computers and people

formerly *Computers and Automation*

Jan.–Feb., 1988
Vol. 37, No. 1

MASSIVE PARTICLE DETECTOR ASSEMBLED DEEP UNDERGROUND

Robot Submarines Are Learning to Think and to Move Where Humans Can't Go

Glenn Zorpette
157 E. 99th St., Apt. 6
New York, NY 10029

"Only in recent years has the technology – powerful, inexpensive computer chips and artificial-intelligence software – made autonomous, free-swimming vehicles practical."

Several times a week, D. Richard Blidberg watches the culmination of his life's work disappear into a lake, and then he waits, apprehensively but patiently, for them to return.

"High-Anxiety" Vehicles

Blidberg, an electrical engineer at University of New Hampshire, heads the development program for the world's most advanced nonmilitary robot submarine. His subs are known as Experimental Autonomous Vehicles, or EAVEs, but Blidberg calls them "high-anxiety vehicles."

"In truth," he said in a recent interview, "when one of them goes away, the big question is whether it's going to come back. Remember, you've got a third of a million [dollars] on the hook. You see it go down in the water, and an hour later it's supposed to come back. That's anxiety."

So far, they've always come back. The stubby, 5-foot-long subs -- they look like oversized scuba tanks -- have been swimming around in New Hampshire's Lake Winnipesaukee since March, controlled by tiny but powerful on-board computers.

The EAVEs have been negotiating relatively simple courses so far, but Blidberg's team at the UNH Marine Systems Engineering Laboratory is preparing to test more sophisticated control software designed to guide the subs as they search the lake bottom for big steel drums, pieces of metal pipe and other target objects. The EAVEs were built as test vehicles for the latest in robot technology, but Blidberg hopes they might someday be used to explore marine spawning grounds or make stereoscopic images of the seafloor.

Few Robot Subs Built Outside Military

Few ultra-sophisticated unmanned subs have been built outside the military. Only in recent years has the technology -- powerful, inexpensive computer chips and artificial-intelligence software -- made autonomous, free-swimming vehicles practical.

As Frank Busby, an Arlington, Va., consultant who has advised the Navy and other government agencies on designing and operating unmanned subs, put it, "You just could not put a smart-enough vehicle in the water until recently."

Busby said the emergence of that technology has made possible the development of unmanned subs, which the US Navy had long wanted for ocean-bottom searches, mine sweeping and spying on Soviet submarines. The Navy has tested at least eight unmanned subs, and it has programs under way for still-smarter, more-reliable vehicles with a longer range, he said.

EAVEs As Sophisticated As U.S. Navy Subs

The EAVEs, though smaller and slower, are as sophisticated as any of the Navy unmanned subs mentioned in Pentagon reports -- but those reports cover only vehicles designed before the recent advances in computer chips and software. The reports, as well as interviews with industry consultants, contractors and two Navy engineers, indicate that the Navy's current fleet includes:

- A 100-foot-long, one-third scale model of a new type of highspeed nuclear attack submarine, the SSN-21. The Navy will measure the forces on this sub during test runs at speeds that would endanger people on board. The model was to be tested late this year, possibly in a lake in northern Idaho.

● A highly maneuverable vehicle that hunts down and neutralizes underwater mines. A prototype submarine called Remote Underwater Mine Countermeasure has already undergone tests. Neutralizing mines with robot subs would mean one less risky task that has to be performed by divers and manned, minesweeping surface ships.

● A sleek, torpedo-shaped craft designed to dive three and a half miles to find objects on the ocean bottom. Known as the Advanced Unmanned Search System, the submarine has an array of sonars and can hover above an object, illuminate it with a floodlight and transmit a television picture to a surface craft. It was tested off Southern California last spring.

At least 20 known nonmilitary, free-swimming robots are in operation or under development around the world. Many were built to inspect offshore oil rigs and other underwater structures; others were designed for work hard to do with other kinds of vessels. For example, mapping portions of the ocean bottom under Arctic ice has never been easy -- it's slow with a surface boat and potentially dangerous with a manned sub. The Autonomous Remotely Controlled Submersible built by International Submarine Engineering, Ltd., of Port Moody, British Columbia, can roam as far as 111 miles and dive as deep as 1,300 feet as it maps the sea bottom under Arctic ice.

EAVEs and Artificial Intelligence

The Canadian vehicle may have the most stamina, but the little EAVEs are tops in intelligence. Next spring, Blidberg hopes to test them with two of the most advanced programs written for underwater vehicles, searching for target objects for the first time. Both software programs were written to guide the EAVES on search missions, but they attack the problem differently and will be alternated on the two subs.

One package was provided by the National Bureau of Standards, one of three funding sources for the $850,000 EAVEs project (along with the National Oceanic and Atmospheric Administration and the Naval Underwater Systems Center). With that software, originally written to control industrial robots, the two EAVEs will collaborate on lake-bottom searches, communicating via an acoustic link, dividing the search area and exchanging progress reports. Part of the software already has been used to steer the EAVEs through preset courses, Blidberg said.

The other software package, developed at the UNH lab, was written in LISP, a symbolic computer language well-suited to control machines in changing, unstructured environments where plans and decisions must be based on complex or vague criteria.

The EAVEs must determine if an object they come upon in their search is of interest -- a barrel, for example, may be rusted, partly buried in mud or covered with weeds. A symbolic language can take those factors into account and works through them.

Although such symbolic languages have been around 25 years, the EAVEs are the first undersea vehicles to be controlled by LISP software, Blidberg said. Hardware compact and rugged enough to go on a robot submersible, and powerful enough to handle the software, only recently became available. The EAVEs are equipped with four Motorola microprocessors, each a little bigger than a postage stamp and as powerful as a refrigerator-sized minicomputer capable of handling six or seven users at a time.

In their Lake Winnipesaukee trials, the subs maneuver within a triangular zone marked off by acoustic transponders spaced about 2000 feet apart on the lake bottom. The transponders tell the subs their exact position through sounds emitted every second and a half. Sonar guides the subs around the zone and back to the barge that serves as their base.

U.S. Navy Uses the New Technology

The EAVEs are not the only vehicles to take advantage of new technology. Industry consultants are certain that the Navy, with its relatively large budget for undersea systems, is secretly working on its own. "Where the real action is, where the money is being spent, is mostly classified," said Busby, who once worked for the Naval Oceanography Office. It is believed that the United States already employs drone subs to confuse Soviet forces tracking US submarines, he said.

Those decoy missions probably work like this: A large US attack submarine, its sound picked up by Soviet undersea hydrophones, suddenly releases drone subs. Each mimics the larger submarine's sound, or "signature" as it moves through the water, and the Soviet trackers are at least temporarily unable to determine which vessel they should be tracking.

Most of the Navy free-swimming vehicles built so far are controlled by acoustic sig-
(please turn to page 27)

Vol. 37, No. 1
Jan.-Feb., 1988

Editorial Offices	**Berkeley Enterprises, Inc.** 815 Washington St. Newtonville, MA 02160 (617) 332-5453
Advertising Contact	**The Publisher** **Berkeley Enterprises, Inc.** 815 Washington St. Newtonville, MA 02160 (617) 332-5453

"Computers and People" (ISSN 0361-1442), formerly "Computers and Automation," is published every two months at 815 Washington St., Newtonville, MA 02160 U.S.A., by Berkeley Enterprises, Inc. Printed in U.S.A. Second-class postage paid at Boston, MA and additional mailing points.

Subscription rates, effective Sept. 15, 1987: U.S.A., $24.50 for one year, $48.00 for two years; elsewhere, add $7.00 per year.

NOTE: The above rates do not include our publication, the "Computer Directory and Buyers' Guide." To receive this, please add $24.00 per year to your subscription rate in the U.S.A., and $27.00 per year elsewhere.

NOTE: No organization in Switzerland or Morocco is authorized or permitted by us to solicit for, or receive payment for, "Computers and People" or the "Computer Directory and Buyers' Guide." All subscriptions to and payments for these publications should be sent directly to Berkeley Enterprises, Inc.

Please address all mail to: Berkeley Enterprises, Inc., 815 Washington St., Newtonville, MA 02160, U.S.A.

Postmaster: Please send all address changes to Berkeley Enterprises, Inc., 815 Washington St., Newtonville, MA 02160, U.S.A.

Change of address: If your address changes, please send us both your new address and your old address (as it appears on the magazine address imprint), and allow four weeks for the change to be made.

computers and people

formerly *Computers and Automation*

The magazine of the design, applications, and implications of information processing systems – and the pursuit of truth in input, output, and processing, for the benefit of people.

Announcement

The 1986-87 Computer Directory and Buyers' Guide, the 28th edition, has been published and mailed to all subscribers with a code *D on their address imprint. If you should have received this edition, but have not yet, please let us know.

We thank our subscribers for their patience while we prepared this *Directory*. Future printed editions will be more regular. In the meanwhile, since we are updating our database of names and addresses continually, we are now offering the following service to all *Directory* subscribers:

> If you are looking for information about an organization (with more than 10 employees) before you receive our next printed edition, write or telephone us and we will gladly give you what information we have.

Front Cover Picture

The front cover picture shows one of 256, five-ton modules that make up the Soudan 2 particle detector being moved into place in an underground mine, one-half mile below the earth's surface. The detector is part of an experiment to learn whether nucleons decay. If they do, it will mean that all atoms in the universe will eventually disintegrate – although the process will take billions of years. Physicists from the United States and from England are participating in the experiment. For more information, see page 24.

The photograph is courtesy of the Argonne National Laboratory, Argonne, Illinois.

Computer Field ➔ Zero

There will be zero computer field and zero people if the nuclear holocaust and nuclear winter occur. Every city in the United States and the Soviet Union is a multiply computerized target. Radiation, firestorms, soot, darkness, freezing, starvation, megadeaths, lie ahead.

Thought, discussion, and action to prevent this earth-transforming disaster is imperative. Learning to live together is the biggest variable for a computer field future.

