. All-opera and all-ballet cable channels have come and gone, and the state of public-access TV, which was supposed to have given us a new electronic commonwealth, is summed up by *Wayne's World*, the fictional public-access show hosted by two teenage heavy-metal music freaks in the hit film of the same name. Perhaps the biggest surprise on cable is the success of QVC and other home-shopping networks, which ring up $3 billion in annual sales. After 20 years, cable TV is a lot less like an information superhighway than an entertainment supermarket, or, if the highway metaphor must be maintained, the traffic-clogged road down by the local mall.

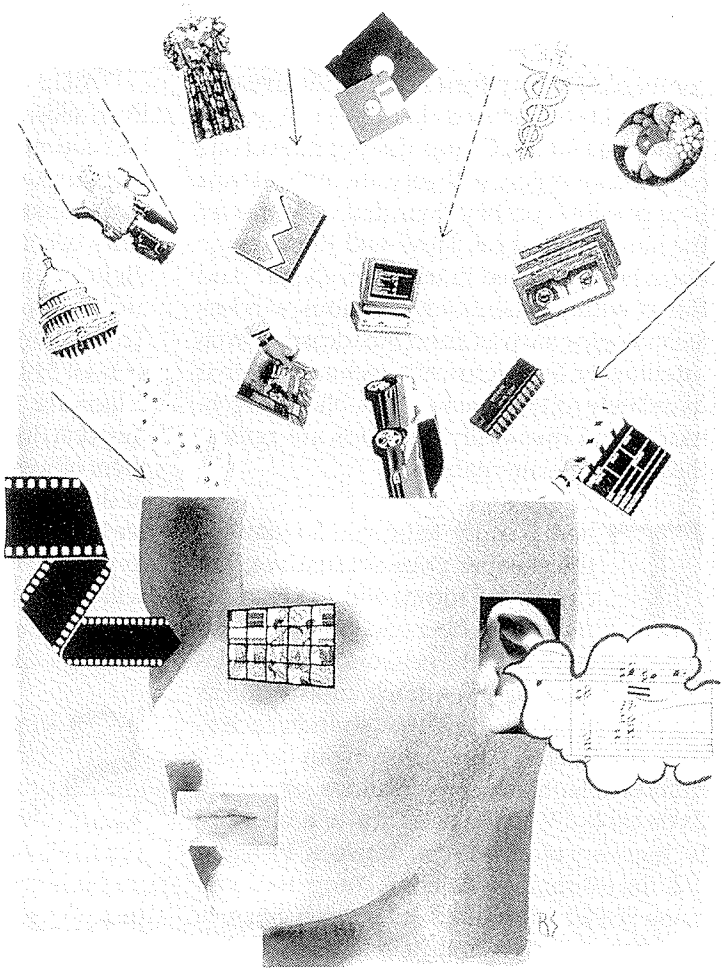
The lesson ought to be plain: Technology alone does not a communications revolution make. Economics trumps technology every time. People must be offered things they want at prices they are willing to pay, and in the information arena, as in other realms of human life, people tend to want things that are not supposed to be good for them. Many of the futurists who see a new day dawning are going to be disappointed by what they find at dawn's early light. The notion that people who spend dozens of hours watching sitcoms every week and never read a newspaper will somehow be transformed into Renaissance men and women by the availability of new information services in the home seems overly hopeful, to say the least.

At the same time, to make at least a few dreams come true, it is important to lay down in the near future a general political and regulatory framework for the new system. The choices range from a more or less laissez-faire approach, favored by many in industry, to something like the regulated monopoly model that governed the nation's telephone system until

***Douglas Gomery**, a professor in the College of Journalism at the University of Maryland, is the former senior researcher at the Wilson Center's Media Studies Project. His writing credits include nine books, most recently* Shared Pleasures *(1992) and* The Future of News *(1992).*

the breakup of the Bell system in 1984. The first possibility would likely get the infohighway built somewhat more quickly; the second would give regulators a stronger voice on such matters as ensuring access for all. All of the competing bills now actively under consideration in Washington represent efforts to strike some sort of middle ground between these extremes. Uncertainty over what the federal government will do is one of the big imponderables forcing a readjustment of corporate timetables.

The technological force driving many of today's developments is *convergence*. Television, movies, radio, newspapers, books, and data have all in the past been composed in different media—on paper or film or magnetic tape. Today, however, all can be reduced to a single form of "information," the common language of the computer's binary code, an endless string of ones and zeroes. No longer is it necessary (technically at least) to print a newspaper on paper or to distribute a movie on film. Everything can be reduced to the same simple form and transmitted directly to—and in some cases from—consumers by wire, or, for that matter, on floppy disc or compact disk. And if film, print, and music are similar forms of "information," then the traditional divisions among industries that produce them begin to make less sense. This partly accounts for the frenzy of business mergers and ventures. "Our vision is: all forms of information, any place, any time," Michael Braun, an IBM executive, told the *Washington Post*.



The human appetite for information seems boundless. Yet the share of regular book readers in the population, 25 percent, hasn't changed since 1930.

The technology needed to reduce sound, pictures, and words to a common form of information already exists and is being rapidly improved. The real economic, political, and technological question is how best to deliver all this information to Americans in their homes. What makes the delivery question so confusing is that some very basic questions have yet to be settled. Will there be one "wire" to the average household or two—one from a telephone company, another from a cable TV company? What kinds of wires will they be? Fiber-optic cables can carry massive amounts of information, but wiring the nation with fiber optics would be very expensive. Since technologies exist to get more out of both the coaxial cable already strung by cable TV com-

panies and the copper wires run by phone companies, it may turn out that the average household will have no fiber-optic connection in the near future. Or one fiber-optic and one copper connection. In theory, there are at least nine possible combinations that may answer the simple question, How will the average household be wired in the years ahead? And this is without mentioning various wireless technologies, such as direct broadcasting from satellites or by microwave technology, that have lately received reams of publicity. (Technically and financially, the odds are against these wireless alternatives.)

There is much to be said for some of the cheaper wire alternatives, but clearly the future will not have arrived until fiber connects all homes and businesses with the network. Fiber carries at least 150,000 times as much information as copper wire. Forty fiber-optic strands, each as thin as a human hair, together can carry 1.3 million telephone conversations or nearly 2,000 cable TV channels. (Parts of a fiber-optic highway already exist. Between 1985 and '92, for example, telephone companies laid some 95,000 miles of cable between cities, in new communities, and in a variety of other places.) Only with the wide bandwidth of fiber optics will the system reach its full potential to carry vast quantities of complex information.

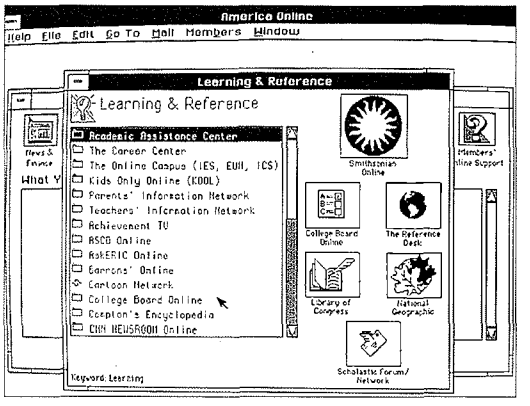
The basic device serving consumers at home will almost certainly be some sort of hybrid telecomputer that marries a computer processor and a television screen. It will display wide-screen images, easily accommodating all of Hollywood's CinemaScope-like images without lopping off the sides. Since sound and pictures will be recorded in digital code rather than as analog magnetic waves, as they are today, they will be crisp, clear, and distortion-free. A CD-ROM component will allow consumers to store and later retrieve data, from train timetables to family photographs. The telecomputer will have a keyboard, but its interactive heart will be a semiconductor chip.

All of this will be enormously expensive. Even allowing for the fact that competition can be counted on to drive down costs, telecomputers of the sort described here will cost thousands of dollars each. When they finally become widely available, for example, digital high-definition television (HDTV) sets are likely to cost in the neighborhood of $5,000. To wire the nation with fiber-optic cable, add at least $1,000 per household, or a cool $100 billion for the whole country. That is not to mention the cost of wiring businesses, government offices, and nonprofit institutions. Sums of this size serve as reminders that, much as we like to think of the infohighway as the centerpiece of a "postindustrial" era, building it will be a very old-fashioned capital-intensive undertaking. It will take a long time, and it will be very expensive.

Since, unlike the actual highway system, the infohighway is being built by private industry rather than government (and is likely to remain a private venture), the question of how to ensure access for all is central. The Clinton administration provides a somewhat contradictory answer. Vice President Gore told the *Wall Street Journal*: "As the National Information Infrastructure develops, President Clinton and I believe strongly that we must choose competition and protect it against both suffocating regulation on the one hand and unfettered monopolies on the other. . . . President Clinton and I are committed to making the benefits of the communications revolution available to all Americans across all sectors of society. It is a priority for this administration that every classroom, library, hospital, and clinic be connected to the National Information Infrastructure by the year 2000."

Clinton and Gore envision corporations developing the information superhighway with modest government encouragement and regulatory nudging. The administration anticipates a bimodal world. On one side, cable TV companies will begin to offer voice and data

High hopes: One highly touted infohighway service of the future is video conferencing for business and families. Limited online conferences are already possible. At left, a meeting on the Internet using an ordinary MacIntosh computer and CU-See Me software developed at Cornell University. Below, a menu of choices available to customers of America Online.



services. On the other side will be the Baby Bells (the seven regional telephone companies) and long-distance carriers such as MCI and AT&T, which will begin to offer entertainment services. There will be two (probably fiber-optic) wires into homes and businesses, provided by competing companies.

Clinton and Gore want the best of both worlds: the advantages of competition and those of monopoly. They call for a classic cross-subsidy, similar to what the Bell system provided in the days before its breakup. Money will be transferred from well-off users to underwrite services for nonprofit institutions and poor people. In this very spirit, Bell Atlantic has already announced that it will give 26,000 public schools free access to the information superhighway, paid for by profits it will make from mainstream users. But Bell Atlantic's free wire does have a catch: It will run only to the schoolhouse door. Local school systems will still be responsible for wiring inside the building, buying necessary equipment, and providing training, not inconsequential expenses in this age when poorer school districts are unable to afford new library books.

Finally, Gore insists on a "switched" system. Today's telephone system is a switched network: It allows one user to connect directly with any other user. By contrast, traditional cable TV systems are nonswitched: The same message goes to everyone who tunes in. For financial reasons, some cable providers prefer a future highway with limited two-way communication capabilities. Their experience as providers of mass entertainment rather than communications further impels them toward that option. The telephone companies and infohighway enthusiasts favor a switched system. The Electronic Frontier Foundation, a self-styled public-interest group founded by software multimillionaire Mitchell Kapor, points out that a nonswitched system restricts access because there must be a fixed number of channels. With a switched network, "anyone with content to distribute—whether to one, 100, or 100,000 users—can do so without the permission or advance approval of the carrier." Such a system is essential to Kapor's "Jeffersonian vision" of the electronic future, in which every American is a potential creator (of videos, software, political tracts, etc.) and every home is a de facto broadcast studio. The unanswered question, however, is whether there will be enough demand for such active uses of the new technology to justify universal service of this kind. The Jeffersonian road could, alas, lead us to a gold-plated version of today's public-access TV.

