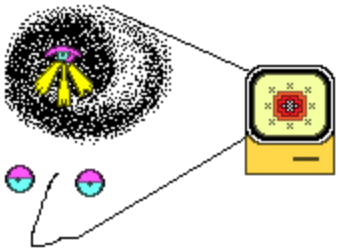

Tools For Thought

by Howard Rheingold

April, 2000: a revised edition of *Tools for Thought* is available from MIT Press including a revised chapter with 1999 interviews of Doug Engelbart, Bob Taylor, Alan Kay, Brenda Laurel, and Avron Barr. ISBN: 9780262681155, 1985 ed, ISBN: 0262681153

> The idea that people could use computers to amplify thought and communication, as tools for intellectual work and social activity, was not an invention of the mainstream computer industry or orthodox computer science, nor even homebrew computerists; their work was rooted in older, equally eccentric, equally visionary, work. You can't really guess where mind-amplifying technology is going unless you understand where it came from.
>
> - HLR

Chapter Fourteen: Xanadu, Network Culture, and Beyond

"*Computer* was a bad name for it. It might just as well have been

called an *Oogabooga Box*. That way, at least, we could get the fear out in the open and laugh at it."

Ted Nelson is one of the most outrageous and probably the funniest of the infonauts. Of pronouncements like the one quoted above, he likes to say, " If that sounds wild, it means you understand it" — a statement that could apply to his life as well as his ideas. He's been called "a tin-pot Da Vinci," and "a weirdo who thinks he's a titan" — and that's how *he* describes himself. Opinion in the computer community is mixed when it comes to the question of whether Nelson will ever amount to anything besides a gadfly, pamphleteer, and tinkerer. He seems to have either inspired or irritated most of the key figures in contemporary computing — academic, commercial, or underground.

Even in a crowd of precocious, eccentric loners, Ted seems to set himself apart from the rest. His fate is less certain than those who started augmentation research in the early 1960s or who created the homebrew computer movement in the mid 1970s. Alan Kay is closing in on the marketable version of his fantasy amplifier. Bob Taylor continues to catalyze the development of on-line intellectual communities. Evans & Sutherland is an extremely successful flight-simulation company, and Ivan Sutherland is a millionaire.

But the idea people in universities and corporate laboratories, the research and development pioneers who made the technology possible, were not the only contemporaries whom Nelson watched and applauded in the mid 1970s as they streaked past him on their way to somewhere. As had happened so often before, some unknown young people appeared from an unexpected quarter to create a new way to use the formerly esoteric machinery. The legend is firmly established by now, and Ted was the first to chronicle it, in *The Home Computer Revolution*.

By the mid-1970s the state of integrated circuitry had reached such a high degree of miniaturization that it was possible to make electronic components thousands of times more complicated than ENIAC — except these machines didn't heat a warehouse to 120 degrees. In fact, they tended to get lost if you dropped them on the rug. In 1971, a team at Intel Corporation developed the special integrated circuits that contained all the components needed to make a fairly powerful von Neumann-type computer — the 4004, followed by the 8008 "computer-on-a-chip."

At the time it was invented, nobody realized that the microprocessor, one of thousands of electronic components

churned out every year, would become a household word. At that point, probably no more than a few score highly placed or technically fanatic people in the world had computers in their homes for their personal use. IBM and DEC didn't exactly see the invention of the microprocessor chip as the signal to start producing consumer computers.

In 1974, a fellow in New Mexico named Ed Roberts, president of a company called Micro Instrumentation and Telemetry Systems (MITS), happened upon the 8008 chip and got a notion. The chip itself was useless to anyone but an electronic engineer. It had an "instruction set" of "firmware" primitive commands built into it, an arithmetic and logic unit, a clock, temporary storage registers, but no external memory, no input or output devices, no circuitry to connect the components together into a working computer.

Roberts decided to provide the other components and a method for interconnecting them and sell the kits to hobbyists. In January of 1975, *Popular Electronics* magazine did a cover story on "a computer you can build yourself for $420." It was called the *Altair* (after a planet in a *Star Trek* episode). Roberts was hoping for 200 orders in 1975, to keep the enterprise alive, and he received more than that with the first mail after the issue hit the stands.

Bill Gates and Paul Allen were nineteen and twenty-two years old when they wrote a version of BASIC for the Altair. They went to New Mexico to work with MITS, developing software for the first hobbyist computers. It had been obvious from day one that a great many people wanted to have computers of their own. MITS had the usual problems associated with a successful start-up company. Roberts eventually sold it. In 1977, Commodore, Heathkit, and Radio Shack began marketing personal computers based on the interconnection method established by the Altair — still known as the S100 bus.

Steve Wozniak and Steve Jobs started selling Apples in 1977 and now are firmly established in the annals of Silicon Valley garage-workshop mythology — the Hewlett and Packard of the seventies generation. Gates and Allen became Microsoft, Inc. Their company sold over $50 million worth of software to personal computer users in 1983. Microsoft is aiming for the hundred-million-dollar category, and Gates still has a couple more years before he reaches the age of thirty.

Alan Kay and Bob Taylor and Ivan Sutherland have already been acknowledged for their past accomplishments, and look forward

to the completion of their future projects under the auspices of well-funded and prestigious organizations. Gates and Allen and Wozniak and Jobs are multimillionaires working on their first billions. They all have what they need to materialize the tools and toys they have dreamed about for decades. Ted Nelson's fortunes, have not (yet) turned out so spectacularly.

What Ted Nelson and his long-suffering associate Roger Gregory have now is a long program written in the "C" language — a program that is either a future goldmine for Ted Nelson and a boon to all humankind, or yet another crackpot boondoggle on the fringes of computer history. Unsettled as his future might be, what he had in the past was the foresight, the orneriness, and the tenacity to talk clearly and plainly about the computer empire's new clothes.