Signals in Table of Contents

[A]	–	Article
[C]	–	Monthly Column
[E]	–	Editorial
[EN]	–	Editorial Note
[O]	–	Opinion
[FC]	–	Front Cover
[N]	–	Newsletter
[R]	–	Reference

Type of Subscription

*D ON YOUR ADDRESS IMPRINT MEANS THAT YOUR SUBSCRIPTION INCLUDES THE COMPUTER DIRECTORY AND BUYERS' GUIDE. *N MEANS THAT YOUR PRESENT SUBSCRIPTION DOES NOT INCLUDE THE COMPUTER DIRECTORY.

Editorial

The Changing of Normal Required Time

Edmund C. Berkeley, Editor Emeritus

One of the facts most noticeable by perceptive observers over the last 60 years is the changing of normal required time relative to human life. In the 1920s it was normal to require 6 days to travel from New York to London; in 1988 the normal required time is 6 hours. In the 1920s no one in Washington could pick up a telephone, dial any telephone number in Paris, and be connected in a moment or two. In 1988 this time is normal. In the 1920s the normal required time to multiply 2 eight-digit numbers was a half minute; in 1988 it was less than a 100,000-th of a second. In the 1920s the normal required time to fight a great war of many nations was 5 years and the toll of dead would be over 50 million persons. In 1988 the time would be a day and the toll of dead would be over 2 billion persons.

This remarkable shrinking of the time required for an action has spread in a great many ways all through the Earth world of humans of 1988. But the time shrinking has not spread to many other actions of humans. For example, learning to read and write has suffered from considerable deterioration in the technique of teaching, decrease of the urge to learn, and competition from radio and television. Another example is that the normal required time to produce a compatible and friendly relationship between two large groups of people continues to be long, not short.

What is needed, in our human Earth world?

One of the great problems is the problem of empire. The organization of almost all nations in the world into a compatible fabric is a problem which excites the dreams of "leaders" from century to century, from Alexander the Great to Genghis Khan, from Napoleon to Hitler. But it is clear that such dictatorial organization is weak and unstable. It should be possible to prove with computer simulation that such organization will regularly succumb and collapse.

Another of the great problems is population growth. Even ordinary arithmetic can demonstrate that the unlimited bearing of children is eventually impossible within any boundary on Earth. Every doctrine, religion, or philosophy that advocates or permits unlimited child bearing is stupid and destructive, like arguing that the Earth is flat.

Still another of the great problems is pollution. We used to be able to burn, dump, or bury muck and trash. It makes no sense to do that any more. We need to stop waste and conserve the irreplaceable materials of the Earth, like oil, helium, and tropical rain forests. To plan for humans to survive in the real Earth world for a thousand years is a vast and complicated task.

There are at least a score of these great problems. It would be wise and sensible to study these and use computer power to test and simulate possible solutions.

Ω

Inventing the Future: The Media Lab at MIT

Stewart Brand
c/o Viking Penguin Inc.
40 West 23rd St.
New York, NY 10010

" 'We write about what we do,' comments Director Negroponte, 'but we don't write unless we've done it.' The focus is engineering and science rather than scholarship, invention rather than studies, surveys, or critiques."

Inventing the Future

In the basement the inventor of the white-light hologram that flickers from America's credit cards is demonstrating the world's first projected hologram. It's an eighteen-inch Camaro parked in midair, and the sponsors from General Motors are pleased. One of them steps from the front of the car around to the back and then has to reach into it. His hand grasps satisfactory nothing. The information is in his eye, not in the air.

Out in the Wiesner Building's sunny atrium, seven-foot-long computer-controlled helium blimps are cruising the five-story space learning how to be like fish -- feeding, schooling, seeking comfortable temperature habitats.

On the third floor, body tracking is in progress, a figure in ultra-punk black leather and studs twirling in sensitive space. The studs are position indicators (infrared-light-emitting diodes) being sensed and translated by a computer into an animated figure on the room-size screen dancing in perfect echo to the human. The computer is paying attention and remembering: this is how humans move.

On the fourth floor a violinist strokes once more into a difficult piece, trying it with a slower tempo. The piano accompanist adapts perfectly, even when the violinist changes tempo again in the middle of the piece. The uncomplaining piano player is an exceptionally musical computer.

In the Terminal Garden on the third floor a visitor pretends to be a schoolchild and types into a computer, "hedake." A computer voice says aloud, "Headache," and shows the word spelled correctly. "The hell with kids," says the visitor, "I need this."

Between the second and fourth floors two computers are chatting on the phone, scheduling an appointment between their human keepers, neither of whom is around at the moment.

That's a small sample of the variety of endeavors going on in the Wiesner Building, but it gives a glimpse of major themes in Media Lab research. Everything mentioned involves communication, empowers the individual, employs computers (the Camaro was not photographed from a model but generated out of pure computer bits), and makes a flashy demonstration.

"Demo or Die"

Students and professors at the Media Laboratory write papers and books and publish them, but the byword in this grove of academe is not "Publish or Perish." In Lab parlance it's "Demo or Die" -- make the case for your idea with an unfaked performance of it working at least once, or let somebody else at the equipment. "We write about what we do," comments Director Negroponte, "but we don't write unless we've done it." The focus is engineering and science rather than scholarship, invention rather than studies, surveys, or critiques.

The Lab is a fascinating visit, a techno-feast of goodies from "Movies of the Future," "Toys of the Future," "School of the Future," Et Cetera of the Future, drawing no end of visitor traffic. On one somewhat heavy day, a year after opening its doors, the Lab was toured by forty computer scientists from China, the Chief Scientist from IBM, thirty-five Japanese architects, fifteen members of a Japanese study mission, the Secretary of State from West Germany, and the president of the German Newspaper Federation. Industrial sponsors of the Lab come to see if they're getting their money's worth. Potential sponsors come to see if they should buy in ("Less than $200,000 it's not really worth our time," Negroponte observes). Journalists come looking for The Story and go away confused, but still with plenty to write about. Scientists and researchers come to see who's ahead or behind on what. Distinguished visitors come because this is the kind of technological excitement that America and MIT want them to see, and it's one of the few places where so much is so concentrated.

They see the demos and are suitably dazzled or puzzled, but what draws them here is that they've heard or sensed the Media Laboratory has a Vision, capital V. ...

Terminal Garden

The carpeted corridor floor clanks hollowly as you approach the Media Lab room called the Terminal Garden, signaling the kind of environment you're entering: wired.

Overhead maroon trays bearing cables veer suddenly through walls. As you enter the Garden's glass doors you spy a catastrophically short human ... no, a human sticking out of the floor. One of the clanking squares of raised-floor has been removed and the human is busy rewiring something to something else. Down in the two-foot-high cellar is a spaghetti of video cables, power cables, networking lines, odd storage -- archaeology of the Garden's rapidly layering past.

The light in the large, populated room is jungle twilight. Instead of using the flourescents in the ceiling the fifteen workstations are lit by local lamps and large glowing monitor screens. Potted trees by the couch in the middle of the room suit the room's tropical sound -- from each workstation comes a fluttery clicking of keys, like frogs on their lily pads, each with a different voice.

Walter Bender is the Terminal Garden's keeper. A Media Lab veteran at thirty, he got drawn into the heady pace of invention at Negroponte's Architecture Machine Group back in 1978, when he was an undergraduate visiting from Harvard. Referred to as "Arch Mac" (pronounced "ark mac"), the Architecture Machine Group was the mainline predecessor to the Media Lab, the source since 1968 of nearly all the earlier research mentioned in this book. Arch Mac's Terminal Garden worked so well it was re-created in the Wiesner Building. Bender's husky voice, boyish look, and easy manner make him a natural demo-giver. He bears an exceptional burden of demo traffic because the zoo-like Garden is fascinating to visitors, and his domain of Electronic Publishing is a readily understandable one.

Personal Newspaper

The standard opening demo for visitors is of NewsPeek, a selective home-publishable semiautomatic electronic newspaper that knows the reader, made of material drawn daily from Dow Jones News Retrieval, Nexis, XPress, and wire services, along with television news. Walter punches it up on his monitor screen. Topic headlines in different colors indicate "International," "Technical," "Financial," "Mail," "People," etc. When he slides his finger across the screen, the image on the screen slides with him, revealing more text. He runs his finger across a lead paragraph, and that story fills the screen. He calls for other newsclips on the topic, and three come up, one of them colored pale yellow like aging newsprint, indicating it's an old item.

Illustrations on the screen in color, such as the map of Cuba or the photograph of the President, are drawn locally from a videodisk capable of holding 54,000 such images, the sort of thing that might be mailed out monthly by a subscription service. When Walter touches an article under "Today," suddenly the illustration comes to life, flames and smoke pouring up, a television voice announcing, "In Mount Bellevue, Texas, today there was an explosion at an oil refinery that set off a spectacular fire. Flames from burning propane, butane, and gasoline towered 800 feet ..." The clip was captured from the evening news by NewsPeek and formatted into the presentation. The most significant item on NewsPeek's front page, Negroponte insists, is "Mail," where news from the user's own electronic mailbox is summarized. "It's news only to him, but it's the most important of all."

The demo is impressive but not as convincing as Negroponte and Bender would like because it can't be individualized for each visitor. That's a significant frustration, since the idea of intense personalization to the user is at the heart of most of the Lab's projects. Negroponte says, "I don't read newspapers myself. My wife, Elaine, reads them and tells me what I need to know because she's an expert on me. Artificial intelligence could do that, but in all the literature and programs I've come across I've never seen an expert system that pretended to be an expert about the user."