Once all the wires and other hardware are in place, what will they bring to America's homes, schools, and offices? And who will pay

for it? These are questions that, apart from a number of agreeable generalities, have not been widely examined. If you build it, they will come, seems to be the attitude of Gore and many of his fellow enthusiasts. One formulation of Say's Law, a controversial hypothesis of 18th-century economics, holds that supply creates its own demand. But Say probably could not have imagined a market already overwired with 80 or so cable channels per household and about to move up to hundreds of channels. Research shows that as things stand now most cable viewers simply tune out the vast majority of their choices and repeatedly view only five or six channels. (Another item from the annals of survey research that does not augur well for a high-tech future is the finding that more than half of all VCR owners have not even managed to program the time on their machines, apparently preferring to stare at an eternally flashing "12:00.")

What will Americans want from their wired world? One embarrassing truth is that plain old TV programming will almost certainly be a mainstay during the early days of the highway, and possibly for quite a long time. Only one entirely new service seems obvious to all: video on demand. It is easier to order up movies from the comfort of one's couch than to hop in the car and drive to a video store, where inevitably every copy of the latest Arnold Schwarzenegger epic has already been signed out. The video rental trade is now a $12 billion business, and the high-tech info entrepreneurs are intent on capturing a slice of the humble home-video pie. Time Warner's chief executive officer Gerald M. Levin is blunt: "People clearly want [these movies] and they are already paying for them now. All we need is a fraction of that demand."

Some other possibilities for interactive systems include home shopping, video conferencing, education at home, town meetings, video games, and home banking. Some of these are bound to fail. Michael Noll, dean of the University of Southern California's Annenberg School of Communication, observes: "[Home banking] has gone through generations of failure and failure and failure. Until we invent a home terminal that dispenses cash, home banking won't get far, except for people who want to do extra work." When *Wired* magazine asked four experts to predict when interactive TV would be widely available, two said never. (The other two said the turn of the century or later.) Yet entrepreneurs will certainly invent entirely new and as yet unimaginable kinds of products. For example, Carol Peters, one of Silicon Valley's most respected computer designers, has formed DaVinci Time and Space to develop an interactive video network for children. Blending the lure of a Disneyland-style electronic theme park with the pedagogy of *Sesame Street*, DaVinci Time and Space seeks to go beyond video on demand to provide a computerized "space" in which kids can play games, watch videos, or simply hang out on-line. Since someone has to pay, the plan is to sell advertising and provide the service free. In that respect, DaVinci Time and Space is like old-fashioned TV; interactivity is what makes it radically new.

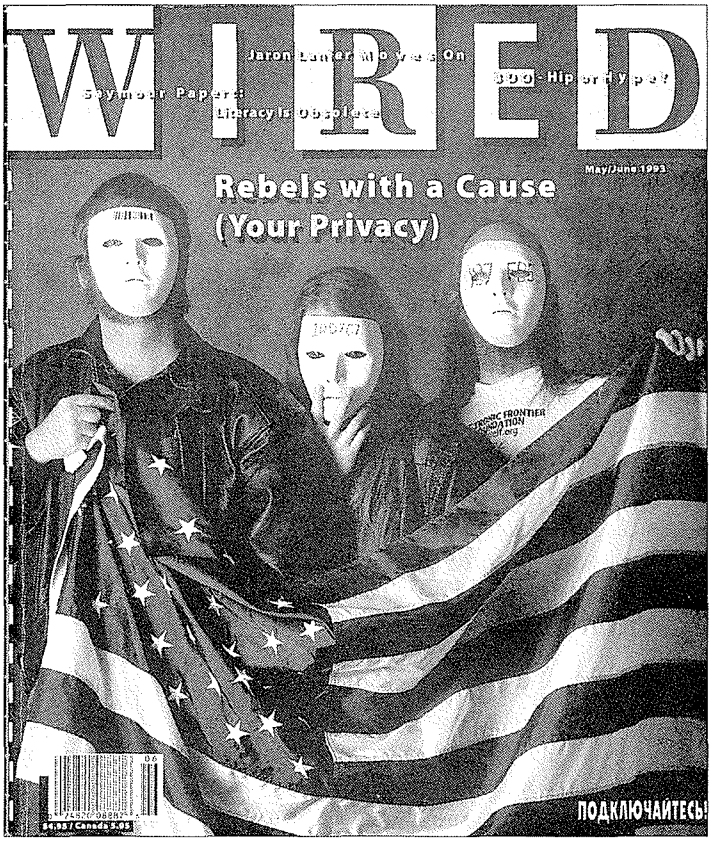
Leaving aside such experiments, the basic economic principle best suited to an understanding of the technofuture is simple (and uninspiring) enough: the substitution effect. If one technology is currently being used, can an interactive on-line video version do a better job? Can catalogs now printed on paper and delivered by the U.S. mail be displaced by interactive TV sales that allow customers to enter an electronic showroom? Economic logic says that business elicited by printed catalogs will go down as sales generated by TV technology increase. The big players already recognize this. The substitution effect target list, when added up, is staggering. In 1993, shopping ($160 billion), telecommunications ($150 billion), information services ($35 billion), and entertainment ($28 billion) totaled well over a quarter-trillion dollars. Yet "obvious" substitutions do not always work and experiments frequently backfire. In suburban Denver,

where TCI is running a market test offering its customers movies on demand, it has found that customers like the service, but also that those who sign up simply cancel HBO and the Movie Channel, making the experiment essentially a wash for the company.

Some futurists see the germ of the 21st century in today's nascent "on-line" services, such as America Online, Prodigy, and CompuServe. Pay a membership fee and dial up one of these services using a modem attached to your personal computer, and you can catch up on the news, check your mutual fund investments, and chat with like-minded folks on bulletin boards devoted to such specialized topics as your hometown hockey team, office etiquette, opera, or nuclear proliferation. But so far the services have attracted only a specialized clientele of affluent, highly educated, gadget-oriented users. The total subscriber base of these three top on-line services stands at less than three million, smaller than the subscriber base of *Newsweek*. At America Online, the hottest of the services, the largest number of pioneers actually traveling in cyberspace at any one time is only about 8,000.

One sticking point is money. After a burst of keystrokes, sticker shock sobers up even the selected sample of on-line users, and thereafter those who remain on-line—the dropout rate is high—rarely again exceed their minimum monthly charge of $10–$15. It would cost hundreds of dollars per month to make full use of these services. And even at these prices, providers are not having an easy time making a go of it. Prodigy, jointly owned by Sears and IBM, has failed to turn a profit in six years.

To see what consumers want, telephone, cable, and other technology companies are testing other combinations of services in a variety of places around the United States and Canada. Experiment after experiment so far has proved inconclusive at best. In June 1993, Bell Atlantic began offering movies on demand over existing telephone lines to a selected set of employee-customers in a suburb of Washington, D.C., with plans to extend the test to two New Jersey sites. Results will be coming from other tests in Seattle, Omaha, Denver, Salt Lake City, West Hartford, and various sites in California and Ontario throughout 1994 and '95. The biggest experi-



Defining the First Amendment in cyberspace is becoming increasingly difficult and controversial. In the future, on-line communications will be encrypted. The issue: Should the government be given the keys to the code?

ment is scheduled to commence at the end of 1994 with Time Warner's trial offering to 4,000 Orlando, Florida, consumers of the world's first true "full-service network": switched, digitized, fiber-optic, multimedia, and interactive. The lucky few will be able to see any movie they want at any time, view all current and any new TV services, shop, play video games, telecommute, and read E-mail.

Interactivity is the heart of this million-dollar experiment. "Our new electronic superhighway will change the way people use television," declared Time Warner's Gerald M. Levin when he announced the plan in January 1993. "By having the consumer access unlimited services, the Full Service Network will render irrelevant the notion of sequential channels on a TV set." In other words, out go NBC, CBS, ABC, and Fox, and in comes Time Warner.

Yet all has not gone well. For the moment Levin has quietly placed his full-service network test on hold; his two major software and converter suppliers cannot meet the deadline. It is one thing to display the power of 500 or so channels in a laboratory, quite another to make the future work in 4,000 homes. William Weiss, the chief executive officer of Ameritech, one of the regional Bell telephone companies, deserves a prize for realistic punditry for telling the trade publication *Electronic Media*, "There are about five quantum steps between the prototype and what the customer will eventually pay for its use."

Apart from the commercial on-line systems and the experiments by Time Warner and other corporations, there are two other models that in interesting ways mark out some future possibilities for the information superhighway.

To see true popular interactivity of the kind envisioned by some futurists actually working today—albeit in a crude, simplistic way—one must turn to, of all places, France. The Minitel system links 6.5 million French households, using a simple video screen and keyboard combination that allows users to play chess, scan lists for bargain vacations, and chat with new friends by means of typed messages. When Minitel was introduced 10 years ago, teenagers made it a fad. The yellow pages became passé; it was more fun to type in the requested name and see the phone number appear magically on the screen. Punching in "3615 arts" provides newspaperlike lists of the latest movies. To order a pizza, a hip French teen no longer calls, but types "Zapizza."

Minitel works with an unassuming little box and a relatively primitive computer system. The device costs about $4 per month to rent from the national telephone company and is attached to the copper-wire (not fiber) French telephone system. This is a highway based on early-1980s technology. An American telephone company, US West, is conducting tests in San Jose and Minneapolis of a version of Minitel that links parents and schools. Minitel has the great virtue of being practical and workable, but its decade-old technology is a severe limitation.

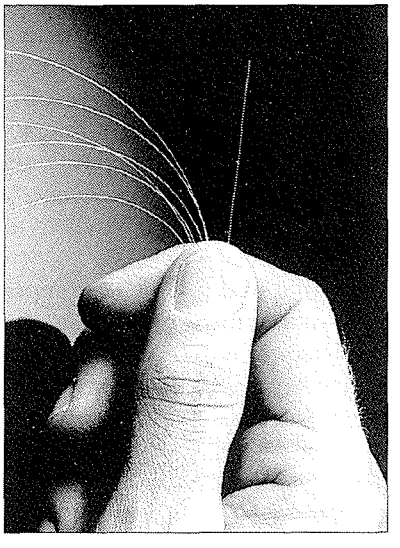
A better-known model is the Internet. "The future will look and work like the Internet today," Vice President Gore declared recently. Started during the 1960s by the Pentagon for scientists in universities and other research institutions, the Internet has expanded rapidly in recent years. It has gone beyond the exchange of scientific studies and academic data to become a vast international network whose users enjoy such things as E-mail, data bases, and specialized bulletin boards and lists where Chaucer scholars, foot fetishists, rock 'n' roll junkies, and particle physicists can converse in text. At least 15 million people in more than 100 countries are hooked up—there is no central authority, and the system's unofficial demographers have lost count.

There is much to admire about the Internet. It promotes diversity; it is truly interactive; it encourages commentary by one and all. But the Internet will not work as a mass medium in the future. There is no revenue stream (it is underwritten by the federal government, universities, and other institutions), and it requires too much time and expertise to

learn and use. Indeed, in the next few years there will be a struggle for the soul of the Internet as advertisers seek to use its reach to send messages to its millions of users.