Ted Nelson was another one of the few people who saw the personal augmentation potential of computers early in the game and grasped the significance of the work being done at Utah, SRI, MIT and PARC. Unlike many of the more sheltered academics, he also saw the potential of a hobbyist "underground." Nelson chose to bypass (and thereby antagonize) both the academic and industrial computerists by appealing directly to the public in a series of self-published tracts that railed against the pronouncements of the programming priesthood.

Nelson's books, *Computer Lib*, *The Home Computer Revolution*, and *Literary Machines*, not only gave the orthodoxy blatant Bronx Cheers — they also ventured dozens of predictions about the future of personal computers, many of which turned out to be strikingly accurate, a few of which turned out to be bad guesses.

As a forecaster in a notoriously unpredictable field, Ted Nelson has done better than most — at forecasting. His business and scholarly ventures have yet to meet with success in either the academic establishment or the computer marketplace. He has a history of disenchanting and antagonizing the people who have enough respect for his wild talents to take the risk of hiring him. He's currently on his "third career crash." and still has a while to wait before he knows whether the stock he holds in the company that is going to market his dream will make him a millionaire, thereby vindicating his long struggle, or leave him penniless, thereby branding him as

a bona fide crank instead of a late-blooming visionary.

Like so many other computer prodigies, Ted Nelson started his often lonely and always stubbornly unique intellectual journey when he first realized what they were trying to do to him in school. "I hated school all my life," he claims, "from the first grade through high school, unrelentingly and every minute. I have never known anyone who hated school as much as I did, although my assumption is that other dropouts do."

Despite his repeated clashes with educational authorities, Ted Nelson managed to establish himself as an "extreme loony on campus" at Swarthmore , in the late 1950s, a place and an era where extreme loonies were rather more rare than they became a decade later. He also managed to graduate with an academic record good enough to give him his choice of graduate schools. He decided on Harvard, an institution known to tolerate intellectual arrogance as long as it was accompanied by near-genius originality.

In the fall of 1960, during his second year of graduate school, Ted Nelson found out about computers, and not a moment too soon. He was drowning in his own information, carrying around an already monumental collection of barely collated notes about his abundant dreams and schemes. He found out about Vannevar Bush's paper and embraced the idea that he could use a computer to keep track of his own prodigious stream of thoughts and sketches.

Ted was disappointed to discover that there were no computers equipped or programmed to perform such a service. Down the road at MIT, the first time-sharing computers were only beginning to be built. But Ted needed a storage and retrieval system to keep track of his notes, and it seemed like such an obvious way to use computers as aids to creative thought that he set out to create such a program himself. Twenty-three years later, he admitted: "It seemed so simple and clear to me then. It still does. But like so many beginning computerists, I mistook a clear view for a short distance. "

The Harvard course in computer programming that Ted took in 1960 used the only computer then available at Harvard, the IBM 7090 at the Smithsonian Observatory. As a term project, Ted decided to write a machine-language program that would enable him to store his notes and manuscripts in the computer, to change and edit drafts in various ways, and produce final printed versions. Somewhere around the forty-thousandth line of his

program, it dawned on him that his first estimates of the magnitude of the task — and the amount of time it would take to establish it — had been overoptimistic.

Nelson's inability to create something even though he was able to clearly envision it is not unusual in the software world. The problem is so widespread that one of the unofficial rules of computer programming (known in some circles "Babbage's Law") is: "Any large programming project will always take twice as long as you estimate." Even though the simplest of the text-handling capabilities he specified in 1960 were to become, in the hands of other programmers, the software spearhead of office automation in the 1980s, Nelson went far beyond simple text manipulation in the program he set out to write for his term project.

Like Doug Engelbart, whose work he had yet to learn about, Nelson yearned for more than a lazy man's typewriter. They both wanted the freedom to steer their thought paths in new ways. And Ted especially desired the prerogative of changing his mind. He wanted the freedom to insert and delete words and move paragraphs around, but he also wanted the computer to *remember* his decision path. One of the specs was for something he called "historical backtrack," in which the computer could quickly show him the various earlier alternative versions of his ever-changing text.

"Alternative versions"? From a place to store notes to a tool for sculpting text, his term project had now landed him in even more wondrous science-fiction territory, a place where it was possible to think in terms of parallel alternatives. Of entire libraries of parallel alternatives, and automated librarians to perform the most tedious of searches in microseconds. Why should we abandon any thought at all? Why not just store every variation on everything and let the computer take care of sifting through it when we want to view something?

Ted Nelson was hooked, and desperately wanted to become a "computer person," but came up against the still-prevalent notion that computers are "mathematical." Never one to be accused of excessive modesty regarding his intellectual powers, Nelson admits that he was "a mathematical incompetent." He was even an outsider to those outsiders who were dropping out of MIT and hanging around Building 26. A Swarthmore/Harvard person just wasn't versed in the way Bronx-Science/MIT people talked about computers.

He couldn't find any jobs as a computer dreamer, but he did manage to find a position as a photographer and film editor at a laboratory in Miami where a man named John Lilly was conducting research on dolphin intelligence. Lilly had a very rare piece of instrumentation — one of the original LINC microcomputers designed by Wes Clark. (Nelson didn't use the machine in his work, but its existence convinced him that the idea of small, personal computers was indeed sensible.) After that came a job teaching sociology at Vassar.

Over the next two years, while he taught sociology and thought about the complexities of storing and cross-referencing that had prevented him from finishing his note-keeping program, Nelson realized that he was trying to create a new kind of thing. It was a tool, but it was also a library, and a medium, and a legion of slave-librarians. In the mid-1960s, when he was working at a book firm, he started to call the whole scheme *Xanadu*. He says it is "a traditional name for a magic place of literary memory," but it is worth noting that Coleridge's poem of that name, like Nelson's term project, was unfinished.