The Nature of Newsworthiness

The Lab's current direction for the personal newspaper is exploring the nature of newsworthiness. Negroponte told an audience at Royal Dutch/Shell corporate headquarters in London, "If last night Mr. Gadhafi had invaded the United States and also last night you had had to cancel this meeting, in my morning newspaper the top headline would be: 'Shell Meeting Canceled.' Somewhere down below it would say, 'Gadhafi etc.' In your newspaper Gadhafi might have made the headline, but on your front page someplace it would say, 'Negroponte Presentation Canceled.' To nobody else would the cancellation be news. I was in Milano yesterday. If I had this newspaper printed out in my hotel room I would expect to find somewhere in it a weather report for Heathrow Airport in London, because I would have expected my travel-planning program to have told my newspaper program my flight schedule."

What all of this might soon imply for newspapers is suggested in a book called "Goodbye Gutenberg," about the recent computer revolution in newspaper production. Author Anthony Smith observed:

> Only about 10 percent of the total information collected every day in the newspaper's newsroom and features desk (all of which is held on-line, i.e., in continuous direct communication with a computer) is actually used in the paper, and yet, according to most surveys, the reader only reads 10 percent of what has gone into his paper. It seems, therefore, that the whole agony of distribution is undergone in order to feed each reader just one percent of the material that has been so expensively collected.

With an electronic newspaper, the whole 100 percent of what the newsroom has could be accessed, and most of what would be selectively delivered to the reader might be used. It's far more efficient at both ends. The reader (the reader's machine, that is) has the additional advantages of assembling material from a variety of sources and of getting versions of articles of special interest that are much more in-depth than current newspapers can offer. There would be only one copy of "The Daily Me," but it would have a devoted readership.

Interface With the User

At the Media Lab the emphasis of research is not so much on the content of the personal newspaper as on its interface with the user. Negroponte tells what he learned from the "Wall Street Journal": "I think its middle column is the best international news synopsis in print, so I made this arrangement to get it electronically when I was in Greece. I was seeing it even before American readers did. But I found I just didn't use it. I preferred to wait for the regular paper edition and read it there, even though it was two days late. That printed column is a highly evolved scanning device using four different type faces, two of them in its headlines, and it's a format I'm familiar and comfortable with. Electronic newspapers have to duplicate that level of sophistication, or they won't make it."

He adds, "The newspaper as a mass medium is going to die much less rapidly than broadcast television because you already have personalization in its design for easy scanning. Television is vulnerable because there is no personalizing so far except with VCRs."

Personal Television

Text and television media are constantly mixed at the Lab, in fine violation of their apartheid in the world. The same people and equipment are working on personalized television as on the personalized newspaper. One tool for that is a service called "closed-captioning," an optional service that some broadcasters provide for the hearing-impaired; lines of text appear along the bottom of the video image like foreign-film subtitles.

As Negroponte proposes, "One of the most hearing-impaired people I know is a computer. The computer could look at television all day for you, reading the closed-captioning, and when you get home at night, it says, 'I have twenty-five minutes of really great stuff I recorded today that you should look at. Your old friend so-and-so was on a talk show -- he's just written a book. The company that you're competing with is reported to be going into Chapter 11. ...' And if I like the 'Bill Cosby Show,' but I only have fifteen minutes, how about a fifteen-minute version of it, with skits and anecdotes it knows I'm interested in?"

The Lab already has a working program called NewsPrint that every night prints out the closed-captioning text of the "ABC Evening News" along with images it's taken off the air for illustration. (The news format is so predictable that the program can figure out pretty reliably when to capture the best television picture with each report -- about a third of the way through each item.) NewsPrint could be expanded into kind of a personal "TV Guide" that summarizes graphically what the computer has collected for you today.

Interactive or Passive Mode

Many Lab visitors voice the fear that all this implies too much interactivity by the viewer. Walter Bender: "We had a guy from ABC here one night who was saying, 'When I get home what I really like to do is kick my shoes off, sit in a comfortable chair in front of the television, and veg out. I don't wanna interact, I don't wanna play games, I just wanna get fed.' But if the computer's been watching TV for you and knows what you're interested in, that's what you'll passively watch, instead of what everybody watches. That's Couch Potato Mode 1.

"Mike Bove, a graduate student here, is doing another level of generalization upon that, where he's not restricted himself to just television as input, but is using wire services, electronic mail, whatever. So if you're watching the news and it says, 'The stock market went crazy today,' then that's the appropriate time for your personal stock quotes to scroll across the bottom of the screen. That's called Network Plus -- Couch Potato Mode 2."

Mike Bove fantasized further in a piece of e-mail addressed to the NewsPeek researchers: "I want to sit in an armchair reading the "Boston Globe" or the "New York Times," and if any of the networks have any pictures to go with the story I'm currently reading, I want them to appear on the TV." ...

"Interactive television," claims Andy Lippman, "represents a change as fundamental to the world of broadcasting as television itself was when introduced to the existing world of broadcast radio." A primary characteristic of interactive television is that it's asynchronous -- stuff is broadcast at one time, viewed at another, just as people are doing now with VCRs. This could be a great relief to the broadcasters, who at present kill themselves trying to fill 8,760 hours a year with programs of potential interest to everyone. At the viewing end, interactive, asynchronous television could solve the major problem of viewers, which is scheduling. " 'Prime Time,' " predicts Negroponte, "becomes 'My Time.' "

A by-product of personal television would be conversation -- what you see on your news may well be news to the rest of your office.

"Broadcatch"

In 1968 MIT's J. C. R. Licklider coined the term "narrowcasting" for what broadcast television should become -- a much wider range of good programming targeted for specific audiences. The Carnegie report that his coinage appeared in led directly to the founding of PBS, America's highbrow TV channel. "Narrowcasting" soon came into general usage to describe what cable television was supposed to bring, and later it defined nicely what VCRs and satellite broadcasting in fact began to deliver.

The Media Lab is attempting something else entirely. If "narrowcasting" is the opposite of "broadcasting," we need a term that's the opposite of both. "Broadcatch" perhaps.

It's not utterly new. The station-selector buttons on a car radio are a kind of broadcatch device, since they are user customizable, but they only can select for source, not content. What's new at the Media Lab is the content-specific selectivity and repackaging at the receiving end that computer technology is offering. If printing and industrialization were revolutions that transformed civilization, a counterrevolution is under way.

The printing press mass-produced books, creating the mass audience, and to some extent, nations. The industrial revolution mass-produced hardware, creating mass consumers, and to some extent, world wars fought with massive hardware. But the most recent world war was won primarily by information -- enemy signals captured from wireless transmissions and decoded by the world's first electronic computers. Winston Churchill was reading Hitler's orders before the German field commanders they were addressed to. Power was shifting from the material world to the immaterial world.

The first two decades of computer science following World War II were funded almost entirely by the American military. (Why this is not a major theme in contemporary history books I'll never know.) The direct, intentional result was the computerizing of society, and then the funny thing happened. Computing power dispersed. It went from the middle to the edges, from the broadcaster toward the broadcatcher. Thanks to the deliberate grass-roots revolt of the creators of personal computers and the lavish cleverness of the makers of consumer electronics, the bit business began to be taken over by citizens and customers.

How Information is Sought

When you shift perspective from how information is sent to how it is sought, a different pattern takes shape.

Some of the Media Lab researchers like to quote an optical disk prophet named Mark Heyer on the subject of information seeking. From Heyer's chapter in the book "CD ROM":

> In my view, there are only three ways in which we gather information -- by grazing, browsing, or hunting.
>
> Grazing is the well-known activity of sitting in front of the TV in an alpha trance, eyes wide open, with information, good or bad, flowing in. The networks used to point with pride to the fact that viewers who tuned in at 7 p.m. were most likely to watch the entire evening without bothering to change the channel.
>
> Browsing means scanning a large body of information with no particular target in mind. Newspapers and magazines are the high-technology browsing media today. They have lots of instantly accessible 2-D bandwidth. Browsing on TV has become popular with the advent of cable. During a 30-second commercial I can check out 15 different channels for 2 seconds each.
>
> In the hunting mode we are seeking specific information. Computers are superb hunting tools. Time-shift recording on VCRs is also hunting, although many people quickly find that they don't want their evening info-graze to become a hunt.

Broadcatch technology will change or accellerate each of the modes. Grazing -- Couch Potato Mode -- is intensified and perhaps made even more attractive by having an inquisitive robot do one's selective browsing all day, all night. Hunting by computer at present is an exhausting business, frequently jobbed out to data-search specialists. But much of what they do can be automated by broadcatch technology and soon will be.

What can't be automated, quite, is quality detection. The computer may be told, or even find out for itself, what subjects you are interested in. It will have a hell of a time detecting which of the infinity of junk out there you will consider, quote, good. The way around this, of course, is citation and review. The computer can query people whose opinion you share or respect on which of the junk is good. I can usually rely on the movie reviews of Sheila Benson in the "Los Angeles Times" or Jay Carr in the "Boston Globe." I would inform my movie-search program of this.

One of the unexplored prospects of broadcatch is how opinion about quality will spread laterally among the populations of broadcatchers. Imagine innumerable highly specialized, highly judgmental "TV Guides." Are fortunes to be made in that industry, or is it necessarily amateur? I would predict both, with successful amateur reviewers gradually becoming professional, as is already happening in the world of e-mail. Another question is whether broadcatch will exacerbate the excesses of best-sellerdom -- popularity feeding on popularity and reducing variety -- or will it provide a cure?

The Economics of Broadcatch

Meanwhile, part of what is driving the technology of broadcatch into existence is simple economics. More of the information at the source becomes potentially salable. If the filmmaker's cutting-room floor, the reporter's notes, the musician's outtakes, the author's earlier or longer drafts, can be accessed by inquiring audiences, then they will be.

At attractive prices, probably. Negroponte: "In principle it's much cheaper to get information this way." Take text. Pool noted, "Of the four distinguishable functions in the processing of words -- input, storage, output, and delivery -- storage is already cheaper in computers than in filing cabinets."

Electronic delivery of text is conspicuously cheaper than doing it on paper, and the booming of the laser printer market suggests that newspapers, magazines, and books will soon be more efficiently and conveniently manufactured in home and office than at printing plants. "The paper industry has cause for optimism," observed Pool. The printing industry does not.