The future will not look like America Online, Minitel, or Internet. If the information superhighway is to be for all, then it cannot (and should not) be limited by price, technological crudity, or scientific configuration. The new infohighway ought to be as advanced as possible and available to all who might like to use it. But here is the central contradiction: Cost of access will be high if corporate combatants expect to rake in millions of dollars in fees. But such access fees will limit use and growth. Michael Schrage, a columnist for the *Los Angeles Times*, calculated the real cost of the new technoworld by adding up a mock monthly bill for the wired consumer of the future. His "United Multimedia's First Consolidated Monthly Statement" for two dozen on-line connections, setups, entertainment and news services, home-shopping purchases, and assorted extras came to $2,467.48—a bit of exaggeration that makes an important point. The fear that the information superhighway may be only for the well-to-do, even if every household in America is wired, is not entirely unrealistic.

Building the infohighway is the most immediate challenge, and the phone and cable companies are justified in complaining that it is difficult to figure out how to invest when no rules and regulations are in place. Congress has moved very slowly. The Energy and Commerce Committee of the U.S. House of Representatives has approved two sweeping telecommunications bills that allow cable and telephone companies to compete on a limited basis. The House Judiciary Committee has approved a conflicting version of permissible bimodal competition. Fights on the House floor, actions by the Senate, compromises, the signature of the president, and reviews by the courts await.



In the meantime, new regulatory schemes continue to be floated to satisfy the major corporate players (who desire deregulation) or consumer advocates (who call for regulations requiring universal access and affordable rates). Some sort of requirement for universal access probably will be written into law, but legislating a requirement is one thing and devising definitions of terms such as "universal" and the regulations to implement them is another. Accustomed to free access to information—television, radio, public libraries—we are perplexed by the prospect of pay-as-you-go information.

With significant technical, economic, and regulatory impediments to overcome, our multimedia future will remain unsettled for some time to come. When there is risk involved, conservative corporate America treads ever so carefully and ever so slowly. Alexander Graham Bell invented the telephone in the 1870s, but as late as 1940 most Americans did not have a phone at home and the vast majority had never made a single long-distance call. Everything about the information superhighway will continue to be the subject of vigorous debate. Hype and hysteria will continue, as will mergers and megadeals. But because of the uncertainties that remain, it will be a long time before somebody peddling access to the information future knocks on your front door and makes an offer you cannot refuse.

LEARNING FROM THE NET

BY EDWARD TENNER

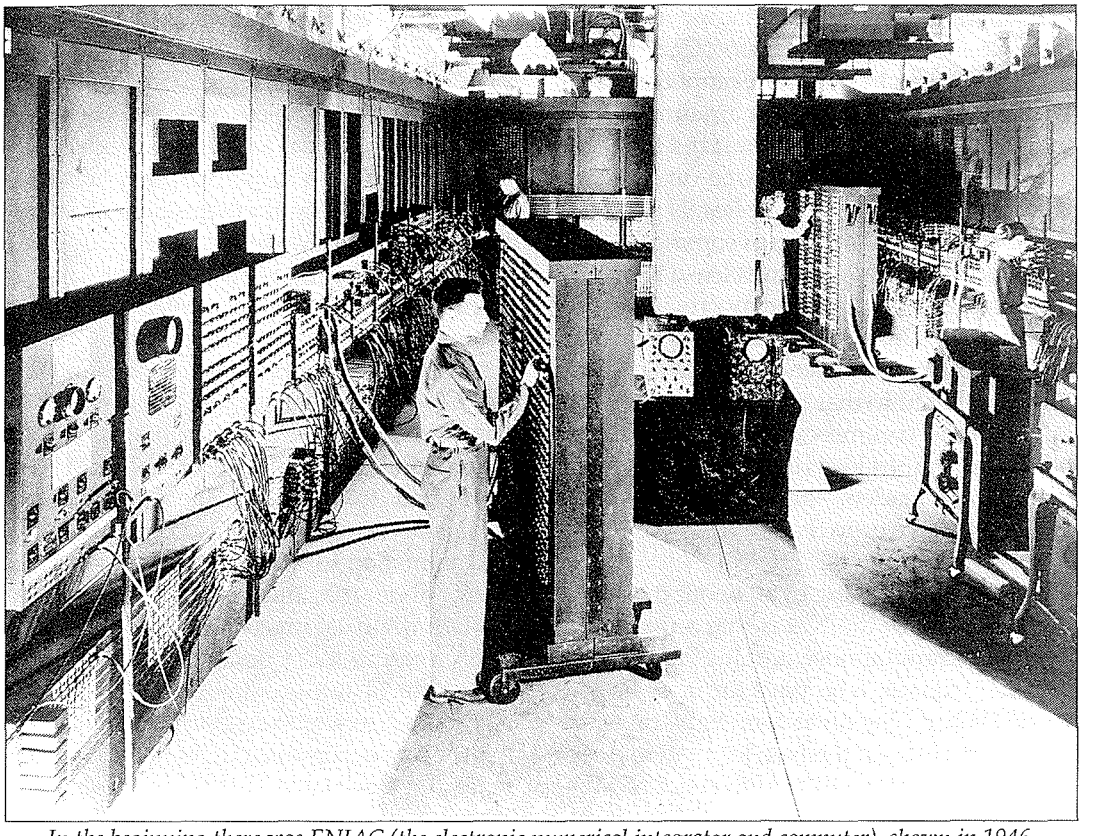
The end is NII. That's the National Information Infrastructure, of course, the amorphous web-to-be that has become an inkblot test of the national psyche. Some proponents dream of a 24-hour global symposium combining the best of Madame de Staël and Mortimer Adler, while skeptics fear a future of conference calls with the likes of John Wayne Gacy and Joseph Goebbels. Some fear a surveillance machine of the Federal Bureau of Investigation and Internal Revenue Service, others a witches' sabbath of hackers and virus artists. And while dreamers await a fiber-optic fountain of packet-switched wisdom, naysayers expect an overflowing bathtub brew of banalities, recycled programming, and junk messages. Glimmerings of all of these things are already visible.

What will the NII really be, whatever its ultimate name? The central problem of electronic futurism is that even the most gifted pioneers miss essential features of systems to come. That is inevitable. How can we know what is to be discovered and invented without discovering or inventing it? Paul Valéry pointed this out when he wrote in 1944 that "unpredictability in every field is the result of the conquest of the whole of the present world by scientific power." Even the legendary John von Neumann, one of the fathers of the computer, did not foresee small, personal machines. As a colleague of his has pointed out, von Neumann was interested mainly in developing machines for weather prediction. Yet many of the issues that will concern us for at least the next 10 years can already be seen in the operation of networks today. Much of this experience suggests that a National Information Infrastructure may be depressingly like real life.

The NII's promoters use a highway metaphor to describe it not only because the NII will allow individuals to travel hither and yon electronically but because the metaphor powerfully suggests other possibilities as well. Americans believe that an Infrastructure grows a Superstructure. Look what the interstate highways did. Americans are still willing to contemplate the prospect of immense wealth generated by something that has yet to be described or explained. We are all aware that hype is our birthright, that most of us are here because our ancestors believed equally extravagant promises. The fact that nobody knows how the NII will work or be financed is no great concern. Few people can describe all the workings of the Internet, but it works.

The real problems with the NII are in the Superstructure we expect. As to that, no one can safely say that an open, competitive order by itself will create the electronic promised land we hope to find. To the contrary, the benefits created so far by the Internet have come not from market-oriented firms but from enlightened monopolies and oligopolies, and these seem increasingly endangered just as the Internet is making their value clearer. Moreover, experience with the Internet today suggests that no matter what is done to promote access, electronic networking will promote elitism and secessionism as much as it does collegiality and community. The issues are, respectively, "depth" and "breadth." But first a few words about what today's Internet is.

In computer networking as in real life, results often do not have much to do with intentions. The free-spirited, cosmopolitan, decentralized Net was hatched under the wing of the Cold War eagle. It depends on a technique called packet switching: cutting up data into discrete, labeled units, sending them over high-speed lines by various routes,



In the beginning there was ENIAC (the electronic numerical integrator and computer), shown in 1946.

and reconstructing them for the recipient shortly before they reach their destination. If it is a highway, it is one in which vehicles and contents are dismembered, the pieces carefully labeled for reassembly, and each sent independently to be joined again in a single unit at the destination. The packet-switching idea was put into practice three decades ago by the Air Force-funded RAND Corporation as a safeguard against the collapse of defense-related communications in a nuclear attack or other emergency. There was no master switchboard; if one node went down, data could be routed around it. The first organization to use this system was the Pentagon's Defense Advanced Research Projects Agency (DARPA), which sponsored "Arpanet" at the University of California at Los Angeles in 1969 and expanded it through the 1970s. The network soon assumed a life of its own. In the early 1980s, Arpanet split into military and civilian networks, and the U.S. National Science Foundation (NSF) began to administer the Arpanet backbone. The NSF still contracts out the maintenance of lines and equipment to a variety of telephone, hardware, software, and service concerns.

During the 1980s three developments helped networking expand. First, the NSF insisted that all faculty and students at member institutions, not just those receiving NSF or Pentagon funds, have access to the network. Second, the adoption of the Transmission Control Protocol (TCP) and Internet Protocol (IP), already embraced by the Department of Defense in 1974, gave all Internet members a common method of sending and receiving data. Third, the organizations and committees in charge of the Net allowed new members—chiefly universities and other institutions—to

join at flat fees related to the number of users rather than the volume of traffic. Commercial information services such as CompuServe and Dialog can readily track the amount of time individual users spend on-line (and bill them accordingly). This is not done on the Net. Knowledge, the system implies, is good for you. Because most owners of copyrighted information are reluctant to release it in this freebooting realm, the Net may provide a very spotty view of human knowledge. But the Net is also available for extended use at a cost trifling compared to that of the commercial databases. The commercial sector is hard on browsers. The Net loves them—perhaps more than it loves readers—and that is one reason for its explosive growth.

The best thing of all about the structure of the Net is that a user need know almost nothing about who runs it, who pays for it, or how it works. When I log on to something on a faraway computer on the Net, let's say to a service called Gopher at the University of Minnesota, I am doing a number of things. From my home personal computer, connected by a modem to telephone lines, I am operating a sophisticated Sun computer in a nearby Princeton University building. (A dozen or more other users may be on-line at the same time, but each appears to have exclusive control.) That machine is linked to the university's high-speed Ethernet ring, one of two networks that circle the campus. Another Princeton computer then forwards my request to one of 19 regional centers around the country. Here the request, broken up into packets or units the size of a typed page of text, passes through dedicated fiber-optic lines to the regional center for Minneapolis, and from there to the right computer on the University of Minnesota system. Data flowing back to me from that computer follows a similar course in reverse.

The Minnesota Gopher can be imagined as a branching burrow offering the user a series of new menus. Each menu may offer from one to dozens of choices, or more. Each item may be as practical as a campus telephone book, as broad as a nationwide list of research library catalogs, or as cute as a mock dictionary of electronic smiley faces. Gopher—named after the university's mascot—is only a few years old, and it illustrates the fact that the wider and more powerful the Net becomes, the easier it is to use.

Convenience has made Net connections contagious. According to *Computerworld*, by 1994, 15 million users around the world were connected to the Net. The system's size doubles every year. And as graphics, sound, and animation supplement plain old text, the size of files transmitted is growing rapidly as well. (A digitized image for a book jacket can easily require more disk space—perhaps a megabyte of information—than the whole text.) The Net seems destined to become the main way corporations exchange data internally and externally. This is unsettling news for most of the people who have been regular users of the Net. While industrial laboratories have been members since the beginning, the Net is most uncorporate. Suits are not its strong suit. Users revel in individualism. They are proud of the absence of a central authority and, in many cases, of their ability to overcome whatever local authority or obstructions exist. Of course, that means investing a small amount of time, and often the result is that one simply finds more things to waste time on in the Net. But value is not the point. Freedom is.