By the late sixties, having offended anyone who could help him in the worlds of academic, commercial, and military computing, Ted was free to find a few like-minded and computer-obsessed friends and attempt to write the software that would make Xanadu possible. By this time, he had not only dreamed up the specifications for the full-blown version of this new information processing system, he had managed to attract a few equally fanatic allies.

The basic note-keeping scheme that started it all was meant to have a system for taking care of all backtracking. The next step was to expand this capability to handle alternative versions and to show the user which parts of different versions are the same and which are different. This *versioning* capability, which Nelson now estimates to consume about 5 percent of the Gross National Product — from the boiler-plate paragraphs used by attorneys to the 47 different versions of the 747 design that are stored in Boeing's computers. In real life, there is hardly ever such a thing as "the contract" or "the 747 blueprint." Mixtures of standard and custom features that make for slightly different versions of contracts or blueprints are more often the case.

Historical tracing and versioning, however, don't make for much more than a powerful word processing system. Things started getting extradimensional when Nelson thought about adding *links*. Engelbart thinks that he and Nelson just happened to come up with something similar around

the same time, although Engelbart had the technology and the wherewithal to actually get such a system up and running. The whole idea started out as a kind of computer-dynamized footnote — a way to jump from part of the text to something outside the main body of the current document.

Instead of encountering an asterisk and looking at the bottom of the page for a footnote, and possibly looking up another document elsewhere in the library to verify a reference, the user would point a lightpen or a mouse as the electronic equivalent of the asterisk, and automatically bring the appended or referenced material to the screen. A return button would bring the user back to the point in the original text where the link symbol appeared. A very similar feature was built into Doug Engelbart's early NLS system.

Engelbart was more concerned with constructing the toolkit and workshop for solving problems than speculating about the kind of literary form such a facility might create. Nelson, however, being a liberal arts type rather than an engineering type — a dichotomy he deplores, since it kept him away from computers for so long — wondered what art forms and intellectual systems might emerge. In its simplest essence, a link is a reminder that "there is something to jump to here." Links meant that literature no longer had to be sequential.

The link facility, Nelson insisted from the first, provides something far more powerful than a means of attaching odds and ends. A system with backtrack, versioning, and links would create the possibility of a new way of organizing thoughts into words, a nonsequential form of writing that was never possible before computers, a literary form he called *hypertext*.

Hypertext, as he first imagined it, could apply to scholarship as well as to poetry. Scientific literature, the very basis of worldwide scientific scholarship, consists of published documents which refer to many previously published documents. An experiment is usually performed to test a hypothesis that was based on previous experiments. Performing a "search of the literature" is the first thing a scientist does when confronted with a new research problem.

The problem today is that scientific research is *too* successful. As Vannevar Bush warned forty years ago, the rate and volume of scientific publication have overwhelmed the coping capacity of our print-era technology. With a hypertext system, each scientific document could have links to its intellectual antecedents and to documents regarding related problems.

The entire body of relevant scientific literature could be collapsed into each individual document. The links would function in the same way as footnotes, but with immediate access to the cited material, as if each footnote was like a window or door into the cited document.

A system with links, backtrack, and versioning needs only an economic structure to become a publishing system. Nelson sees an anarchic but self-organizing system based on his conception of royalties and subroyalties. In a Xanadu-like system, royalties are automatically monitored by the host computer network, and are based largely on transmission time — the amount of time people pay on-line attention to a given document. Every document in the system has an owner, and every owner is paid "a whiff of royalty" whenever somebody calls their document from the memory and displays it in words, sounds, or images.

Everybody can create what text they want and put it on the system, from sonnets to pamphlets to textbooks, and everybody can quote or cite any other document. Documents can consist of links. Compendia, guided tours, directories, and indexes will spring up as independent documents; order would become a valuable commodity. "The result is a seemingly anarchic pool of documents, true, but that's what literature has been anyhow . . . ," Nelson claims. "Its orderliness is not, as some would suppose, imposed by the computer or its administrators, but by something which arose long ago in the natural structure of literature, and which we are merely retaining." Just as literary critics and librarians have found ways to organize and categorize the apparently chaotic stream of traditional literature, Nelson claims that people will spontaneously invent methods of organizing a hypertext-based body of literature.

Nelson sees his ultimate concerns about the technology as political. Where most revolutionaries have regarded the computer as a tool of totalitarian oppression, a symbol of centralized power and dehumanization, Nelson has long known that these ideas are based on an outmoded kind of computer. Distributed networks of individually powerful computers are an entirely different thing from a central computer with a lot of extensions, and Nelson was one of the first to point out this technology's potential for creating social forms directed by the individual members, who are beyond the command of any old-fashioned, mainframe-type central control. He is enthused by the personal power that comes with having ready access to usable forms of information — the bite of the old hacker apple — and zealous about preserving the freedom to explore it in your own way:

> Those of us who grew up believing passionately in ideals that made our country great, such as liberty and pluralism and the accessibility of ideas, can hardly ignore the hope of such an opening-out.
> Libertarian ideas of accessibility and excitement might unseat the video narcosis that now sits on our land like a fog. I want to see the writings of Herodotus, Nostradamus, and Matthew Brann as accessible as those of Rod McKuen, along with the art of the renaissance and movies of tomorrow — an all-encompassing picture-book encyclopedia tumult graffiti-land, the Whole Works.
>
> If this all seems like a wild idea, that means you understand it. These are times wild with possibility. In an age of pocket calculators, the Pill, hydrogen bombs by rocket, and soap operas by satellite, we can try to create whatever wildness we want in our society.
>
> . . . I say these worlds are possible soon. We need them, and they will make lots of money. The software is on the way. But what is really lacking are the visionary artists, writers, publishers, and investors who can see the possibilities and help carry such ideas into reality.