Anticipating all that, the Media Lab is driving the quality end of broadcatch technology as far as it can. Lab doctrine states that everything you can see on present-day television and computer screens is unacceptable, both technically and aesthetically, and it says the same about what the Lab has

(please turn to page 25)

The Role of Computers in the Automated Workplace

Carlton Rochell, Dean of Libraries
with Christina Spellman
New York University
New York, NY 10003

"A great deal of labor is now organized to work with the computer rather than to direct it. As a result, workers are not only losing control over their work, they are also losing their understanding of it."

The major actor in the high-tech revolution is the computer -- miracle itself, maker of miracles in the workplace and in our lives. We may take the computer for granted; we may stand in awe and fear of it as something beyond our understanding; we may welcome it as a benefit the equal of penicillin. But what is this reshaper of our lives, and where did it come from?

Evolution of the Computer

The computer originated in the laboratory, and its enormous potential was initially limited to scientific and military applications. Historically, the demands of warfare have provided great stimulus for technological development. Funds for the development of computers in the United States were made available from defense budgets. The first decimal computer, ENIAC (Electronic Numerical Integrator and Computer), was a product of World War II ballistics research. Prompting further development was the need for rapid collection and manipulation of statistical information by business. Engineers were also quick to recognize how computers could solve complex calculations and modeling problems, while increased international economic competition created a demand for sophisticated telecommunications and rapid information transfer. /1/

The history of the computer is a tale of ambition and genius, filled with eccentric personalities. The machines that now make mathematical computations at increasingly dazzling speeds can be traced back to the abacus and the counting machines of Pascal and Leibniz. By the mid-nineteenth century, the Englishman Charles Babbage was experimenting with an "analytical engine" that was the ancestor of ENIAC.

Babbage, considered the father of the computer, can be thought of as the prototypical Victorian, and his combination of practical and theoretical problem-solving occurs again and again in the evolution of computer design. Throughout his career, Babbage was concerned with creating calculating "engines." He not only devised methods of calculation for his machines, but also developed the tools needed to build them. He spent his own fortune and enormous sums from the British government on his computing machines, the differential engine and analytical engine. In the end, others built the differential engine, using Babbage's design. But Babbage himself built the more complex analytical engine, with its potential for programming through card-coded instructions.

The machines Babbage developed were sophisticated calculators. Their design shows how well he understood both advanced mathematics and the state of manufacturing technology. Babbage also had a knack for adapting other people's discoveries. For example, he appropriated a system for programming looms developed by the French weaver and textile producer Jacquard to solve the problem of entering information into his computer. Jacquard had developed a system for punching cards with instructions so that a loom could reproduce a design or portrait.

Compiling Statistics

Punched cards were also applied to statistical compilation by Herman Hollerith, an American engineer working in the 1880s. Hollerith combined a card-reading machine with a tabulator to produce the world's first mechanical data processor. This machine proved its worth when it was applied to U.S. Census data. It quickly (for those days) provided information on city size, the ratio of rural to urban population, household composition, and the like. Hollerith was quick to see the advantages of electricity. With it, he produced a calculating system far faster than any of its mechanical predecessors. Tested during the 1880 census, Hollerith's electrical card-counting machines completed the transcription of data on 10,500 Saint Louis people in 72 hours and 27 minutes, and the tabulation in 5 hours and 28 minutes. Its closest competitor, the Pidgen chip machine, took 110 hours and 56 minutes to transcribe the information and 44 hours and 41 minutes to tabulate it.

As an inventor, Hollerith also combined traits that can be found repeatedly in the history of the computer. In his case, these were a clear sense of how to use technology to solve certain types of problems and a desire to see commercial applications of his ideas. Although his machines were expensive, they were indispensable. When a number of tabulation machine producers merged, Hollerith's company became part of the conglomerate that came to dominate the computer industry -- the International Business Machines Corporation, or IBM.

The first half of the twentieth century brought the development of increasingly sophisticated calculators -- both analog and digital computers. Symbolic logic and binary conversion -- the transposition of information into a two-unit format (0 and 1) -- were critical elements in the production of the first digital computers, as was the development of more elaborate forms of electronic feedback. Experimentation and development were accelerated by the pressing needs of national defense.

Development of ENIAC

By the standards of previous wars, World War II was as much a contest of technology as military skill and strength. The accelerated development of the digital computer, for example, was the result of the U.S. Army's need for precise firing tables for sophisticated guns. In 1941, the differential analog computer was the state of the art in high-speed calculation. When it proved impractical for the ballistics task, the army established a computing research operation at the University of Pennsylvania's Moore School of Engineering. Working under a high-security classification, Moore researchers, including John Mauchly, J. Presper Eckert, Jr., John Brainard, and Herman Goldstine, completed ENIAC in June 1944. The ENIAC project emerged too late in the war to have much impact on ballistics, but it captured the imagination of John von Neumann, the brilliant mathematician, then working at the Los Alamos Scientific Laboratory. At his urging, ENIAC was applied to Los Alamos calculations for the development of the hydrogen bomb.

ENIAC's achievements stirred rivalries among institutions like the Massachusetts Institute of Technology, the Institute for Advanced Study at Princeton, and the Moore School -- all then vying to produce computers. It also stimulated the scientific community in general, because ENIAC established digital computing as a reliable, quick, and expandable means of computation. ENIAC became the standard from which succeeding developments in computers derived. More versatile and more accurate than the analog computer, it could be programmed to respond to a variety of data needs, including alphabet-based languages. However, even before its completion, ENIAC's designers and most scientists familiar with its development knew that what was needed next was some means of storing memory and a more efficient way of programming instructions.

The postwar period was characterized by intense enthusiasm and competition among engineers and managers who envisioned the enormous potential to be realized from further development. Mauchly and Eckert of the original Moore School team developed BINAC, the Binary Automatic Computer, and UNIVAC, the Universal Automatic Computer. In Britain, the Manchester Mark I was developed by a team that included mathematician Alan Turing, who in 1936 had published what is acknowledged to be one of the most important papers in computer science, "On Computable Numbers."

By the early 1950s, IBM had emerged as the most aggressive commercial developer in the field. While the primary thrust of research was still defense, and other governmental applications came second, the computer's potential for systematic information access and processing was widely recognized. Soon it was accepted that, for any number of accounting or recordkeeping activities, the computer could replace the manual worker.

Computer Technology Changes as Users Increase

The technology of computers changed rapidly as the number of their possible uses increased. A major breakthrough came when mechanical tape replaced vacuum tubes for storing memory. Another milestone was MIT's Whirlwind Project, which produced the first "real time" computer. Capable of meeting instant information needs, it could be used for assembly lines and air traffic control. Whirlwind employed multiprocessing -- that is, the simultaneous processing of several predetermined programs. It thus pioneered the technology of networking by coordinating and organizing information passed among its different units. Among its most valuable assets was the high speed at which information could be exchanged. As opposed to a single machine, Whirlwind was a system that combined several computers and devices to coordinate information. It also was the first computer to use magnetic core memory and interactive monitors. In the genealogy of computers, it is the parent of the 1960s minicomputer.

The next technological innovations were the transistor (1947) and the integrated circuit (1959). The transistor replaced the vacuum tube. It made possible solid-state circuits, combining many transistors with fewer components and wired connections. Thus, reliability increased and miniaturization became possible. Integrated circuits came next, as sets of solid-state circuits or semiconductor devices were mounted on a single board or piece of plastic. Integrated circuits not only permitted faster and more reliable information transfer, but they also were easier to maintain and less expensive to mass produce.

In 1971 came the programmable microprocessor in the form of a general-purpose logic chip. By combining memory with a logic chip, a microprocessor can be used in any machine that manipulates information. Its applications range from thermostats to programmable home appliances. Heir to the microprocessor is the microchip, which made possible vast memory storage at low cost and accelerated the development of robotics as well as computational computers. Progressively smaller and more sophisticated chips have made possible progressively more sophisticated applications.

Today, different kinds of machines programmed in different languages can communicate via local area networks (LANs) and intelligent terminals act as gateways to stored data. Combined with telecommunications technology, the chip transforms the terminal into an intelligence device with access to a variety of data and services from multiple locations.

By the time the personal computer hit the marketplace in the 1970s, microchips had become capable of storing increasing amounts of memory at less and less cost. The advent of the Apple and, later, the IBM Personal Computer, made Americans in general increasingly conscious of the computer and its uses for them. While this diffusion to the public was taking place, leading engineers were designing superpowered machines with super memories, designed to operate at extraordinary speeds. The technique they developed was multiprocessing, which involves the dense packing of chips into a compact C-shaped cabinet to minimize the time it takes for electrical currents to travel from one part of the machine to another. In the Cray-2, which has the world's largest internal memory capacity (2 billion bytes), 240,000 computer chips are used. The Cray-2 is 40,000 to 50,000 times faster than a personal computer. What this represents in speed alone is summed up by Robert Borchers, associate director of the Lawrence Livermore National Laboratory: "What took a year in 1952 we can now do in a second."

These multiprocessors represent a radical new stage in the development of computer technology. Astrophysicist Larry Smarr has assessed it as the "biggest development in forty years." Multiprocessors also create a new set of expectations for still more improvement. Seymore Cray (who founded Cray Research in 1972) describes the current environment: "As far back as I can remember I was very proud to make factor-of-four improvements from one generation of machines to another. Instead, we're moving forward by factors of ten." /2/

The Accompanying Need for Programming Languages

As computer technology evolves, the need for programming languages develops along with it. The programs for ENIAC were basically wiring diagrams, and much of the early program language consisted of flowcharts. With FORTRAN (formula translation), which was developed at IBM between 1954 and 1957, computer programming was opened up to anyone who had a good sense of logic and the persistence to learn. Initially used by the IBM 704 computer, it was soon adapted for use in other IBM machines and sold to other manufacturers. This enhanced the ability of computers to communicate with each other, because they could speak the same language.