The system works as well as it does for two reasons. First, at a cost of about $11 million annually the federal government modestly subsidizes the Internet backbone, the leased lines that connect regional centers, branching out to cover the entire country. Second, each Internet "site" is a network of its

***Edward Tenner** is author of* Tech Speak *and a Visiting Fellow in the Department of Geological and Geophysical Science at Princeton University. He is writing a book about the unintended consequences of technology.*

own, often with multiple servers (computers that supply end users' machines with programs and data), which are accessed by individuals using personal computers or work stations. Such decentralization has advantages. It allows academic departments, computer administrators, and others to make their own decisions about software and other matters, yet keeps the whole Net working together.

Behind the Net's usability and expansion is a paradox. Its agreeable anarchy rests on an efficient and unobtrusive (and largely informal) bureaucracy, just as the individualism of the American suburb and the romance of the open road require billions in tax and public works subsidies. The spirit of the Net may be self-realization through exploration of infinite possibilities and sources of knowledge. But the soaring fantasies of its users require untold subsidized person-hours. Holding up the Net is a corps of professionals paid by universities, government laboratories, and businesses, yet often doing work that benefits users elsewhere. The Internet would be useless to me and most other Princeton users, for example, if people in the university's academic computing and telecommunications departments did not troubleshoot the cables, upgrade the software, keep out the rogues (usually), and otherwise make the world safe for individualism. Other people at Princeton and other institutions develop and support the software that even proficient users need. Still others provide, free of charge, the amazing multifaceted contents of the Net: the endless supply of bibliographies and texts and data files and images. They need salaries, grants, and contracts. In other words, they need to be part of a well-funded organization.

Feast or Famine?

Thousands of discussion groups have blossomed on the Internet, a good number of them fairly exotic, as this sampler from the Chronicle of Higher Education *(June 1, 1994) suggests.*

"AACUNY-L" is for discussing Asian American culture and is available from LISTSERV@CUNY-VM.CUNY.EDU.

"ARL-ERESERVE" is for discussing electronic-reserve systems in libraries and is available from LISTPROC@CNI.ORG.

"HARRY-STINE" is for conversing with the author G. Harry Stine and is available from HARRY-STINE-REQUEST@ILC.COM.

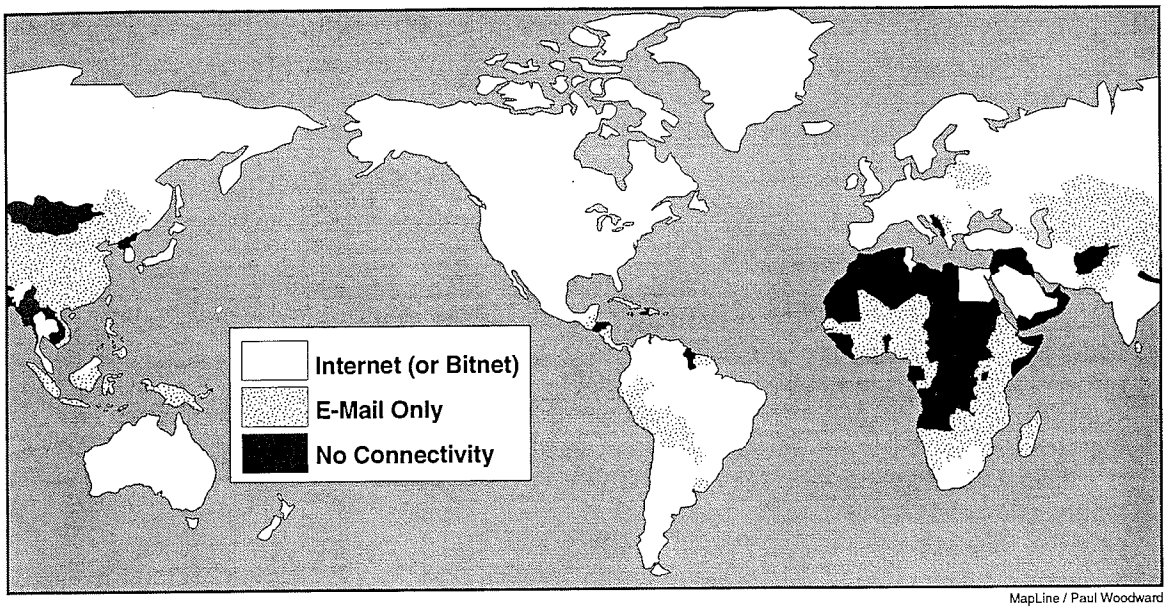
"MAXLIFE" is for discussing ways to work toward a positive, healthy life style that avoids heavy consumerism and is available from LISTSERV@GIBBS.OIT.UNC.EDU.

"PIANOMAN" is for discussing the life and career of the singer Billy Joel and is available from LISTSERV@PSUVM.PSU.EDU.

"SCUBA" is for discussing scuba and skin diving in either English or Turkish and is available from LISTSERV@CC.ITU.EDU.TR.

The software commonly used on the Net comes not from entrepreneurs but from big technological corporations and academia. Unix, the Net's basic operating software—the equivalent of the personal computer's DOS or Windows—is an industrial-strength operating system written for programmers, not end users. ("User" and "user friendly" have long been disparaging words in some programmer circles.) Unix is uncompromising and

Toward a Wired World



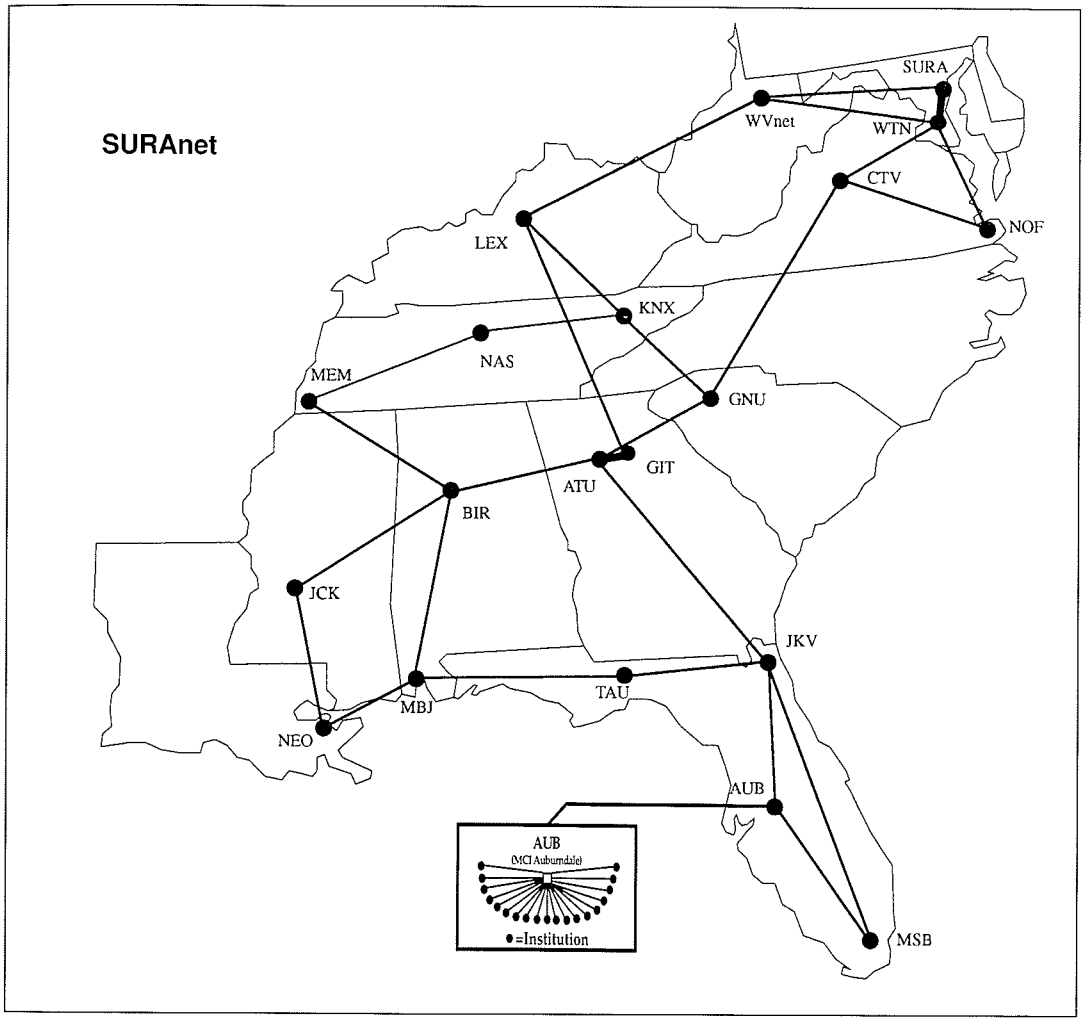
MapLine / Paul Woodward

A new network connects to the Internet every 20 minutes, but less than one percent of the world's population has access to it. (E-mail users cannot search databases or send or receive large files.) The map at right is a simplified view of SURAnet, a regional unit of the Internet. Individual users are not shown, only the institutional networks they are linked to. Information may travel any number of paths to get from one point to another.

unforgiving to the novice. On-line help consists of a stark, laconic glossary of commands mastered by trial, error, peer advice, and a growing number of third-party handbooks. But Unix is fast and effective once the user learns it. It should be. Bell Telephone Laboratories originally developed it for the operation of long-distance telephone switching. Barred by regulators from marketing it—these were Bell's monopoly days—the company gave the program away to educational users.

More recently, universities have developed Net programs on their own. From Columbia University comes the nearly indispensable Kermit communication software. From the University of Minnesota comes Gopher, the almost foolproof menu system for navigating the Net. The World-Wide Web (WWW) is an even more flexible and powerful system for doing the same thing. A click on a computer's mouse can point a user from one document to another source containing related information—possibly on computers thousands of miles away from the one containing the original document. The Web was developed for research at the European Particle Physics Laboratory (CERN) in Geneva, big science at its biggest and best. The Mosaic software that lets me access the WWW comes from the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana, another elite government-funded program.

What makes the Net so accessible, in other words, is research the public has funded in one way or another: not only through taxes but through ordinary payments for products and services, especially tuition and long-distance phone service. The cost of this research was always hidden in the prices of other things. It all seemed part of overhead, like new scales and postal meters for the mail room. Up to a point, it was. But by the



early 1990s, it had become clear that the whole Net had become much more than the sum of the parts.

Now that the Net appears about to go public, the depth that helped create it is increasingly seen by captains of industry and finance as a luxury and "curiosity-driven research" as a profanity. In real dollars, industrial research and development spending has stagnated since the late 1980s, according to one estimate. A few miles from my Princeton home, one of the country's greatest research organizations, RCA 's Sarnoff Laboratory, was devastated during the early 1980s when its main project, the videodisc, floundered. Other corporate laboratories are shadows of their former selves. More than ever, universities are the deep organizations of last resort for established researchers. But they have few career positions to offer young Ph.D.'s.