What Nelson is raving about is not a technology, but a *community*. The idea of electronic communities is no longer just an idea. Lap-sized computers with crude display screens are already on their way to being commonplace. The visual displays will grow far more sophisticated, and the computers' processing power will increase as prices drop. Dynabooks and ARPAnets are suddenly not limited to research laboratories or military bureaucracies. On-line interactive communities are evolving right now, all around the world, through the wholly voluntary efforts of teenagers with modems, traveling business people with briefcase telecomputers, information utilities, computer bulletin board systems, and telecommunes of every stripe.

Ted Nelson is voicing what a few people have known for a while, from the technical side — that the intersection of communication and computer technologies will create a new communication medium with great possibilities. But he notes that the art of showing us those possibilities might belong to a different breed of thinker, people with different kinds of motivations and skills than the people who invented the technology. After Gutenberg came Cervantes. After movable type came novels. As Alan Kay pointed out, literature was the software of the era. The Cervantes of Hypertext might be learning to read right about now.

Twenty years ago, the few hundred people who built time-sharing began to get excited about several new means of communication

that were becoming possible via computer mediation. Fifteen years ago, the thousand-odd people who joined the first version of ARPAnet began to experiment with the new media — in their daily work as a way to have fun. About a decade ago, another group of people began to concentrate on software systems specifically designed to facilitate communications among a dispersed community — *computer teleconferencing*.

The concept of computerized conferencing came from the usual convergence of unexpected factors — in this case the Berlin airlift of 1948, a decision tool invented by a think tank, and the wage-price freeze of 1971. The idea was to build a system in which computers make it possible for groups that are separated by both space and time to communicate in various ways, over common-carrier communication lines. Community communication was first tired during the Berlin airlift, when the only agency with direct real-time communications of its own to all the NATO countries was the State Department, with its old-style teletype machines. Somebody tried to wire all these machines together, without the aid of computers to help organize the message-stream — which created a classic mess, and the classic story of the birth of the new medium.

The earliest development of the idea of using computer mediation in geographically dispersed conferences is most widely associated with Murray Turoff, the standard eccentric prodigy, the character who happens to see everything differently and who, like other young, independent-minded thinkers before him, liked to follow an idea wherever it led him.

In the late 1960s, Turoff was working on war games and other kinds of computer-based simulations for a Washington, D.C., think tank, the Institute for Defense Analysis. Some of these games involved connecting several "players" at once, via remote computing systems. As a result of this experience, Turoff became interested in using computers to mediate a special process developed at Rand, known as the "Delphi Method," in which printed questionnaires and responses circulate among a community of experts. Delphi was a way to reach a quick collective judgment about a complex situation; Turoff thought the process was ideally suited to the kind of on-line communications then being demonstrated on the ARPAnet. So he started to experiment with a computerized Delphi system.

In the early 1970s, Turoff had moved to the Office of Emergency Preparedness, where his job wasn't related to his immediate interests in teleconferencing. His superiors found out that he was using his computer terminal to experiment with an

unauthorized conference system, and there was some on-the-job friction. But then came the wage-price freeze of 1971, an action that required the rapid collection and collation of an unprecedented amount of information. Turoff's superiors changed their minds. The Delphi Conference System was ready just in time.

In the process of putting it together, the people who designed the system and the people who used it began to discover that some of the system's features just seemed to become popular with the on-line community, with no official urging and often with no connection to the task at hand. There was, for example, a feature simply called "messages." Anyone plugged into the system could leave a message for anyone else on a kind of computerized blackboard. Like a blackboard, you could check your message later and see if anyone appended a note. Notes proliferated so fast that people began to develop programs for sifting through them.

The fancy part of the software came in when you wanted to be able to review only the last five messages, or only those relating to a particular topic, or all the messages from a particular person, or on a given date. Similar efforts to build electronic mail systems were also going on in conjunction with the ARPAnet. One unique feature of both systems that emerged early was the capability of communicating with a specialized audience, even if you didn't know who was in that audience. For example, if you indicate to the host computer that you want all future messages on the topic of AI research, folk dancing, and Spacewar to be routed to your electronic mailbox, then anyone with news about one of those topics can reach you without knowing who you are.

They were also discovering something that had been unknown in previous communication media — the content of the message is capable of also being an address. Far from being a tool of dehumanization, the computer conferencing system could boost everybody's ability to contact a community of common interest. Some kinds of teleconferencing software were created in order to make it possible to post a message on the topic of zucchini or microprocessors (or emergency preparedness procedures, or organizing an airlift) and be sure that the messages would be transmitted to everyone who needed to know about those topics.

The use of a computer-mediated message system, as Turoff understood, ultimately created several new *social*

phenomena. It was obvious from the vigorous electronic mail traffic on the ARPAnet that some new kind of conversation was going on. At a technical level, the users of these systems were able to share computer resources and research findings, as they were supposed to. But it also turned out that whenever people are introduced to a computer network, they seem to want to use it to *communicate* with each other.

People on the ARPAnet devoted hours to composing messages. For the small community of people who had access to such systems, the continuing dialogues on AI and foreign policy, space shuttles and space-war, diatribes, puns, puzzles, pranks, and running jokes became a kind of combination electronic water-cooler and customized daily news medium. All the other news media were collapsed into subsets of the new one, since it was no problem to plug the wire services into the system. The metamedium seemed to foster new kinds of values, as well. Iconoclasm, debate, the right to an unbridled heterogeneity of interests seemed to be highly valued in the emerging on-line community.

In some quarters of that community, people like Turoff and Engelbart were trying to learn enough from network communication behavior to help them design new tools for group communications. The National Science Foundation, deeply concerned with the problem of establishing a new way for the half-million scientists in this country to communicate with each other, sponsored some of the conferencing research. Under NSF sponsorship, Turoff moved to the New Jersey Institute of Technology (NJIT), to both study and improve the technology. A similar project had already begun in California, at a place called Menlo Park, not far from SRI and PARC, called the Institute for the Future.