As commercial demand expanded and new demands arose, responsive computer languages become more varied: COBOL (common business-oriented language), BASIC (beginner's all-purpose symbolic instruction code), and SPSS (special program for the social sciences).

These languages have become progressively easier for the nonspecialist to use. The advent of personal computers has brought "user-friendly" screen instructions for such programs as Wordstar, Wordperfect, and VisiCalc.

As the computer became more accessible and more broadly useful, its application expanded. During the 1950s, insurance companies and banks as well as research and development-related industries began using computers. With the onset of miniaturization, cost ceased to inhibit use by middle-sized companies. Any operation that could be broken into a logical sequence with specifiable activities was a prospect for computerization.

The Undeniable Advantages of Computerization

Whether a mainframe or a mini, the computer is basically a capital-intensive, labor-saving device. It rationalizes task completion. It works well in the current corporate structure, which is based on centralized control of decision making. It also adapts functionally to the needs of the new entrepreneurial corporations. Computer networks enable a company or a group to transcend the conventional limits of time and space. Effective networking allows engineers in West Germany and Detroit to collaborate in the design of cars. It also means that a manuscript written in Newfoundland can be edited electronically in Boston and delivered electronically to Los Angeles.

The MAP (Manufacturing Automation Protocol) network developed for use at GM, Ford, and McDonnell Douglas allows different technical systems involved in manufacturing to be coordinated. The MAP users' organization, which in 1985 included 240 companies, recognized that incompatibility among systems had created a "communications monster." As a result, the organization has pressured vendors to develop computerized machinery that can be used as part of a system. The ideal is nonobstructed, fluid communication throughout the production process. At the GM Saginaw plant, it is estimated that switchovers for the production of axles for 1986 models using the MAP system will take ten minutes. In 1985, it took three days.

In a study called "Impact of Microcomputers on British Business" (1979), the National Computing Centre in Manchester, England, links effective network capability to the adoption of an "integrated workstation." Ultimately, says this study,

> the product which will do most to change the operation of the office will be an "integrated workstation" -- the entry and exit point for information on a digital, voice, data, text, and image network. In its fully developed form, this will replace the typewriter, the office copier, the telex machine, the computer terminal, and the desk calculator, and will provide the key terminal facility for electronic mail. ... It will also have access to public data banks and information systems. /3/

Not only will the integrated workstation streamline work flow, but it will enable data to be transmitted to other sites. Limitations of time and distance will no longer impede work, and computerized cottage industries will have the same access to data as multinational corporations. Through the National Library of Medicine's IAIMS Program (Integrated Academic Information Management Systems), it is already possible to see the vast improvements this kind of system makes in information availability and access. Through the IAIMS Program, medical service delivery and research are expedited by information programmed to address specific needs. For example, at the University of Utah Medical Center it is possible to cross-reference medical information with a large genealogical database and conduct epidemiological studies that show the relationship between the country of origin of immigrants to the United States and the inheritance of diseases.

The Dark Side

By their nature and formidable capability, computers are changing the workplace. A great deal of labor is now organized to work with the computer rather than to direct it. As a result, workers are not only losing control over their work, they are also losing their understanding of it. Many high-tech workers today do not know why certain designs are considered more effective than others. As computers control more aspects of work, the gap between knowledge workers, who control the technology, and line workers, who are its custodians, will become wider. In the process, a number of skilled jobs will simply disappear, as intelligent machines become capable of performing more tasks with a competence that exceeds that of human workers. Already, draftsmen have been replaced by CAD (computer-assisted design) systems, telephone technicians by multilink transmission systems, and production line welders by robots. Recently, the tomato growers of California started using a robot called the Tomato Harvester to pick tomatoes. The implications for the migrant workforce are devastating: The number of farm jobs in the tomato industry in California dropped from more than 40,000 in the 1970s to 8,000 in the early 1980s. There are also negative implications for those who like the taste and texture of tomatoes, since growers are now concentrating on breeding plants tough enough to withstand the robot picker.

How Are Tasks Chosen for Computer Application?

The plight of migrant workers raises an interesting question about the costs and benefits of automation. How are tasks targeted for computer application? The economics of adopting high technology, of course, depend on certain production-specific factors. How much risk is involved in a specific task? Robots clearly are superior to humans for handling toxic wastes. One designer pioneered the use of robots to move inventories in deep-freeze warehouses. Immune to extreme cold, the robots were subject to considerbly less danger and discomfort than human inventory clerks in the same situation. Work situations involving hazardous conditions are, therefore, one area where high-technology substitutions unquestionably improve the overall safety of the workplace. Savings in the costs of extra pay for hazardous and unpleasant conditions, as well as of workplace insurance and disability, are other obvious benefits in this sector.

Another production-specific factor is speed and accuracy. The utilization of computers and robots in industry was initially geared toward simple repetitive tasks that could be systematized at high speed. Spot welding currently accounts for the use of thirty-five to forty-five percent of all the robots in the United States. At General Motors, which has been one of the strongest advocates of robotics, each first-generation industrial robot purchased in the early 1980s eliminated an average of 1.7 to 2.7 jobs in plants that operate on a three-shift, twenty-four-hour-a-day schedule. Taking into account a British study which suggests that for every 2.5 jobs lost to robotics only four-fifths of a new job is created, it is easy to see some of the economic benefits of the new technology for employers. Researchers have estimated that by 1990 the United States will have lost 100,000 to 200,000 manufacturing jobs to robotics. /4/

Factors Miscalculated in Computerization

But automation does not necessarily produce immediate economic benefits. In work situations where precision and accuracy are the basis of cost-profit ratios, computerized equipment can increase profits -- but only if it is introduced with adequate knowledge and training for those who maintain and use it. Several recent anecdotal accounts indicate that without adequate knowledge of the new technology, workers responsible for it become unintentional saboteurs. Companies have consistently overestimated the ease of transition from mechanized and computerized production, and have underestimated the skills and training the new technology demands, with costly results in terms of time and wasted materials. A well-documented example is the flexible manufacturing system at Caterpillar Tractor. According to Jack Hollingum, writing in "The Engineer," it took four years from the time Caterpillar ordered the system in 1971 for it to become operational. /5/

Furthermore, the capital investment that new technology requires (estimated at $51 billion for computerized equipment in 1984) can lock corporations and institutions into rigid, inefficient time-tables. Too often, the complexity involved in designing an automated system is underestimated. Close examination of even the most basic tasks reveals that the actual work process is much more complicated than the sum of its parts. This has been one of the strongest challenges in the transition to an automated work environment.

Another concern is the degree to which workers whose tasks are being automated are able or willing to provide information for designers and programmers. The hidden aspects of job competence are consistently the most difficult to teach a machine. These are often highly variable and unquantifiable: they involve experience, trial and error, and sense, touch, or knack. A case in point was the Campbell Soup Company's decision to create an artificial intelligence program for the master soup-taster's job. While this might seem to be a straightforward set of tasks, it took the soup-taster and a programmer more than three months to map out the job so that it could be programmed.

What is true of workers is also true of management. Recent studies have indicated that a good deal of what managers do is gather information informally. Exchanges in the corridor are common, and power is brokered in ways that resist documentation. This makes it unlikely that electronic management systems will ever be designed with all the capabilities of human managers.

Worker Resistance

Designers and programmers also often encounter resistance when they are researching system specifications. Workers, including managerial workers, are suspicious of computerization, especially when it might threaten their job security, minimize their skills, or challenge their judgment. Misrepresentation of work organization or data and outright refusal to adopt the technology are all aspects of such resistance. A familiar example is the middle-level manager who resists using a word-processing pool in order to retain a secretary. Not only are two hierarchically different positions involved, but also an intricate web of status, dependency, and habit.

Toward the Postindustrial Society

Overall, the benefits to the company of automation outweigh the costs, particularly when planning takes into account indirect costs, such as maintenance and upgrading. The reticence American industry has shown recently toward the robotics market is an example of the pendulum swing between overenthusiasm and its natural fallout, disillusionment. The euphoria of the computer age has begun to give way to realism regarding what the technology can do. However, a new thrust is expected, built on such sophisticated technologies as the MAP network, once such systems demonstrate their true capabilities.

Industrial competition from Japan and Western Europe will also continue to fuel U.S. research and development. Japan is now ahead of the United States in the successful use of automation in certain industries, and this is weakening our international competitive position. Given the economics of the marketplace, according to "Forbes" and "Fortune" and many of their readers, strategic implementation of high technology is critical. American manufacturing industries recognize the threat and are acting. In part, the result is job displacement. In a provocative editorial on why the United States won't become a permanent debtor nation, "Forbes" editor Howard Banks writes: "Robots and computers are achieving efficiencies that reduce the importance of wage costs in calculating where to locate a plant." /6/ His thesis is that, with high technology, industry will not have to continue to relocate to cheaper labor markets in the third world in order to compete in the international market.

Most businesses have a straightforward motive for automating: rationalizing production and reducing the number of people required to meet production goals. The first allows centralization of control, a process complementary to the bipolarization of the workplace. The second allows cost reductions in wages and benefits, and raises the thorny social question of who will assume responsibility for the unemployed and underemployed sacrificed in the process.

References

/1/ The succeeding history of computer automation is drawn from the following sources: Stan Angarten, "Bit by Bit: An Illustrated History of Computers" (New York: Ticknor and Fields, 1984); Roger Draper, "The Golden Arm," "New York Review of Books" (October 24, 1985), pp. 46-52; Christopher Riche Evans, "The Making of the Micro: A History of the Computer" (New York: Van Nostrand Reinhold, 1981); Raphael Kaplinsky, "Automation: The Technology and Society" (Harlow, England: Longman, 1984); Lenny Siegel and John Markoff, "The High Cost of High Tech" (New York: Harper and Row, 1985).