In the new age of the lean, "reengineered" corporation, depth no longer counts for much. We once resented the arrogance of big science, big government, big education, and big medicine. But we respected their competence and above all their commitment to planning and standard-setting. Even today, a battered IBM maintains specialized laboratories to test com-

puters for interference with other electronic devices so that airplane passengers, for example, can use their portable computers without endangering aircraft navigation systems. The second-tier suppliers and clonesmiths of the world cannot afford such high-mindedness. It is true that for all their contributions, big, proud, securely financed organizations are not always fun to work with. They offer few bargains. But they do have the luxury of assigning people to worry about standards, systems, and details. With secure market share, they can help out weaker firms and niche producers. They also can impose private and semipublic taxation systems in the public interest. Stiff rates for long-distance calls helped the Bell System keep local residential service cheap and reliable before its 1984 breakup. The British Broadcasting Corporation's license fees supported in-house symphony orchestras. The Ivy League's stratospheric tuition permits guaranteed financial support for low-income students. These attitudes and practices are what IBM, DuPont, Merck, and others have, at least in the past, shared with the British Museum, the former Soviet Academy of Sciences, the great universities, and at different times the Benedictines and Jesuits.

The fate of deep organizations may also have a powerful affect on the content that will travel on the NII—and, for that matter, via conventional media. Thin is a polite term to describe much of what is now produced. Creating innovative, exciting projects to feed the NII will be an immense challenge. Editors and producers already struggle to find good work in conventional form. Commercial media depend not only on the marketplace but on deep organizations, with their academic salaries, libraries, and computer centers. Even so, more and more high-quality books and documentary films have shifted from the commercial economy to more or less deep, subsidized, nonprofit institutions, such as university presses and public television. And these, too, are under financial pressure that new technology will not relieve. Somehow people have to be paid to produce new knowledge.

Financiers, journalists, and even customers once respected depth, even if they did not always like the haughtiness and conservatism that often accompany it. But depth seems to be waning, and nobody knows whether institutional leanness will turn out to be technological anorexia.

Can we substitute new broad structures for depth? Can a network take the place of deep organizations? Using programs like Gopher and Mosaic, can the newly empowered masses navigate their way to new knowledge and connections? Once more, the Net is all too much like real life.

For people who belong to an existing community, whether it is a corporation or a research project involving a dozen or more universities, the Net can be a powerful tool for collaboration. Yet as communication specialist Phil Agre has pointed out in a document widely circulated on the Net, the system does not alter certain fundamental human truths. Behind electronic communications there are still the same three-dimensional people, occupying the same points in space and time, and having the same power. The Net mirrors their social structure. An "alias group" of six, a dozen, 50, or more researchers or administrators seems to form a key social unit of the Net. They are another expression of what the sociologist Diana Crane has called "invisible colleges"—communities of researchers intensely concerned with the same problems, such as earthquakes in southern California. In general, the more prominent a person, the more likely that most of his or her time on the Net will be spent with these close electronic collaborators, not chatting with casual inquirers.

The reticence and indifference of much of the elite makes space for the rest of us, allowing the bright graduate students, postdoctoral fellows, and some assistant professors to shine. It encourages people from related fields to join discussions. But the silence of the Establishment also creates problems. On a science-

studies mailing list (an automated bulletin board for subscribers, sometimes open to all and sometimes not) I once saw a call for action against the Acoustic Thermometry of Ocean Climate (ATOC) for using sound waves to measure possible effects of global warming in the oceans. The author predicted ear injuries fatal to thousands of whales and other marine mammals. Disturbed, I consulted a colleague and through the Net he was able to search the resources of the Scripps Institution of Oceanography in La Jolla, California, and retrieve page after page of description and environmental defense of the project. Nobody at Scripps or elsewhere had posted a rebuttal to the original item on the list—they may not even have seen it. Somebody who relied only on the list would not have enough evidence. ATOC *might* still be hazardous to marine life, but the Scripps people had a good case that it would not be. Unfortunately, the case was not made when and where it should have been.

"On the Internet, nobody knows you're a dog."

Anonymity is a major feature of social existence in the on-line world, allowing users to shed, for better or worse, all manner of inhibitions.

There are excellent, balanced discussions on Net lists as well as dreadful ones. The expertly moderated Risks Digest (available as *comp.risks* on most systems offering news groups), one of the best, is an invaluable chronicle of cautionary tales and informed opinion on the hazards of computing. But in most lists, lacking participation by the best and most active minds in the field, exchanges may be irregular and turnover rapid. Flaming—the practice of sending scorching reproofs and rejoinders via E-mail—is less common than I had expected, but what might be called fading (just dropping out) is endemic. So are drift and fatigue. Where the Net excels is less in evaluating ideas than in pooling factual intelligence. It is a great place to get suggestions for a reading list on almost any subject. If one needs a reference on the origin of left- and right-hand driving rules, on the location of a 19th-century French artist's papers, on the refraction of light through water, or on Aristotle's rhetorical terminology, the Net is superb. But it is an impractical substitute for any other form of learning, and is likely to stay that way.

The real test of breadth, though, is not the experience of academics, writers, scientists, and technical people in discussion groups. Most of these people are connected in some way with a deep organization, even if they are independent professionals or entrepreneurs. Nor is it the medical use of networks. What the Clinton administration wants is much broader: access for

all citizens and connections for all primary and secondary schools. If the old AT&T was the ultimate deep organization, the American public schools are the consummate broad organizations, curiously like the Net in their loose coordination and grouping in autonomous districts.

Americans are proud of depth but not always convinced it pays. They are even prouder of breadth, though, and the political support for the NII shows it. In a December 1993 speech, Vice President Al Gore declared that "broadcasts, telephones, and public education were all designed to diminish the gap between haves and have nots" (a debatable assertion), that the NII should do the same, and that "schools and our children are paramount." He went on to call for giving "every child access to the educational riches we have in such abundance."

Admirable as the idea of wiring all schools sounds, it is financially not a simple thing. As the vice president himself noted, only one-quarter of all schools possess even a single modem, even though one can be had for about $100. And wiring and hardware are only a small part of the true cost of computerizing. Far greater costs accrue in the time specialists spend installing, maintaining, and debugging equipment and software. Computer prices may be dropping, but these hidden costs of computing are not. Indeed, some have been rising sharply as hardware and software manufacturers discontinue free telephone support services for customers.

Setting aside such difficulties, the real challenge to breadth is the character of the educational software on the future NII. Vice President Gore seems to assume that this material already exists in "abundance." But does it? True, vast amounts of literary, scientific, artistic, and musical material can now be transmitted electronically, and more will certainly become available. Even at today's prices, a book can be scanned and digitized for under $10; a library of 10 million volumes could be scanned for a price modest by Washington standards. In the near future, students presumably will be able to download great books, hear symphonies, visit the great art galleries of the world, and so forth. But the vice president may be missing the point.

Using any resource demands what social scientists call "tacit knowledge": skills and ideas that may not be recorded in written form but that arise from person-to-person learning and experience. One of the functions of computer networking at the highest professional levels is to draw on just this kind of experience. An expert radiologist, for example, may see patterns in a nuclear magnetic resonance scan sent over the Net that most other physicians would probably overlook. My colleagues in structural geology and geophysics can see things in plots of seismic data that elude even many experienced petroleum geologists. The Net lets people with a high degree of tacit knowledge share it with others at similar levels.

The anthropologist and computer writer Bryan Pfaffenberger shows in *Democratizing Information* (1989) that even for adults, using on-line information depends on tacit knowledge acquired through personal interaction, information and skills that may not be documented anywhere. Someone beginning to study a subject, whether as a schoolchild or an

The E-Mail Crisis

More than half of all traffic on the Internet is E-mail, and much of that is inconsequential chatter. After raising the subject of electronic communication in the New Yorker, *writer John Seabrook was deluged with E-mail, including the missive below.*

From: peter911sc@aol.com

Real problem with the Information Superhighway is typified by this letter: God only knows how many idiots like me will tie up your time with responses.

adult, needs these hard-to-define abilities. Learning any game or skill requires immersion in a group of people who already have the skill. Weight training can improve an athlete's game, and a flight simulator can sharpen a pilot's abilities, but machines cannot develop a skill that is not already there.

Networked information can develop and extend skills that have already been taught by schools. And many computer operations are becoming important skills in their own right. It is another thing, however, to expect networked software to replace the social world of the school as a social order of teachers and learners. We do not really know what learning is, and we do not understand why some people are so much better at teaching and learning than others. We certainly do not know how to teach a computer to teach. By brute force, today's dedicated chess computers can defeat even grandmasters in the speed game. What programs alone still cannot do is tutor an average beginner to expert level. Even if the same material is available free to all schools, students without a strong basis in tacit knowledge will benefit far less than those who have it. If the haves and have-nots are treated equally, then the gap between them will probably grow, not shrink.

When it comes to building better software for a future Net, educators are likely to find another unpleasant surprise. The better and more powerful the hardware and the greater the network bandwidth, the more expensive software may be to produce. As the historian Steven J. Ross has pointed out, the improved production values of motion pictures after World War I increased costs and helped concentrate power in major studios. Labor unions and political dissenters had far fewer opportunities to get their views into national distribution. While improving the medium, technology had helped multiply producers' expenses. In the 1990s, movies with spectacular electronic special effects, such as *Terminator 2* and *Jurassic Park*, have had the biggest budgets. Educational animation and sound are unlikely to reach the same stratosphere of cost, but software development remains both labor intensive and risky; some of today's acclaimed educational CD-ROMs have sold only a few thousand copies. The outlook for high-quality products is good, but they will not be cheap, and in one way or another they will need heavy public financing, especially if equity is a concern. How will schools that can barely afford almanacs pay for on-line multimedia software?

If the deep organizations that developed the Net are in trouble and the broad organizations do not yet provide the base that can take advantage of it, what can the future of an NII be? We already have multiplied our ability to communicate and to collaborate. Our problem, and the challenge of any future network, is that we have multiplied it all too well. Communication is the only thing in society that risks self-destruction as it is multiplied. Imagine an Infotopia in which any person or organization could send a multimedia file of any size to anyone else, at almost no charge. Infotopia would collapse almost instantly. Many people already resent junk E-mail and incipient advertising on the Internet. Newsgroups, the discussion forums that are probably the best-known feature of the Net, are already dangerously unwieldy just because of the growing volume of traffic. That does not mean the Net itself is going to collapse, but only that selection and self-selection are going to grow.

It might be time to think again about the overused but unavoidable superhighway metaphor. Roads and networks do have something important in common. Both make it easier to work with people dozens, hundreds, or even thousands of miles away. And both thereby give you an alternative to getting along with the people next door. You can get out of uncomfortable situations. You can limit your visits to people who share your interests, biases, and outlook. And if your new space becomes unpleasant, why, you can move again. Building suburbs and exurbs is

not so different from building networks.

Yes, networks can help people strengthen neighborhoods and communities. But they also encourage people to find ways out. Unhappy with your schools? Join the parents who have turned to home schooling. Teaching materials and mutual support are already available on-line, and home educators have been using electronic mail effectively to organize and lobby for their rights. Their children may learn all they need to, but the economist Albert O. Hirschman has pointed out that when the most quality-conscious users are free to leave a troubled system, whether railroads or schools, the system suffers further by losing its most vocal critics. Any future information network will help unhappy people secede, at least mentally, from institutions they do not like, much as the interstate highway system allowed the affluent to flee the cities for the suburbs and exurbs. Prescribing mobility, whether automotive or electronic, as an antidote to society's fragmentation is like recommending champagne as a hangover remedy.