Roy Amara and Jacques Vallee and other staff members at the Institute for the Future worked on a system known as PLANET (for Planning Network, because it was initially directed at planners in government and industry). Both Turoff's and the institute's systems began with electronic mail, a shared notebook space for joint compositions, a conference facility for in-line and off-line group communications, and an open-message/bulletin board.

Turoff and his associates' EMISARI system that had evolved from the Delphi Conference System evolved again into the RIMS (Resource Interruption Monitoring System) which had been used, according to Turoff, by the "Federal Preparedness Agency in every major national commodity shortage and transportation strike since 1971."

By the time he joined NJIT, Turoff's interest had expanded beyond the development of a communications tool for crisis management: "I think the ultimate possibility of computerized conferencing is to provide a way for human groups to exercise a 'collective intelligence' capability," he noted in 1976. "The computer as a device to allow a human group to exhibit collective intelligence is a rather new concept. In principle, a group, if successful, would exhibit an intelligence higher than any member. Over the next decades, attempts to design computerized conferencing structures that allow a group to treat a particular complex problem with a single collective brain may well promise more benefit for mankind than all the artificial intelligence work to date."

In 1977, the National Science Foundation funded the NJIT to build "an electronic communication laboratory for use by geographically dispersed research communities." By July, 1978, seven trial projects were under way, each one a part of an established research community of ten to fifty members. The system was set up to collect data on its own operations, in order to test the hypothesis that a teleconference-like system could enhance the effectiveness of research communities.

The Electronic Information Exchange System, known as EIES (pronounced "eyes"), was one of those experiments that never shut itself down because the experimental subjects just wouldn't let go of it. It seemed to happen with every new development of interactive computing — people would simply refuse to stop experimenting with the system, and wouldn't give up the experimental tools when the experiment was over. As Jim Fadiman noted of ARC, people seem to be as reluctant to be deaugmented as they are resistant to augmentation in the first place.

EIES was first set up to enable members to send private communications to individuals or groups, maintain permanent transcripts of comments on discussion topics, and provide text processing and file management services that participants could use to construct jointly authored papers. The protocols for using all the communication features, like Engelbart's NLS system, were not easy to learn. It took some commitment to the idea that it was worthwhile learning, which is one reason why research communities were ideal laboratories for the experiment.

EIES quickly expanded from pure scientific research communities to legislative researchers and medical researchers. Another project in the late seventies used a modification of Engelbart's NLS system to enable EIES subscribers in one experimental group to quickly browse through time-sensitive technical information. By

1978, policy-makers, artists, long-range planners, and others began to join EIES. Roxanne Hiltz and Turoff published a book that year, entitled *Network Nation*, in which they predicted that the medium wouldn't be limited to a few laboratories and think tanks. They noted that any microcomputer with a modem and appropriate software could plug into any network its user knew how to enter. They saw the development of easier-to-use, population-wide teleconferencing networks as a means of reducing the distance between people's minds and thoughts, as a forum for intellectual discourse and group decision-making, as a model for a new kind of community where one's age, gender, race, or physical appearance would no longer matter as much as what one has to say.

By the early 1980s, personal computers were being sold by the millions, and some of the people who bought them wanted to plug into these networks they were beginning to hear about. EIES has always been something of an elite — you have to apply and pay a relatively high fee. But the first public information utility wasn't long in coming. In June, 1979, the Telecomputing Corporation of America opened for business out of a host computer in McLean, Virginia. Reader's Digest bought the company in 1980, and it was renamed Source Telecomputing Corporation. Reader's Digest, not an organization known for small-scale pursuits, carried the organization through the early years when computer sales crept into the hundreds of thousands. By the end of 1982, The Source had over 25,000 subscribers, and a growth rate of over 1000 new subscribers per month. Satellites and state-of-the-art computers and new software were added to accommodate up to a quarter-million subscribers.

To those who can afford an initiation fee of $100, and a connect-time fee of $7 to $22 per hour, The Source and its newer competitor, Compuserve, offer computer owners admission to an electronic community-in-the-making. Besides remote computing, electronic mail, communications, telemarketing, software exchange, game playing, news gathering, bulletin board, and other services, The Source provides something called "user publishing."

Since subscribers are billed according to how much time they spend with their computer connected to the Source host computer, it is possible to pay royalties to "information providers," based on a portion of that connect time. Every time a Source subscriber reads wire service information, the information provider gets a cut of the take. The same is true of user publishers. You have to pay for everything you put in storage, so the popularity of your service with the subscribers is what

determines whether any publication is economically viable. To a creative writer, the challenge is tempting — as long as you can keep your audience reading, the royalties will outweigh the storage charges. The artist can now be the publisher and go directly to the audience.

Two electronic magazines I encountered my first time out were called *Sourcetrek* and *Mylar's Warp*. *Sourcetrek*, subtitled "Journeys through the Electronic Void," is put out by "Sourcetronaut Dave," aka "Sourcevoid Dave." When you give The Source the command to connect you to *Sourcetrek*, you get a choice of menus on your screen, along with a list of different statistics about the choices — reading time, number of times read, the exact time it was last read. I selected the first "article," entitled "Hello," which went (in part) as follows:

> Hello.
>
> I am "Sourcevoid" Dave. David Hughes otherwise.
>
> I was born in Colorado, descended from stubborn Welshmen who were never too loyal to the king. Which is probably why I am content being a maverick of sorts, with a Welsh imagination.
>
> I live in Historic Old Colorado City at the base of 14,114 foot Pike's Peak.
>
> I work out of my 1984 Electronic Cottage with a variety of microcomputer and telecommunications tools. . . .
>
> I am a happily married middle-aged family man who has seen enough of Big Government, Big Industry, Big political Causes — either of the left or the right — to now prefer to operate a small business out of a small house, in a small neighborhood, working with small organizations, using a small computer to make it all possible.
>
> I also have a small computer bulletin-board to link my local friends with my brain — asychronously and in the noble written form of English. . . .