/2/ Philip Elmer De Witt, "A Sleek, Superpowered Machine," "Time Magazine" 125, 4 (June 17, 1985) p. 53; and Lucia Solorzano, "Computers on Campus: The Good News, Bad News," "U.S. News and World Report" 99, 15 (October 7, 1985), pp. 60-61.

/3/ National Computing Centre, "Impact of Microcomputers on British Business" (Manchester, England, 1979). Quoted in Raphael Kaplinsky, op. cit., p. 91.

/4/ Roger Draper, op. cit., p. 47.

/5/ Jack Hollingum, "The Engineer" on Caterpillar Tractors, quoted in Raphael Kaplinsky, op. cit., p. 90.

/6/ Howard Banks, editorial, "Forbes" (October 25, 1985), p. 32.

Based on Chapter 1, *The Springboard of the Automated Workplace: The Computer*, of *Dreams Betrayed: Working in the Technological Age* by Carlton C. Rochell with Christina Spellman; published by and copyright 1987 by Lexington Books, D.C. Heath & Co., 125 Spring St., Lexington, MA 02173. Reprinted with permission.

Editor's Note: Copies of this important book are available from the publisher.

Ω

Computers, Customer Communications and the Need for Human Intelligence

Samuel J. Sackett
Joy Reed Belt & Associates, Inc.
P.O. Box 18446
Oklahoma City, OK 73154

"The human ingenuity which devised the computer in the first place can also devise a total communication process into which the computer can take its rightful place as a useful business tool."

Use of Computer-Generated Communications

During the past several years many, if not most, companies have found they can save time and money with computer-generated letters. This is all to the good, but the computer can generate problems as well as letters in customer relations.

Two reasons explain why the computer, which is supposed to improve communication, has in many cases corrupted it. One is that the computer is still new, and appropriate procedures for its use are still being developed. The other is that people put too much faith in the electronic system itself, forgetting the human beings who use it, and the other human beings who must deal with it.

The situation is not hopeless, however. The human ingenuity which devised the computer in the first place can also devise a total communication process into which the computer can take its rightful place as a useful business tool.

In this article are three examples of communication problems which, if not actually created by the computer, were exacerbated by it. Two of the examples selected are in the area of credit and collections, and the third involves an insurance claim. The three cases are significant because they suggest specific steps which might be taken to improve communications between a business and its customers.

The goals of collections communications should be (1) to achieve voluntary compliance with the request for payment, so that the delinquent account is brought current; and (2) to maintain desirable customer relationships after the payment is made. In the two collections cases explained here, however, the computer-generated communications do not achieve voluntary compliance and maintain good relationships, but seem planned to provoke resistance, reluctance, and hostility. Indeed, a major gasoline company received the following letter from a customer who had received such an infuriating collections communication: "You will get the pieces of our [credit] cards in the mail, we will continue to pay you as we get the money to do so until we have paid you off completely, and we will never buy another drop of [your] gasoline or any other [of your products] as long as we live." This is hardly the result the company wished for.

Problem of a Third Party Credit Company

The first example began on 3 February 1986, when a notice was sent to a customer from Los Angeles concerning a past due balance of $53. While the business and the customer were both located in Oklahoma City, the firm had sold its accounts to a credit company in California. On 12 February the customer wrote a letter to the address on the notice explaining his situation and promising payment as soon as possible.

On 13 February a delinquency notice was sent from Los Angeles. The customer made no response to this because it obviously crossed his 12 February letter in the mail.

The customer heard no further word until, on 17 March, he received a telephone call from the Oklahoma City credit manager. The customer explained that he had written an explanation to Los Angeles. The credit manager became angry and informed the customer that he should have written her instead. That day, the customer wrote the credit manager, sending her a summary of the letter he had written to Los Angeles.

The customer became able to make payment on 25 March and sent a check for $27. Then, two days later, he sent an additional check for $26, which brought the account current. Both checks were sent, as the collection notices instructed, to Los Angeles.

You can imagine the feelings of the customer when, on 3 April, eight full days after he had sent the first check and six days after he had sent the second, he received from the Oklahoma City firm a "Notice before Suit," falsely saying, "Repeated demands for payment of this just obligation have been ignored." It was signed by a collection clerk. Not only had he paid the obligation in full, but he had previously written two letters and had spoken personally to the credit manager. When the customer telephoned to protest this notice, the collection manager was not in, but would call back the following morning.

The collection manager never did call. Perhaps she was too embarrassed by her mistake to face the customer. Instead, the collection clerk called to apologize, though at the same time indicated that it was really all the customer's fault anyway.

This experience reveals eight specific communication problems, which may be divided into three categories: those which were directly originated by improper use of the computer; those which were indirectly associated with the computer; and those which resulted from purely human error.

A Poorly Planned Computer System

Three of these problems arose because the computer system was badly planned, revealing an attitude that simply having a computer is enough; intelligent use of it is unnecessary.

- The computer network linking Oklahoma City and Los Angeles was poorly designed. Although the Oklahoma City firm had sold its credit accounts to the company in Los Angeles, there were no lines of communication whereby the credit company could transmit the information that it had received correspondence from Oklahoma City customers. It would have been simple to build into the network a method by which a computer operator in Los Angeles could have notified Oklahoma City of any communication received from a customer, simply giving the customer's account number and a numerical code indicating the type of communication.

- Only ten days intervened between the past due notice and the delinquency notice. There was insufficient time between notices, which gave the debtor inadequate time for response. This was a problem in setting up the initial computer program.

- No communication was sent from the bookkeeping department to the collection department when the check was received, resulting in continued prodding of the debtor after he had already met the request. This was a flaw in setting up the communication system within the Los Angeles office as well as between Los Angeles and Oklahoma City. The computer could have been programmed to send an automatic message from bookkeeping to collections for every payment entered; the computer could then have searched a list of account numbers in arrears and removed the account from the list. In addition, the credit company could have simultaneously notified its client of the receipt of payment.

Customer Communications Without Human Intervention

Three other problems did not arise from the design of the computer system itself but were instead associated with it indirectly. They reveal a common misapprehension that once a communication function has been turned over to a computer system, it has been adequately taken care of no matter what the computer communicates.

- The past-due reminders sent from Los Angeles were poorly designed, since they contained no indication of where responses other than checks should be sent. They needed a line saying that if there were any questions, customers should write or call the business in Oklahoma City.

- Procedures were not set up to deal with a sufficiently wide range of responses. A procedure should have been developed for debtors to follow if they wanted to request a delay, and a policy needed to be provided for helping debtors work out payment plans.

- Where human contacts were involved, they revealed inadequate training of personnel to handle customer relations. While this has been a problem since well before the time of the computer, it has become more serious since many managers assume that once computers have been assigned the task of communicating with customers, personnel don't need to know how to do it any more.

Unclear Lines of Responsibility

The last two problems revealed by this case have been with organizations probably since cavemen banded together in tribes and will doubtless be with them for as far into the future as man endures. They have nothing to do with the computer.

- There were unclear lines of authority and responsibility within the collection department. Responsibility was given to a clerk for signing and mailing "Notices before Suit," although the clerk had no authority to determine whether those actions were correct.

- The collection department personnel were unwilling to accept responsibility for having made errors, probably because they were inadequately trained.

Problem of Collection Effort Beyond Point of Payment

The second example began on 10 March 1986, when a computer-generated letter was sent from the credit manager to the customer, concerning a $40 past-due balance. One week to the day later the customer wrote a reply to the credit manager, explaining the situation and promising payment as soon as possible. Eight days later, on 25 March, the customer sent a check for $40.

On the same day that the customer mailed the $40 check, a computer-generated letter was sent from the credit manager, informing the customer that the account would be assigned to someone from the collection department unless payment was received within ten days. There was no problem in that alone, since obviously the payment and this letter crossed in the mail. But the form letter took no notice of the customer's 17 March reply. Ignoring that response generated in the customer the frustrated feeling that efforts to communicate with the company were futile.

On 31 March the customer called the company, and the matter was apparently settled. But then, on the following day, by now a full week after the customer had mailed payment, a computer-generated letter was sent from the credit manager to the customer, threatening to have the matter referred to an attorney and giving the customer the name of a "collection specialist," though the letter did not tell the customer what he was supposed to do with that name.

On 4 April, by now ten days after the customer had mailed payment, the customer received a taped collection message via telephone late at night. The customer tried to call the company back that night, but he met with yet another tape recorded message, this one saying that the office was closed and would be open only during working hours (which are during the hours when most customers are also working) and giving no opportunity to record a response.

Weaknesses in Design of Computer Operation

This example also reveals eight specific communication problems. Five of these are related directly or indirectly to the computerization of the company's customer communications. Four of the five problems are traced directly to the poor planning of the computerization.

- The collection effort continued beyond the point when the check was received, resulting in antagonism of the customer. This happened because of weaknesses in the design of the computer operation. There was no communication to the credit department when the check was received by bookkeeping, so that the credit department continued to prod the customer after he had already met the request. This problem could have been alleviated, by the computer since it would be easy to send a message automatically from the bookkeeping department to the credit department as soon as the check had been entered in the books. But when the computer system was planned, no one thought to provide this capability.

- The telephone communication was taped so that no response was possible, resulting in frustration on the part of the recipient. This problem reflects the misuse of a computer-operated automatic telephoning operation. The computer link to put telephone numbers into the operation was in place, but the link to take them out once payment was received was missing.

- There was inadequate time between communications to the customer, allowing inadequate response time and leading to frustration of the customer. The harrassing telephone call followed the threatening letter by only three days. This resulted from poor planning of the computerized operation.

- The company's automatic answering machine, a rudimentary computer, was programmed only to give messages. This frustrated the customer in any effort he wished to make to reach accommodation. The machine should have accepted incoming communications.

While not directly related to the design of the computer network within the company, two other blunders reveal again the pervasive attitude that once communication functions have been assigned to a computer, no human supervision needs to be given them.