Equality, like community, can also be elusive. We have seen that much of the real business of the Net is invisible to most of the people on it, not through elitist conspiracy but through operational necessity. It turns out to be not an alternative world but an extension of the conventional world and its hierarchies. For example, the Net in its majesty grants to the faculties of rich and poor universities equal electronic means for filing grant applications, but if government panels include affiliation snobs (as they often do), all the equal access in the world will not help the first-rate applicant from the second-rate school. Electronic networks, like highways, may bring you to the door but won't necessarily let you in, or upstairs.

Why are so many people ill at ease with the administration's proposals for telecommunications law reform? It's because of the assumption that more flexible regulation will unleash investments that will open a cornucopia of knowledge. It's because of the claims that a system can assure universal affordable access *and* respect copyright as we know it. But above all, it's because of the tendency of communication to divide people as effectively as it unites them. What desperately needs attention is not tomorrow's infrastructure but the knowledge base, in depth and breadth, on which it will depend.

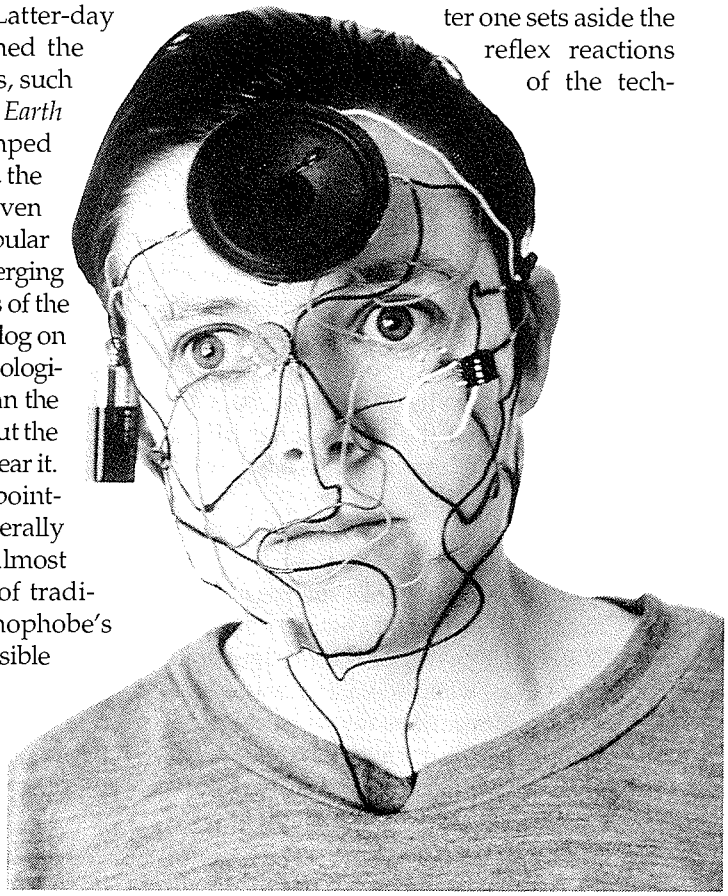
THE CULTURAL CONSEQUENCES OF THE INFORMATION SUPERHIGHWAY

BY TOM MADDOX

The coming of the information superhighway, or, more modestly, the National Information Infrastructure (NII), has reanimated America's running debate about the vices and virtues of technology. It has also reshuffled the ideological deck in interesting ways. Latter-day counterculturalists who have joined the ranks of the technological optimists, such as Howard Rheingold of the *Whole Earth Review*, find themselves encamped alongside the likes of George Gilder, the onetime apostle of Reaganomics. Even as Theodore Roszak, one of the popular prophets of the 1960s, assails the emerging "cult of information," staid members of the academic establishment scramble to log on to the Internet. In truth, these new ideological divides are little more helpful than the old, for it is as right to be hopeful about the future unfolding before us as it is to fear it.

As technophobes are fond of pointing out, technology's effects are generally unpredictable, often negative, and almost always produced at the expense of traditional ways of life. From the technophobe's point of view, therefore, a moral, sensible response to the NII is to reject it in principle and fight against it with whatever means are at hand—to sabotage it intellectually and combat the policies that would bring it into being.

Persuasive as some of its concerns may be, such a neo-Luddite view of the NII seems beyond the pale of serious consideration. As a people we are wont to explore the paths along which our desire leads us, and it seems virtually foreordained that our desire will lead us to build and use the NII. Even after one sets aside the reflex reactions of the tech-



nophobe, however, there is much reason to feel uncertainty and anxiety over the NII. The history of electronic media, especially television, is a powerful reminder that new information technologies can easily be turned to malign ends. Through advertising and other means, they have been used not only to exploit our hearts' desires but to manufacture new ones. Along with the specter of greater government control over citizens' lives that becomes possible with the new information technologies, this "commodification of desire" must be considered one of the darker prospects of the NII. Add to it the inescapable unease one feels in contemplating a wired world, an almost subliminal fear of the accession of what historian Manuel de Landa, in *War in the Age of Intelligent Machines* (1991), calls the "machinic phylum"—the set of things that operate according to the machine's laws of rationality and order. To put these fears more succinctly, with the NII, it seems likely that the machines will grow stronger, as will marketers and governments.

It is possible that another, less defined group, at once the weakest and least organized and also the most numerous, subtle, and relentless, can wrest control of the NII. That is the group of each of us, insofar as we represent ourselves and not the need to consume, on the one hand, or to behave obediently, on the other—each of us as we represent what the philosopher Michel Foucault called "a certain decisive will not to be governed."

Certainly, in many situations this group has virtually no voice and no power. Against it, Foucault insisted in books such as *Madness and Civilization* (1961) and *Discipline and Punish* (1975), is the power of the modern state. And there is as well the vast array of businesses and organizations that exist primarily to sell us images of our wants and needs, to ply us with our own fantasies. Their most effective and characteristic medium is commercial television, where the advertising surrounds and overwhelms a content that, as MTV videos and elaborate "infomercials" illustrate, increasingly becomes indistinguishable from it.

The same groups can be seen working, along with others, to create the NII. Government spokespersons and telecommunications industry flacks ply the media promising manifold blessings, at least to citizens of the United States. "All Americans have a stake in the construction of an advanced National Information Infrastructure," according to a U.S. government "Agenda for Action." "Development of the NII can help unleash an information revolution that will change forever the way people live, work, and interact with each other." In *Business Week*, an MCI Telecommunications ad fantastically asserts: "The space-time continuum is being challenged. The notion of communication is changed forever. All the information in the universe will soon be accessible to everyone at every moment." All because of a dream known as the information superhighway and a vision known as network MCI. The pitchman's hyperbole and the government's bland assurances alike should tell us that we are being hustled, worked—like a crowd standing in front of the ring-toss stand at a traveling carnival.

Note the two passages' common theme of changing things forever: "communication," according to MCI; "the way people live, work, and interact," according to the government. Oddly, just here, where the hyperbole appears to be at its worst, both advertising agency and government are telling the simplest of truths: Should the NII come to pass, it will change things forever. Like the magician's showy gesture or the pitchman's barked promise, these declaiming voices serve to distract our attention from something else: in this case, the subtler, more disturbing truth that no one—neither the White House nor MCI nor anyone

***Tom Maddox** is writing coordinator at Evergreen State College. He is the author of* Halo *(1991), a science fiction novel, and a columnist for* Locus *magazine.*

else—can predict the nature of the changes that will be brought about by the NII.

Consider some of the characteristic technologies of the last 100 years: the telephone, the automobile, the radio, the television, and the computer. At the time of their inception and for many years afterward, no one understood the implications of their invention and use. Sociologist Colin Cherry, writing about the history of telephone systems, says, "The new invention can first be seen by society only in terms of the liberties of action it currently possesses. We say society is 'not ready,' meaning that it is bound by its present customs and habits to think only in terms of its existing institutions. Realizations of new liberties, and creation of new institutions means social change, new thought, and new feelings. The invention alters the society, and eventually is used in ways that were at first quite unthinkable." That the automobile would become such a common killer of adolescents, for example, or the telephone a powerful instrument for the gratification of a distinctive brand of aural sexual pleasures that did not exist as such before its invention—who could have predicted these and a myriad other such things?

"Mechanical properties do not predestine the development and employment of an innovation," social historian Claude Fischer notes in his study of the social consequences of the telephone, *America Calling* (1992). "Instead, struggles and negotiations among interested parties shape that history. Inventors, investors, competitors, organized customers, agencies of government, the media, and others conflict over how an innovation will develop. The outcome is a particular definition and a structure for the new technology, perhaps even a 'reinvention' of the device."

One could write the history of the broadcast media in the United States in very similar terms. When radio stations began broadcasting in the 1920s, they sprang up almost at random and did pretty much what they wanted. "Radio" was still up for grabs; the nature of the medium was undefined. Advertisements, for example, were extremely controversial in the early days, many people (including Secretary of Commerce Herbert Hoover) holding that the airwaves should be employed for the public good, not for commercial purposes. In 1927, motivated in part by the need to keep stations on separate wavelengths, Congress created the Federal Radio Commission (FRC), directing it to regulate the radio waves according to "public interest, convenience, and necessity." This remains the standard for the regulation of broadcast media today by the FRC's successor, the Federal Communications Commission, the justification for de facto censorship of radio and television and other regulation of program content.

There were dissenters, of course. Radio preacher Aimee Semple McPherson, who in fact trampled all over other stations' wavelengths, telegraphed Washington:

> PLEASE ORDER YOUR MINIONS OF SATAN TO LEAVE MY STATION ALONE STOP YOU CANNOT EXPECT THE ALMIGHTY TO ABIDE BY YOUR WAVE-LENGTH NONSENSE STOP WHEN I OFFER PRAYERS TO HIM I MUST FIT INTO HIS WAVE RECEPTION STOP

Despite her plea, the situation was becoming clear: If the Almighty wanted to go on radio, he would have to play by the U.S. government's rules. Anybody who has listened to much radio or watched much television can draw his or her own conclusions about how well those rules have served the public interest, the public convenience, or the public necessity. Whatever defects unregulated radio and television might possess theoretically, it is difficult to imagine that they would be more numerous and thoroughgoing than those of the existing regulated varieties.

The NII today is in a condition much like that of radio during the 1920s. The stakes, however, are much greater. Through the NII, it may become possible for businesses and

"Emoticons" (viewed sideways) are a popular form of expression among some E-mail users. These are from the book Smileys *(1993).*

:-)
standard smiley

:-(
sad smiley

:-D
very happy smiley

:-o
amazed smiley

arms of the government to acquire an intimate knowledge of every citizen—what we love and hate, what compels us and what we ignore—and with it perhaps the ability to manipulate our needs and our behavior. Every choice we make could be recorded, as could every moment of consumer bliss or image consumption. We could be profiled in terrifying detail, almost casually, as a kind of side-effect of the network software. Viewed this way, the NII becomes the Panopticon triumphant, to borrow Michel Foucault's notion of a machine for constraining our desire within socially acceptable limits, on the one hand, and commercially viable ones, on the other.