Dave has opinions and poems and stories to tell. He teaches classes via modem to students around the world. And all subscribers can read what he has to say, at their own expense, and reply by electronic mail if they wish, also at their own expense. The other electronic magazine I sampled, *Mylar's Warp, an Electronic Serial*, by Floyd Flanagan, was strictly fictional. The idea is the same idea behind any serial — the writer has to keep it interesting in order to keep the readers' attention.

The title of Chapter 1 was "Reflections on Ice," and this is as much as I read before I realized how much I was spending in connect time:

> I know I'm freezing to death. Wasn't supposed to feel a thing. Ha! A sucker born every minute. Just because you're frozen alive, that doesn't mean you can't still be freezing to death. I may be slowed down, but I ain't dumb. Sure as hell, I'm freezing to death.
>
> So, how did I get here? No reason not to go over it again for the eleven millionth time. Nothing else to do. I'm Johnny Mylar, from Peabody, Utah. Peabody's claim to fame was Dinah, a life-sized pea-green cement replica of a dinosaur, like me, frozen out of time. . . .
>
> Anyway, it all started when I was getting my drivers license renewed and the lady asked me if I would like an organ donor sticker on the back of my license. Hadn't ever really thought about it before, I told her. So, she explained how, if I died and there was a sticker on my license, the hospitals would be able to use my organs to help people who had lost an eye, or heart, or brain, or tooth, or whatever. "Sure," I said. "Whatever's right." I had always had a cavalier attitude concerning the most basic matters, like sex and death. Didn't I always buy Girl Scout cookies from the little girls in the short green skirts, and . . .

While the community of subscribers to EIES, The Source, Compuserve, Dow Jones, and other information utilities is still small enough to keep the costs of services high, the inevitable growth of telecomputing population from tens of thousands to millions, spurred by the proliferation of modem-equipped home computers is sure to lower the price enough to make it possible for more Floyd Flanagans and David Hughses to experiment with their electronic magazines. But the big info-utilities are not the only kind of on-line community in existence. At the same time that the larger utilities seek to plug individual subscribers together into what is essentially a centrally controlled time-sharing technology, a different way of interconnecting computers is giving birth to an even wilder mutant of network culture — the computer-based bulletin boards.

A computer bulletin board system, often called a CBBS, or simply a BBS, consists of a computer controlled by special software and the hardware needed to connect it to an ordinary telephone line. The software enables a small host computer to automatically answer when its telephone number is dialed, and transmit and receive messages to and from remote computers. By leaving such a system hooked up continuously, and posting the access number in one or two places, the grapevine takes care of the rest. Come back and read all the messages a week later and you'll discover that a community has created itself.

The first software that enabled microcomputer owners to set up CBBS was created by Ward Christensen and Randy Seuss, in Chicago, in 1978. By 1984, the number of such systems is difficult to determine, but it must at least be in the hundreds, and probably will soon be in the thousands. To connect to a BBS, you need a personal computer, a modem, telecommunication software, and a

telephone. Plug the telephone into the modem, use the communication program to dial the BBS number, then when the computers are connected, the host system will put words on your screen and tell you how to work the system.

Most people know of these systems, and the underground community of users, because of the movie *WarGames*, television programs about computer whiz kids, and publicity about dark-side hackers. In fact the community has changed so swiftly that piracy, phone-freaking, destructive hacking, and even obsessive interest in how computers work now occupy only a small part of the BBS scene. Many bulletin boards have been in existence for years, but even more seem to spring up and die out on a weekly basis. In my own limited sampling of the BBS world, over the span of a few months, I encountered teenage philosophers, homespun lecturers of all ages and both sexes willing to ramble about any topic you'd care to name, and I even stumbled onto a couple of on-line religions, both cybernetic and pagan.

I met Clyde Ghost Monster one night out in the bulletin board zone, and Clyde ultimately turned me on to the number that led me to the on-line religion. It started the way it usually does when you browse the boards. A list of bulletin board numbers had led me to a list of bulletin board numbers that led me to another lively discussion group called "Sunrise" in New Jersey, consisting of random drop-ins from anywhere in the country, like me, and a core group, mostly local, who seemed to know each other, and who spent hours trading messages about utterly anything at all.

While some boards are strictly for hackers or computer enthusiasts or science-fiction freaks or sex freaks or peace types, Sunrise appeared to be a kind of electronic cracker-barrel store crossed with a public restroom wall. I joined Sunrise as "Johnny Jupiter" when I decided to add my two cents to a very funny ongoing conference that consisted of nothing but lists of "my favorite people." You can say a lot with just a list of people, the Sunrise community discovered one night, when "Ivan Idea" started it all by posting the first list. The creators of the lists that followed within hours signed themselves with names like "Tater Tot," "Clock Speed," and "Clyde Ghost Monster."

I checked in on Sunrise from week to week, and one night, while scrawling some graffitist reply to an ongoing epistemological debate, the words "SYSOP REQUESTS CHAT" appeared on my screen. I typed "OKAY LET'S CHAT," hit the return key, and started conversing in real time with an utterly fascinating individual, via an exchange of quickly typed messages.

It turned out that the host computer was located in Clyde Ghost Monster's bedroom, which made Clyde the system operator. Sysops are like benevolent dictators. They can weed you out of the community memory if they want, but then again, their computer is the one that provides a message-mediation system to anyone who wants to drop in, electronically speaking. Clyde Ghost Monster was an anarchist sysop, who preferred the rule of wit. Clyde Ghost Monster, I was to learn weeks later, was also a sixteen-year-old girl. Tater Tot was a seventeen-year-old boy who went to her high school. They had no idea who Ivan Idea was.