- When the customer originally called the company to say he had paid, the person he talked with did not tell anyone else about the conversation. Therefore, efforts to bring the customer into compliance continued beyond the point where he had already complied. The employee evidently felt that since the company had computers to take care of its communications, she didn't need to inform the relevant personnel that payment was sent.

- The threatening letter contained the name of a collection specialist, but no instructions were given as to whom would initiate contact, leaving him perplexed and confused about what was expected of him. This suggests that it is not enough simply to have a computer send a letter; the letter must be intelligently written.

Failure to Keep Customer in Mind

Only two of the problems were totally unrelated to the computer, though they show the same kind of bad planning that went into the computer operation as well.

- So many people communicated with the customer that he had no way of knowing whom to contact. This bewildered him and caused him to feel that no matter whom he contacted, it would be the wrong person.

- The office hours of the credit department were restricted so that it was frustrating for the debtor to try to make accommodation. though it is not necessary to make them into 24-hour-a-day operations, credit and collections departments are so vital to the operation of large corporations that employee hours should be staggered to extend beyond the traditional nine to five.

Problem of Unclear Billing

The third example deals with an insurance claim. In this case the customer had purchased hospitalization insurance. After the premium anniversary in February 1980 the premium was increased. In April the computer kicked out a quarterly premium-due notice for May which requested only the amount of the increment, not the total amount of the new premium. No explanation of the premium increase or the amount of the invoice was included.

The customer was puzzled by the bill, which was much lower than he usually paid, but he paid it without question. He explained later that he thought perhaps he had made and forgotten a partial payment earlier, and that this invoice was for the difference between the erroneous payment and the correct one.

When the bookkeeping department received the payment for May, finding it less than required, it canceled the policy for nonpayment. There was a delay of several weeks in sending out the notice of cancellation. During the first week in June the customer was in an automobile accident and was hospitalized with five broken ribs. He received the notice of cancellation while he was in the hospital.

He called the company from his hospital bed. He was informed that his last quarterly payment had been made in February, and consequently his coverage had expired 30 April and the grace period had expired 31 May. No payment was possible on an accident which had occurred 3 June.

The customer began a letter-writing campaign which lasted for weeks. His only replies were computer-generated letters saying that his policy had been cancelled for nonpayment. None of the letters even offered to refund the partial payment he had made toward the May premium.

Eventually, noticing that the company used a television celebrity in its commercials, the customer looked up the celebrity's address in "Who's Who in America" and wrote the star about his problem. The star transmitted the letter to a vice-president of the company, and an apology and payment were forthcoming. The incident also led the company to make changes in its computerized billing system, its computer-generated form letters, and the training of its employees to deal with customer problems.

No compensation was offered the customer, however, for the emotional distress that the delay caused him, or for the time and energy that he put into pleading his just cause. On the other hand, once the customer had received payment for his claim, he allowed his policy to lapse and took hospitalization coverage with another company. This outcome surely was not intended by his original insurance company.

Misuse of Computer

This experience reveals four specific communication problems, three of which are more or less intimately related to misuse of the computer. One miscommunication especially strikes at the very heart of the problem.

- There was a delay of several weeks between the receipt of the partial payment and sending out the notice of cancellation. It is often stated that one purpose of using computers is that they speed up the processes in which they are used. In fact, however, they often slow processes down. Efficient use of computer time requires that tasks be hoarded until a sufficient quantity of similar tasks can be performed at the same time, using the same program. Businesses need to determine what tasks require speed, whether speed can actually be achieved by computerization, and if it can be achieved, what other computerized tasks will be delayed.

Two other communication problems in this case are computer-related, though not so directly.

- The May quarterly premium notice was badly designed. Instead of being notified that they needed to pay a higher premium for May, policyholders were notified only that they needed to pay the amount of the increment. As the company later admitted, many customers paid only the amount invoiced and had their policies canceled as a result. Fortunately, most of them received the notice of their cancellation before they had an accident and were able to get the matter straightened out. Some, however, simply found another insurance company. Once again, the computerized communications did not communicate adequately because adequate human thought was not put into their composition.

- The computer-generated letters in the company's repertoire simply were not responsive to this individual's case. Yet nobody was assigned the responsibility of determining whether they were relevant or not. There was an assumption that when the customer had been sent a letter he had been communicated with, whether the communication was appropriate to the situation or not. To correct this the company should train its employees to identify letters that are not suitable for computer-generated response and to flag such letters for personal response.

Inadequate Employee Training

The fourth problem which this example reveals, while similar to the one just mentioned in that it involves employee training practices, cannot really be blamed on the computer.

- As the company itself ultimately recognized, it was not adequately training its employees to deal with customer problems. The procedures were too few and too rigid, and there was no procedure for an employee to follow when a situation arose that did not fit into one of the authorized procedures.

Four Major Computer-Related Problems

These three examples have four major computer-related problems in common:

1. The computerized communication was poorly designed, giving too little information to the recipient.

2. While there were computerized lines of communication between Department A and the consumer and Department B and the consumer, there was no communication internally between Department A and Department B.

3. The timing was bad. The computer was programmed to emit messages more rapidly than the customer could reasonably be expected to respond to them.

4. The computer was provided with an inadequate number of responses and was not programmed to distinguish among types of cases so that its response would be appropriate.

Obviously, any business which is already, or is planning to become, dependent on computer-generated communications must successfully address these problems. No business can afford to lose customers because communications are poorly planned. A business must make sure that the communications are intelligently designed, that adequate internal lines of communications have been established, that the timing of computer-generated correspondence is appropriate, and that care is taken to program the computer so that it can distinguish adequately among types of cases and can select an appropriate response from a wide enough range. Solving these problems is especially important when a business uses the computer in credit and collections.

Use of Credit Companies

A recent development spawned by the advent of the computer has been the sale of accounts receivables to credit companies. As computers have become more sophisticated and the continuous and rapid upgrading to achieve state-of-the-art has become increasingly expensive, many small (and even medium-sized) businesses have turned to large credit companies. These larger companies can afford upgrading because they sell their services to many clients and thus have a lower cost per account than most individual firms can achieve.

Sometimes these credit companies are the credit branches of large corporations, such as the General Electric credit operation in Atlanta, which handles credit and collections for many small companies all over the United States, or General Motors Acceptance Corporation, which performs similar services for GM dealers throughout the country. At other times these credit companies are maintained by banks, such as the Citibank branch in Baltimore, which until recently had taken over credit responsibilities for Radio Shack and other national clients; Security Pacific in California, which handles credit and collections for used-car dealers and other businesses nationwide; and Ameritrust in Cleveland, which performs the same services for Firestone Tire and Rubber Co. and other major clients.

The problems in credit and collections which are outlined here should be of serious concern to the clients of such credit companies, since not many customers distinguish between dissatisfaction caused by the company they bought the goods from and dissatisfaction caused by the company which that company sold its credit accounts to. To take a purely hypothetical example, it is easy to imagine a customer of Firestone being badly treated by Ameritrust, becoming hostile, and deciding, "I'll never buy another Firestone tire again as long as I live." In such a case the innocent would suffer for the crimes of the guilty. If it could be demonstrated that this occurred in any substantial number of cases, it is possible the client might even seek recovery of damages from the credit company. This possibility makes it important for the credit company itself to establish good communications with its clients' customers.

The Communications Audit

The defense which credit companies and other businesses can utilize against generating customer antagonism in collection efforts is the communications audit, a relatively new service for businesses. The idea of a communications audit is to explore all aspects of a company's communications to see how they can be improved.

One of the problems which can be detected by a communications audit is deficiency in the number and content of computer-generated letters. Most companies have far too few form letters to deal adequately with the number of different situations which arise. For example, many companies have only one series of collection letters, whether computer-generated or not. While every delinquent customer is different, such customers generally fall into two main categories -- the deadbeat, who is trying to escape payment altogether, and the honest customer who is doing the best he can to pay his debts but just needs more time to do so.

The collector needs to be tough with the first type, and it really doesn't matter if the company loses him as a customer. But if the collector treats the second type like the first, the company will alienate him and cause him to take his business elsewhere. A human being can easily judge which type of customer he is dealing with. It's much harder to train a computer to make this decision, but it can be done. And once the decision has been made, the business needs a different series of letters for each type.

In order to make this decision, the computer must be programmed to search accounts for the criteria to determine which letter is appropriate. Such criteria should include the length of time the account has been open and the proportion of timely payments which have been made. If the account has been open many years and the proportion of timely payments is high, the company has a valued customer who should not be alienated or antagonized by a series of computer-generated "get tough" letters.

In this way and in other ways already suggested, by the exercise of human intelligence, the computer can be harnessed to improve customer relations. All too often, however, human ingenuity and tact are not employed in establishing computer networks and programs. The result is that businesses lose valued, and potentially valuable, customers.

Ω

Computing and Data Processing Newsletter

UNDERGROUND EXPERIMENT ATTEMPTS TO MEASURE PROTON DECAY, REVEAL LIFESPAN OF UNIVERSE

David S. Ayres
Argonne National Laboratory
9700 South Cass Ave.
Argonne, IL 60439

An 1,100 ton iron particle detector and sophisticated electronics are being assembled in an underground laboratory deep in a Minnesota mine, where an experiment is being conducted that could measure the lifespan of the universe. The experiment's major goal is to learn whether nucleons (protons and neutrons found in the nuclei of atoms) decay. If they do, it will mean that all atoms in the universe will eventually disintegrate, although the process will take eons.

Located one-half mile beneath the earth at the Soudan mine in Northern Minnesota, the particle detector (known as Soudan 2) consists mainly of finely segmented iron, interspersed with sensitive instruments. The detector is so large because nucleon decay in a stable atom, such as iron, is extremely rare. Very large numbers of nucleons, those located in the 1,100 tons of iron, must be observed if scientists hope to record the decay of several nucleons within a few years.