The experience of the Internet suggests how this can be prevented. It shows that the individual users of telecommunications and computer technology can sometimes achieve a kind of victory by wresting control of the technology. Originally created by the Pentagon to keep defense-related computers connected even in the aftermath of a nuclear war, the Internet has become one of the prime sites of many kinds of individual and collective activity. Almost from the beginning, the Internet has served the individual's purposes with enormous flexibility—as much as, if not more so, than it has served the institutions that brought it into being. As personal computers became nearly ubiquitous during the 1980s and Internet connections commonplace, they unlocked possibilities entirely unforeseen by the technicians or the managers who oversaw the system. Defense Department bureaus found their employees swapping recipes; staid and reputable organizations of all sorts found their members or employees engaging in unlicensed and uncontrolled debate, discussing the theory and practice of sado-masochism or chatting about whatever they wished with people from all over the world. In short, while the technology (of computers and networks) made such things possible, it neither anticipated nor encouraged them, nor could it stop them.

Perhaps we can expect more of the same from the NII. If, as seems likely, there emerges out of today's struggles and negotiations over the new medium considerable freedom for individuals in their use of the NII, people will exploit it in currently unimagined and unsanctioned ways. To many people, some of what occurs will seem wasteful, disgusting, obscene, sexist, racist, even criminal; to others, merely vulgar and depressing. Some already lament the waste of network resources—or "bandwidth"—resulting from the storage and transmission of binary files of explicit sexual images or from "anti-social" modes of behavior such as "flaming" (i.e. sending abusive E-mail to an individual one finds annoying). Such practices stand as honorable evidence of that "certain decisive will not to be governed," and so we must protect them above all, as we must protect the speech that most offends us and the religious beliefs we find most stupid and repulsive.

Presidential smileys

=I:-)
Abe Lincoln

:(=)
Jimmy Carter

:'}
Richard Nixon

7:^]
Ronald Reagan

=:o]
Bill Clinton

In fact, because the new information technology we are creating seems to lend itself more readily to improvisation and freedom than to rigid planning and control, it is not unreasonable to hope for triumph. Still, the possibility remains that the NII could turn into a largely one-way street, one where "consumers" receive information but will not have freedom to retransmit or alter it. This is the "500 channels of TV" model, the worst scenario for the future because it implies an audience composed of inert consumers and passive paracitizens, easily manipulated by any technically adept spin doctors with access to the profiles. Many of today's cable television providers are eager to offer just this sort of service.

The history of American broadcast media is not greatly encouraging. Network and local programming alike have proceeded according to unspoken canons of propriety that defy adult standards of free speech and journalistic practice. As a result, we have a national standard of infantilized media, which allow necessary human chaos only as it sneaks through in the form of eroticized violence and violent eroticism, both typically subtextual, subliminal, and dishonest. If we wish the NII to escape such a malign fate, we should work toward an opaque and open NII, one that, for instance, allows universal and near-anonymous access, guarantees the individual the right (which the government does not currently do) and means to encrypt information, and provides individual control over content, both outgoing and incoming. Taken together, these technical attributes would combine to create an NII that might actually serve us without entangling us even more in the embrace of commercial and governmental forces.

Telecommunications and computer technologies are themselves also forces to contend with. Building the NII, we create a vast and productive niche for the enlargement of de Landa's "machinic phylum," worlds in which machines can grow and evolve, and this eventually may have profound implications for human consciousness. Even in the relatively primitive forms it takes today, information technology seems to encourage a fixation on virtual rather than real experience—on technologically mediated perception, not direct apprehension. It can also saturate us in a hypnotic image-repertoire that works to render us passive and dream-struck no matter who, if anyone, controls it.

%*@:-(
smiley with hangover

:-{#}
smiley with braces

=8->
nerd smiley

M-) :X) :-M
see no evil, hear no evil, speak no evil

Marvin Minsky, the dark knight of the information age, generally considered, along with John McCarthy, one of the founding fathers of the field of artificial intelligence, said in a speech a few years ago that he preferred virtual sunsets to real ones because the virtual sunset could be constructed so as to be perfectly enjoyable. Provocative lunacy, I thought at the time, not realizing how many people agree with him.

The virtual can seduce us because it offers the promise of being completely shaped to our wishes, while the material world remains refractory—there we suffer and die and live out fates that cannot be edited or replayed to render them more beautiful, more charming, less disastrous. The virtual worlds we can master, the material world we cannot. Even the most open model of the NII—one that does not lock individuals into passive roles as consumers and citizens—forces us to contend with this dialectic of virtual and real, and especially with the ethical dimensions of an allegiance to the virtual.

As the electronic media make us more aware of conditions around the world—or, at least, of images of such conditions—we realize how much horror exists and how

Dark Days on the Net

The many virtues of the Internet are being undermined by the system's sudden popularity and rapid democratization, staff writer Paul Wallich observes in Scientific American *(March 1994).*

Someday the Internet may become an information superhighway, but right now it is more like a 19th-century railroad that passes through the badlands of the Old West. As waves of new settlers flock to cyberspace in search of free information or commercial opportunity, they make easy marks for sharpers who play the keyboard as deftly as Billy the Kid ever drew a six-gun. Old hands on the electronic frontier lament both the rising crime rate and the waning of long-established norms of open collaboration.

It is difficult even for those who ply it every day to appreciate how much the Internet depends on collegial trust and mutual forbearance. . . . Most people know, for example, that E-mail messages can be read by many people other than their intended recipients, but they are less aware that E-mail and other communications can be almost tracelessly forged—virtually no one receiving a message over the Net can be sure it came from the ostensible sender.

Electronic impersonators can commit slander or solicit criminal acts in someone else's name; they can even masquerade as a trusted colleague to convince someone to reveal sensitive personal or business information. Of those few who know enough to worry about electronic forgeries, even fewer understand how an insidiously coded E-mail message can cause some computers to give the sender almost unlimited access to all the recipient's files. . . .

In the early days, only researchers had access to the Net, and they shared a common set of goals and ethics, points out Eugene H. Spafford of Purdue University. . . . A lack of security . . . did not bother anyone, because that was part of the package, according to Dorothy E. Denning, a professor of computer science at Georgetown University: "The concerns that are arising now wouldn't have been legitimate in the beginning." As the Internet grew, however, the character of its population began changing, and many of the newcomers had little idea of the complex social contract—and the temperamental software—guiding the use of their marvelous new tool.

By 1988, when a rogue program unleashed by Robert T. Morris, Jr., a Cornell graduate student, brought most Internet traffic to a halt for several days, a clear split had developed between the "knows" and the "know-nots." Willis Ware of the Rand Corporation, one of the deans of computer security, recalls that "there were two classes of people writing messages. The first understood the jargon, what had happened and how, and the second was saying things like, 'What does that word mean?' or 'I don't have the source code for that program, what do I do?'"

Since then, the Internet's vulnerability has only gotten worse. . . . Moreover, as the Internet becomes a global entity, U.S. laws become mere local ordinances. In European countries such as the Netherlands, for instance, computer intrusion is not necessarily a crime. Spafford complains—in vain, as he freely admits—of computer science professors who assign their students sites on the Internet to break into and files to bring back as proof that they understand the protocols involved. . . .

If the Internet, storehouse of wonders, is

connected we are to it. Thus, despite our prosperity and plenty, we find ourselves intolerably affronted by images of disease and destruction. We do not wish to see starving children or piled-up bodies as we wait for our evening meal. However, through the virtual worlds we master the horrors, discovering ways to prevent them from deeply disturbing our composure. And virtuality has a wide domain. The Holocaust becomes a museum and a Spielberg movie, a spectacle, as the Situationists say,

also a no-computer's-land of invisible perils, how should newcomers to cyberspace protect themselves? Security experts agree that the first layer of defense is educating users and system administrators to avoid the particularly stupid mistakes. . . . The next level of defense is the so-called fire wall, a computer that protects internal networks from intrusion. Most major companies have long since installed fire walls, and many universities are adopting them as well. Fire walls examine all the packets entering and leaving a domain to limit the kinds of connections that can be made from the Internet at large. They may also restrict the information that can be passed across those connections. . . .

Encryption could provide not only privacy but authentication as well: Messages encoded using so-called public-key ciphers can uniquely identify both recipient and sender. But encryption software in general remains at the center of a storm of political and legal controversy. The U.S. government bars easy export of powerful encoding software even though the same codes are freely available overseas.

Within the United States, patent rights to public-key encryption are jealously guarded by RSA Data Security, a private firm that licensed the patents from their inventors. Although software employing public-key algorithms has been widely published, most people outside the U.S. government cannot use it without risking an infringement suit.

To complicate matters even further, the government has proposed a different encryption standard, one whose algorithm is secret and whose keys would be held in escrow by law-enforcement agencies. Although many civil libertarians and computer scientists oppose the measure, some industry figures have come out in favor of it. . . . The question is not whether cyberspace will be subjected to legislation but rather "how and when law and order will be imposed," says Donn B. Parker of SRI International. He predicts that the current state of affairs will get much worse before the government steps in "to assure privacy and to protect the rights people do have."

Others do not have Parker's confidence in government intervention. Marcus J. Ranum of Trusted Information Systems foresees an Internet made up mostly of private enclaves behind fire walls that he and his colleagues have built. "There are those who say that fire walls are evil, that they're balkanizing the Internet," he notes, "but brotherly love falls on its face when millions of dollars are involved."

Denning counts herself among the optimists. She lends her support to local security measures, but "I don't lose any sleep over security," she says. Farber, also cautiously optimistic, sees two possible directions for the Internet in the next few years: rapid expansion of existing services, or fundamental re-engineering to provide a secure base for the future. He leaves no doubt as to which course he favors. Spafford is like-minded but gloomier. "It's a catch-22," he remarks. "Everyone wants to operate with what exists, but the existing standards are rotten. They're not what you'd want to build on."

Even if computer scientists do redesign the Internet, he points out, putting new standards in place may be impossible because of the enormous investment in old hardware and software. So much of the Internet rests on voluntary cooperation, he observes, that making sweeping changes is almost impossible.

and we watch and weep yet are strangely exultant at the end of it all, and why not? We are alive and have our technology to instruct and amuse us. Today the corpses pile up in Bosnia (or was that Croatia?) and Rwanda, and the day's bald television images and puerile narrations haunt us, but tomorrow they will have become elements of an aesthetically rewarding film.

The NII will serve us efficiently in this regard. In Wim Wenders's film, *Until the End of the World* (1992), characters become addicted

to image technology, lost in reliving memories of their infancy through a device that turns their thoughts into pictures. The NII would not grant us this power, but it would put rich, complex sets of images at our command—"All the information in the universe will soon be accessible to everyone at every moment"—and thus generate the potential for its own kinds of addictions: to beautiful images and to virtuality itself.

Ultimately, the NII finds us being ourselves in the late 20th century: caught in the web of our own fantasies, governed by forces that inscribe their orders into our being, fighting nonetheless, through a stubborn will, to manifest something like authentic individual desire. The sharp-edged technology of the NII can cut a number of ways: It can enlarge the domain of the commodifiers and controllers; it can serve the resistance to these forces; it can saturate us all, controlled and controllers alike, in a virtual alternative to the real world.

Meanwhile, most of humanity will live and die deprived of the wonders of the NII, or indeed of the joys of adequate nutrition, medical care, and housing. We would do well to regulate our enthusiasms accordingly—that is, to remember where love and mercy have their natural homes, in that same material world. Otherwise we will have built yet another pharaonic monument to wealth, avarice, and indifference. We will have proved the technophobes right. More to the point, we will have collaborated to neglect the suffering of the damned of the earth—our other selves—in order to entertain ourselves.