Clyde told me that if I wanted to find out about new kinds of communities, I ought to call a conference-tree bulletin board in Santa Cruz, California, and read the opening message for "ORIGINS." The conference tree is a bulletin-board-based medium that seems particularly well suited to wildly heterogeneous experiments in communitarian communication. The idea behind a conference tree is that you can call in and read from or write to a variety of conferences, each one consisting of a constantly branching list of messages and submessages. The name of the message conveys something of what it is all about, and all the variations of opinion from rabid enthusiasm to utter contempt can be expressed in submessages and submessages of submessages.

My modem beeped its way to the host computer, and when the word CONNECT appeared on my screen, I hit the return key twice. A menu of conferences appeared, in the form of the list of names of the first message in each conference. I selected "ORIGINS," as instructed. ORIGINS first gave me an address to write to obtain a brochure, then the following message appeared on my screen:

> ORIGINS is a movement that started on this computer (Santa Cruz, 408-475-7101). Origins began on the START-A-RELIGION conference, but we don't call it a religion.
>
> ORIGINS is partly a religion, partly like a westernized form of yoga society, partly a peace movement. It is a framework for improving your life and improving the world at the same time.
>
> The movement centers on "practices" — actions you can use in everyday life to build effective human relationships, strength of community, and self-awareness. All the practices are based on action. None require any special equipment, settings, leaders, theories or social status. The human universals of the ordinary, everyday moment, and the personal relationship, form the basis for this training.
>
> ORIGINS has no leaders, no official existence, nothing for sale. Because it started in an open computer conference, no one knows who all the creators are.
>
> This movement has just begun. The brochure mentioned above

> recommends seven practices (Leverage a favor, Ask for help and get it, Use charisma, Finish a job, Use magic, Observe yourself, Share Grace), but these suggestions are only starters. The idea is to continually develop new training/action methods, as a community project, then discuss and share them through whatever communications media are available. This movement will never be finished, because it seeks a community of permanent innovation.
>
> The hope is to build something which can make a better world. The first step is to make your own life better. For a more detailed overview of ORIGINS, get the brochure from the address above. To see how the movement developed, read the START-A-RELIGION message and its submessages.

Although the conference tree that contained ORIGINS, along with its parent and sister and daughter conferences (as submessages and root messages are known in BBS jargon), was one of the most intriguing electronic gathering places I found in a few months of vicarious wanderings via my modem, it was far from the only unusual one.

The pros and cons of religion, and the possibility of starting new ones or reviving old ones, seems to be a popular topic of discussion. ORIGINS was an example of the cybernetic variety. I ran across a few Christian boards and a meditators' BBS, but the most startling discovery was the Pagan faction who announced themselves with a message on a conference tree:

> The covenant of the Goddess is an umbrella organization for pagan groups of all kinds. It was created in the 60s to provide some structure (and maybe some muscle, since some groups were being harassed by the government) to an otherwise amorphous group of covens in Northern California, but eventually had members everywhere. A pagan group mostly refers to witches, although there are Druid groves and other strictly unallied organizations online as well. Witches means any affinity group which holds as one of its general tenets that Jehovah may not be the guy in charge after all — that he is a powerful illusion created by an awful lot of misguided and power-hungry folks, and that the supreme being is and should be somebody with more of a sense of humor as well as compassion, not even to mention love. In short, it might be fair to claim that it's better than any other way, then it's probably pagan. These definitions are by exclusion because one way of defining the whole pagan movement is as a group that believes in saying yes to more. A coven is an affinity group of witches. The name is very old. Some covens have fierce strict codes of behavior and rules of ceremony and others get together now and then and shoot the shit. By and large, witches have the best parties of any groups going. There is another organization in the California area known as the New Reformed Orthodox Order of the Golden Dawn, which was started as a gag in the 60s and presently has several thousand members, a good many of which can apparently be counted on to show up for a bash. It is typically pagan, incidentally, to start your biggest umbrella organization for a joke. Lots of witches compute, and there are probably a bunch on this very tree who have not bothered to identify themselves. (Witches have no identifying marks — except for that humorous glint in the eye.)

Religion, ancient or modern, is still less popular than sex as a topic for BBS discussion. A certain steady percentage of boards are entirely sexually oriented. The problem used to be that there simple weren't any females on the system, but that appears to be changing rapidly. Sexually oriented CBBS and dial-a-date boards are an entrance into yet another subculture, some members of which use the system to arrange real-life assignations with compatible companions, but most of whom use the system to live out fantasy sex lives consisting of hot dialogues with other anonymous participants.

Because computer programs can be sent over the telephone wires as easily as words or numbers, some boards engage in software piracy — passing along proprietary software without paying the licensing fee. Others dispense "public domain" software as a community service. some of them offer access to special information, like an insider newsletter, and issue passwords and bill for connect-time. Some are exclusive, and many are promiscuous, about who is allowed to write as well as read messages.

Then there are folks who are starting to use *temporary* on-line communities as art forms and as experiments in changing the consciousness of larger communities like neighborhoods and cities. In 1983, a literary group in Seattle that called itself *Invisible Seattle* instigated the creation of a fifteen chapter mystery story written by a representative sampling of the half-million citizens of the city itself. The collective novel was not a new form, as far as the more standard kinds of networks go. EIES started a serial years before, in which different writers took on the personae of various characters and wrote the story like a conference.

Invisible Seattle, however, sent "literary construction workers" out into the city looking for people from all works of life who were willing to contribute plots, words, ideas, which were communicated from the point of origin to the other nodes throughout the city via a temporary arrangement of video arcade game parts, two larger personal computers, some custom written software, and six smaller personal computers.