Yet as William Gibson says in *Neuromancer* (1984), the canonical work of cyberpunk science fiction, "The Street finds its own uses for things," the Street referring to the unauthorized, unsanctioned play of human desire. Thus, we can approach the NII in a properly skeptical or suspicious frame of mind and yet remain open to its possibilities. After all, the Internet has shown that even a technology designed to enable the military to fight on after a nuclear holocaust can be made to serve the unfettered human imagination. With this experience to guide us, it is possible, perhaps even likely, that the same can be accomplished with the NII.

WIRED FOR WHAT?

If you have not yet visited cyberspace—and most Americans have not—no amount of description can quite do it justice. The next best thing to a visit to this nerdy netherworld may be a run through **The New Hacker's Dictionary** (MIT, 2d ed., 1993), compiled (from on-line data bases) by Eric S. Raymond. There, among the inscrutable definitions of inscrutable terms such as "pessimizing compiler" and "sandbender," one learns that to gweep is "to hack, usually at night," and that to hack is, among other things, "to work on something (typically a program)." One definition seems to distill the essence of hacker existence:

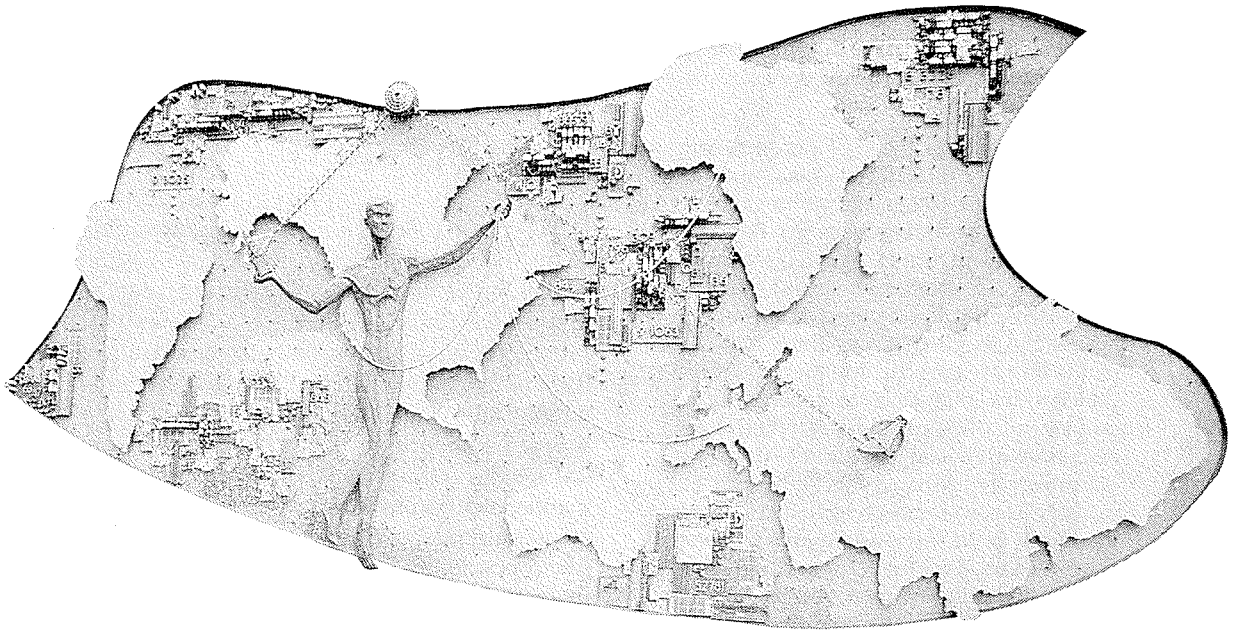
> **ha ha only serious** [from SF fandom, orig. as mutation of HHOK, 'Ha Ha Only Kidding'] A phrase (often seen abbreviated as HHOS) that aptly captures the flavor of much hacker discourse. Applied especially to parodies, absurdities, and ironic jokes that are both intended and perceived to contain a possibly disquieting amount of truth, or truths that are construction on in-joke and self-parody. This lexicon contains many examples of ha-ha-only-serious in both form and content. Indeed, the entirety of hacker culture is often perceived as ha-ha-only-serious by hackers themselves; to take it either too lightly or too seriously marks a person as an outsider, a **wannabe**, or in **larval stage**. For further enlightenment on this subject, consult any Zen master. See also **Humor**, **Hacker**, and **AI koans**.

As the avant-garde of cyberspace, the tiny minority of hackers has so far set the tone, albeit more on the Internet than on the smaller, commercial on-line services such as Prodigy and America Online. (The latter apparently are a bit too user-friendly, with their flashy graphics and easy-to-follow instructions, for most self-respecting technically minded sorts.) In both realms, useful deposits of highly specialized information can be found and retrieved. Alas, many of the bulletin boards and discussion groups, those oft-proclaimed waves of the future, are less than scintillating, with dialogues (or monologues) conducted at a level of sophistication closer to that of the exchanges that occur on the walls of public restrooms than to the great intellectual salons they are often compared to. This world still awaits its chronicler—with luck we may find a book called something like *Dave Barry Goes On-line* stacked by the front door of the local bookstore someday. In the meantime, some insight into on-line goings-on can be gleaned from three magazines (listed in order of increasing distance from the mainstream): *Wired*, *Whole Earth Review*, and *Mondo 2000*. Each has its virtues, but each takes its subject perhaps a bit too seriously. The hacker's smirks—HHOS—that are allowed do not intrude upon the sense, à la *Star Trek*, that readers are boldly going where no one has gone before.

The bookstores *are* full of Internet guide books and directories, and the thinking individual will quickly deduce from the impressive thickness of these volumes that cyberspace is not an easy place to get around in. It is another one of the dirty little secrets of the Internet that conditions on this trendy data highway are quite primitive. Not only are there obscure codes and commands to memorize and all manner of other obstacles to overcome, but there are a multitude of mundane perils, such as the dread possibility (some would say likelihood) that a burst of static on the phone line or some other mysterious occurrence will freeze the cybertraveler's computer—causing him or her to become "hung" or "wedged," according to the *New Hacker's Dictionary*—and forcing a time-consuming withdrawal from the Internet. In any event, the classic introduction to the Internet is Brendan P. Kehoe's **Zen and the Art of the Internet** (Prentice Hall, 2d ed., 1994). **The Whole Internet User's Guide & Catalog** (O'Reilly & Associates, 2d ed., 1994) is one of the oldest and still one of the best of the rising pile of more detailed manuals. Another useful volume is Paul Gilster's **Internet Navigator** (John Wiley & Sons, 1993).

What the guidebooks do not make clear is that learning even the basics of the Net, not to

mention active "Netsurfing," requires a considerable commitment of time. Moreover, a guidebook or two is not really enough to help one get around; human guides and informants are needed. *The New Hacker's Dictionary* speaks of the "guru" ("An expert. Implies not only *wizard* skill but also a history of being a knowledge resource for others"), but this seems too exalted a term to describe what average users need (and the kind of knowledge they are likely to find on the Net). The Net's labyrinth-like quality, as well as the patchiness and recalcitrance of its resources, suggest a more medieval metaphor: the monk.



In fact, medievalism already is an undercurrent in some corners of the Net. A popular segment of the Net is Multi-User Dungeons (MUDs), where users can assume imaginary identities and play out elaborate games set in outer space or King Arthur's Court. Among the various futurists who have tried to think about the consequences of the Net and whatever kind of information superhighway eventually grows out of it, however, the medieval model—of a segmented society of electronic communities—is little discussed. Rather, the optimists among them—and most of them are optimists—tend to see the world moving toward some sort of One-

ness through technology.

At one extreme is Walter B. Wriston, the former chairman of Citicorp, who writes in **The Twilight of Sovereignty: How the Information Revolution is Transforming Our World** (Scribner's, 1992) that the information revolution is empowering individuals and boosting markets while it undermines the powers of nations and corporations. "As long as capital consisted largely of factories, heavy equipment, and natural resources, government felt free to impose rules and exact payments with no fear that the nation's capital base would steal away in the night. Extreme impositions would reduce productivity—the Communist economies never worked very well—but on the whole government held the cards." None of this is possible anymore, Wriston believes. A parallel argument about the collapse of borders is made by Robert Reich, now U.S. secretary of labor, in **The Work of Nations: Preparing Ourselves for 21st-Century Capitalism** (Knopf, 1991).

Wriston's argument is larded with examples of the positive power of information flows, such as that of the Sri Lankan farmers who recently raised their incomes by 50 percent when the coming of telephones allowed them to cut out

middlemen and deal directly with buyers in the capital city of Colombo.

A similarly upbeat note is sounded by George Gilder, imagining the impact of the networked "telecomputer" of the future in **Life After Television: The Coming Transformation of Media and American Life** (Norton, 1992): "Rather than exalting mass culture, the telecomputer will enhance individualism. Rather than cultivating passivity, the telecomputer will promote creativity. . . . Perhaps most important, the telecomputer will enrich and strengthen democracy and capitalism all around the world."

If cyberspace is a place being formed by the convergence of a variety of digital technologies, it is also a place where a degree of political and cultural convergence is taking place. For alongside Gilder, author of the 1981 supply-side treatise *Wealth and Poverty*, stand a variety of distinctly New Ageish sorts. The romance of the Net is best captured in **The Virtual Community: Homesteading on the Electronic Frontier** (Addison-Wesley, 1993), by Howard Rheingold, editor of *Whole Earth Review*. Here, in addition to the best existing reportage on cyberspace in book form, is the idea of electronic community and democracy elevated (albeit cautiously) nearly to utopian heights. In discussion groups and other locales in cyberspace, Rheingold writes, he turns for advice on parenting, collects ideas and information for professional use, engages in political discussion and activism, forms friendships, and shares grief. "In traditional kinds of communities," he writes, "we are accustomed to meeting people, then getting to know them; in virtual communities, you can get to know people and then choose to meet them."

At perhaps the farthest fringe of the optimists' camp—with enthusiastic blurbs from both Gilder and Rheingold—is **Out of Control: The Rise of Neo-Biological Civilization** (Addison-Wesley, 1994), by *Wired* executive editor Kevin Kelly. Resurrecting cybernetics and stirring in, among other things, a few items from William Gibson, the science fiction laureate of cyberspace, Kelly speculates at length about the merger of technology and biology and "the rise of neo-biological civilization."

The critics, of course, have not been silent. In **Technopoly: The Surrender of Culture to Technology** (Knopf, 1992), Neil Postman, a professor of communication arts at New York University, warns of "the Technopoly story." It emphasizes "progress without limits, rights without responsibilities, and technology without cost. The Technopoly story is without a moral center. It puts in its place efficiency, interest, and economic advance." Postman recoils at "neobiological" metaphors: "The computer, it is implied, has a will, has intentions, has reasons—which means that humans are relieved of responsibility for the computer's decisions." In **The Cult of Information: A Neo-Luddite Treatise on High-Tech, Artificial Intelligence, and the True Art of Thinking** (Univ. of Calif., 2d ed., 1994), historian Theodore Roszak offers a similar thought: "The irony behind [information] technology is the tendency it encourages in some of its most talented and enthusiastic developers to cheapen—or even to try to replace—the mind that created the technology in the first place."

James R. Beniger's **Control Revolution: Technological and Economic Origins of the Information Society** (Harvard, 1986), which traces the origins of today's information society to the 19th century, is a useful reminder that technology does not have a life of its own but is created by human beings to serve human ends. Technology, one might conclude, is not destiny.