What do Xanadu, EIES, The Source, Clyde Ghost Monster, and Invisible Seattle have to do with the technology created by Turing, von Neumann, Licklider, et al.? What would the patriarchs think of the infonauts? The changes that were predicted by the earliest software prophets seems to be only the beginning. The religion that germinated on the ORIGINS conference tree — was its origin any stranger or less likely than the dominant religions of today that sprang up centuries ago in dusty Middle Eastern

villages? Xanadu and EIES might seem like novel and unfamiliar media — but so did the printing press and telephones when they first appeared.

The forms that cultural innovations took in the past can help us try to forecast the future — but the forms of the past can only give us a glimpse, not a detailed picture, of what will be. The developments that seem the most important to contemporaries, like blimps and telegraphs, become humorous anachronisms to their grandchildren. As soon as something looks like a good model for predicting the way life is going to be from now on, the unexpected happens. The lesson, if anything, is that we should get used to expecting the unexpected.

We seem to be experiencing one of those rare pivotal times between epochs, before a new social order emerges, when a great many experiments briefly flourish. If the experiences of past generations are to furnish any guidance, the best attitude to adopt might have less to do with picking the most likely successors to today's institutions than with encouraging an atmosphere of experimentation. Is Ted Nelson any crazier than Alan Turing? Did Gutenberg think about the effects of public libraries?

Hints to the shape of the emerging order can be gleaned from the uses people are beginning to think up for computers and networks. But it is a bit like watching the old films of flying machines of the early twentieth century, the kind that get a lot of laughs whenever they are shown to modern audiences because some of the spiral-winged or twelve-winged jobs look so ridiculous from the perspective of the jet age. Yet everyone can see how very close the spiral-winged contraption had come close to the principle of the helicopter.

The dispersal of powerful computer technology to large segments of the world's population, and the phasing-in of the comprehensive information-processing global nervous system that seems to be abuilding, are already propelling us toward a social transformation that we know very little about, except that it will be far different from previous transformations because the tool that will trigger the change is so different from previous tools. Not all of those who have tried to predict the course of this transformation have been so optimistic as Licklider or Nelson. Joseph Weizenbaum, in particular, has voiced his fear of the danger of mistaking computers for human minds or treating human beings as machines.

Weizenbaum's argument, in part, points out that the aspect of human nature that was externalized by the invention and evolution of computers was precisely the most machine-like aspect. The machines that embody this aspect can do some very impressive things that humans cannot do, and at present can do very little of the more sophisticated intellectual feats humans can accomplish. Even so, they are taking over the management of our civilization. Before we begin to give more decision-making responsibility over to the machines, Weizenbaum warns that it is a terrible mistake to believe that all human problems and all important aspects of human life are computable.

This "tyranny of instrumental reasoning" can lead to atrocities, Weizenbaum warns, and in the closing years of the twentieth century, it is not at all paranoid to have some healthy suspicions about what any shiny new technology that came from the Defense Department in the first place might do to our lives when they get around to mass producing it. And there is no dispute that war was the original motivation and has been the continuing source of support for the development of computer technology.

If it is true that the human brain probably started out as a rock-throwing variation on the standard hominid model, it has also proved capable of creating the Sermon on the Mount, the *Mona Lisa*, and *The Art of the Fugue*. If it is true that the personal computer started out as an aid to ballistic calculations, it is also true that a population equipped with low-cost, high-power computers and access to self-organizing distributed networks has in its hands a potentially powerful defense against any centrally organized technological tyranny.

Licklider believed that a human-computer symbiosis would be the means of steering our planet through the dangerous decades ahead. Others have used another biological metaphor for our future relationship with information processing technology — the concept of *coevolution*, an agreement between two different organisms to change together, to interact in such a way that improvements in the chances for survival for one species can lead to improvements in the chances for survival of the other species.

Perhaps yet another biological metaphor can help us foresee the transformation ahead. When a caterpillar transforms into a butterfly, it undergoes a biologically unique process. Ancient observers noticed the similarity between the changes undergone

by a butterfly pupa and those of the human mind when it undergoes the kind of transformation associated with a radical new way of understanding the world — in fact the Greek word for both butterfly and soul is *psyche*.

After the caterpillar has wound itself with silk, extraordinary changes begin to happen within its body. Certain cells, known to biologists as *imaginal cells*, begin to behave very differently from their normal caterpillar cells. Soon, these unusual cells begin to affect cells in their immediate vicinity. The imaginal cells begin to grow into colonies throughout the body of the transforming pupa. Then, as the caterpillar cells begin to disintegrate, the new colonies link to form the structure of the butterfly's body.

At some point, an integrated supercolony of transformed cells that had once crawled along the ground emerges from the cocoon and flies off into the spring sky on multicolored wings. If there is a positive image of the future of human-computer relations, perhaps it is to be seen reflected in the shapes of the imaginal cells of the information culture — from eight-year-olds with fantasy amplifiers to knowledge engineers, from Ted Nelson to Murray Turoff, from Clyde Ghost Monster to Sourcevoid Dave, from ARPA to ORIGINS.

The flights of the infonauts are not the end of the journey begun by the patriarchs, but the beginning of the most dramatic software odyssey of them all. It is up to us to decide whether or not computers will be our masters, our servants, or our partners.

It is up to us to decide what *human* means, and exactly how it is different from *machine*, and what tasks ought and ought not to be trusted to either species of symbol-processing system. But some decisions must be made soon, while the technology is still young. And the deciding must be shared by as many citizens as possible, not just the experts. In that sense, the most important factor in whether we will all see the dawn of a humane, sustainable world in the twenty-first century will be how we deal with these machines a few of us thought up and a lot of us will be using.

| index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Footnotes |

read on to **Footnotes**

howard rheingold's brainstorms