The search for nucleon decay is conducted deep underground to shield sensitive detectors from the rain of cosmic radiation that constantly bombards the earth's surface. On the surface, a small fraction of cosmic rays might give signals that look like decaying protons or neutrons. But the flux of cosmic rays is so high, and the expected rate of nucleon decay so low, that it would be impossible to separate real decays from fake ones. By placing the experiment underground, the cosmic-ray flux is reduced 10,000 times or more.

Underground, background radiation reaching the detector will come from low, natural radioactivity in surrounding rock and from cosmic neutrinos. These massless particles are created by collisions between cosmic rays and the earth's atmosphere and can pass through the earth unimpeded. The particles and energies produced by neutrino interactions inside a nucleon-decay detector are well-known and differ only in subtle ways from those expected from nucleon decay. Consequently, a sophisticated detector is needed to tell between nucleon decay and these neutrino interactions. The Soudan 2 detector will be able to search for nucleon decay that earlier experiments could not distinguish from background neutrino interactions.

Participating in the experiment are high-energy physicists from Argonne National Laboratory, the University of Minnesota and Tufts University in the U.S., and Oxford University and Rutherford-Appleton Laboratory in England. Argonne designed and built the detector's electronics (including a computer system for data collection and storage), engineered the structure to support the massive detector, and is assembling half of the detector modules. Installation of the detector started in fall 1986, and data collection began in summer 1987. The detector is not expected to be fully completed for three or four years.

Soudan 2 is an outgrowth of a smaller prototype experiment. Soudan 1, built by Argonne and the University of Minnesota, paved the way by providing practical experience in building and operating a complicated particle-physics detector deep underground.

For Soudan 2, Argonne and Rutherford are each assembling half of the 256 five-ton modules that make up the Soudan 2 detector. The Univ. of Minnesota and Oxford Univ. are building some of the main components. Tufts Univ. is building a shield to surround the 1,100-ton main detector and signal the presence of cosmic rays.

Soudan 2 is a "tracking calorimeter," a detector that both records the trajectories of particles passing through it and measures the energy each particle deposits. This dual capability provides enough information to distinguish between the shower of particles produced when a nucleon decays and the shower produced when cosmic-ray neutrinos strike iron nuclei.

The 1,100-ton Soudan 2 calorimeter mass is made up primarily of 1-meter-square, corrugated steel sheets, 1.6 millimeters thick. The steel is about 90 percent iron. The detector will monitor iron nuclei in the corrugated steel for signs of nucleon decay.

(please turn to page 27)

Brand – *Continued from page 11*

produced so far. Andy Lippman: "The images should be perfect -- no artifacts." Walter Bender: "Some of the things we've done are presenting information, not selling it, not doing what an alert salesman does."

Negroponte wants interactivity between humans and machines explored down to the finest nuance. ...

Player Pianos of the Future

In the basement of the Media Lab is the world's finest player piano. It's a Bosendorfer Concert Series grand, wired to record every imaginable nuance of the masters that are invited to play it. They go, their performance remains. The Bosendorfer is a signal-and-noise approach to music. Minsky and Kay and some of the rest of the Vivarium researchers are intent on extending music research with computers to include meaning -- what they call "music cognition."

Somewhat cognitive is Barry Vercoe's robot accompanist, which reads the same music you do and follows your live tempo, playing a superbly adaptive piano to your violin, for instance. Somewhat cognitive is David Levitt's music program, which can "learn" by imitating. Levitt observes, "It should be easy to say, 'Use the melodic/harmonic outline of this Bach motet, but resynchronize the voices with swing and syncopation, like this New Orleans dixieland polyphony' -- to see if it delights an audience acquainted with both genres."

I got a better idea of what music cognition might mean talking to Tod Machover, a cheery young composer fresh from France's celebrated computer music center IRCAM (Institut de Recherche et de Coordination Acoustique-Musique), which is directed by the conductor-composer Pierre Boulez. At thirty-four, Machover has an international reputation as an innovative composer of exceptional talent.

Composition's Like Living Organisms

Machover wants to try embodying Marvin Minsky's Society of Mind in music. "One of my dreams for a long time has been to have compositions which are like living organisms." Machover would do this Vivarium-sounding task by devising "musical agents, primitives, each of them a musical tendency, a melodic shape or harmonic progression or tone color. The trick would be to set up an environment with some kind of constraint language where you could put those things in motion. You might just push a button and watch it behave, or it might be a performance system -- you could interact with this structure at any level of detail you wanted. Somewhere between improvisation and composition, it would be a very powerful way of using a computer to allow amateurs to participate in the musical process in a way they've never been able to before."

Machover began sculpting the air with symmetrical hand motions. "I imagine an instrument something like a potter's wheel. There would be this undulating surface. I could mold my sound and in real time I could hear those partials arrive and disappear."

Concert halls, he pointed out, need this kind of technology to head off the prohibitive economics of the business. A symphony can no longer be afforded when there are eighty musicians in a symphony orchestra, each getting $40,000 a year. Doing a program a week, with twenty hours for rehearsals, five hours per piece, they can't afford to try new music. In five hours of rehearsal you can't even get the notes right for a new twenty-five-minute composition. No wonder movie and television scores are now composed and performed on computers by lone musicians like Vangelis or Jan Hammer.

Interactive music might help cure the passivity that music-reproduction technology has brought. Machover: "Music shouldn't be a spectator sport, but it's become completely passive. Most of us now experience music not even by going to concerts but by putting on a record or CD. In previous centuries most people played piano. When something new came out, you'd get the sheet music and play through it. You got your hands on it. You can't play a new Frank Zappa or Boulez piece on the piano, even if you're Pierre Boulez. I think we've lost something major."

Since my time at the Media Lab, Tod Machover has emerged from the shadow of the Vivarium project and is setting in motion a very strong music research center at the Lab. Among other things it is arranging public performances in a cavernous five-story space in the middle of the Wiesner Building called the Experimental Media Facility, which Machover now directs. ...

Humanism Through Machines

Computerists in general and Media Lab researchers in particular have a conspicuously unscientific relationship with their machines and programs. They anthropomorphize freely. A program is said to "know" about this and that; the machine needs a minute to "think" about certain kinds of problems; if malfunctioning, it may be described as "sick." Everybody knows better, but there's something comforting in the practice, and it bends research in the right direction.

Allison Druin, the Vivarium student with an art rather than programming background, would implore her workstation computer when something wasn't coming up right, "Come on, be nice to me!" Programmers nearby would roll their eyes, but in effect the Media Lab as a whole is insisting, "Come on, be nice to her!" and it applauded her building a huge furry computer interface with a lap, a face, and a personality.

Negroponte's goal is "ultra-personalized intimate technology -- everything made to order." In Jay Ogilvy's terms, Media Lab devices are the opposite of industrial machines. Their function is not the production of same-same-same, but the endless creation of a "different different difference, because if it's not different, it's not information." The idea is not to arrive at variety as rich as the variety of human beings, but to start from there and expand even further.

The Media Lab is inventing the technology of diversity. Some institutions that enjoyed industrial-style uniformity will no doubt regard it as the technology of perversity. That happened with personal computers -- corporations fought them, unions fought them, the Soviet Union still is fighting them. But personal computers were a technology of separation originally; almost a survivalist mentality surrounded them. Current Media Lab technology enhances connectedness, yet it also manages to enhance autonomy. Kids at Hennigan School help each other more now, but the variety of student behavior there is also demonstrably greater since Seymour Papert's computers showed up. A player-listener of a Tod Machover piece of living music will be joined to the composer closer than with any other music form, but each listening-performance will be unique.

Connecting, diversifying, increasing human complexity rather than reducing it -- these are instruments of culture.

As a university enterprise and an expression of an ethical vision, the Media Lab seems already to be a clear success. It's too early to tell whether it will be one of the great laboratories like Wiesner's RLE, Edwin Land's Polaroid, Xerox PARC, Los Alamos during the war, or Britain's National Institute for Medical Research, but in the terms of the bet made by the Lab's sponsors, they got a win. The Lab is doing a spectacular job of whetting appetites for juicy new technologies, as they hoped.

I was charged, in doing this book, to help the Lab think about what its emergent academic discipline might be, and in that I've failed completely. What would you call it, "The Department of C&C"? Maybe someone will coin a word for the new activity that joins communicating and computing, and that's what it will be the department of. Pragmatically, I suppose, the proof that it's a department of something will be when other universities and colleges have one too, whatever they name it. Such departments are likely to vary a good bit, to be fuzzier, less turf-bound, more collaborative than the staider, steadier disciplines. They're apt to be effectively the Department of New Stuff, part of the parent institution's dazzle factor, like sports. Having failed in my charge, it suits me fine if the uncertainty continues indefinitely. This is the grand intellectual discipline of Mumble Media Mumble.

"I began to think of communications as one big set of things," said Jerome Wiesner.

As for the media lab of the world, some serious choices are in the process of being made. A major one is whether human individuals will be the experimenters in the world lab or the experimentees, users of the future or mere consumers of the future. It will take a long political, economic, and technological process to work that out, but we can decide now which way we want it to go.

It seems the question "How will we directly connect our nervous systems to the global computer?" may have an answer. If Nicholas Negroponte's Media Lab has any say, we'll connect to the global computer exactly the way we connect to each other, through full-bodied, full-minded conversation. The world as we communicate with it does not have to be overwhelming. It can be an old friend.

I would add one further requirement for properly humanistic machines. The most ethical of all tools are tools of adaptiveness, tools that make tools, tools that remake themselves. Our machines have to welcome us inside them and help us hack around in there. A world of experimenters equipped with such

(please turn to page 27)

Zorpette – *Continued from page 3*

nals from a surface ship. But the Naval Surface Weapons Center in White Oaks, Md., is sponsoring a project just under way at Texas A&M University to develop an electronic controller smart enough to guide an autonomous underwater vehicle through complex missions with only occasional outside help.

Communication With Satellites From Ocean Deep

A vehicle that needs little external guidance would avoid the problems of communicating under water. Since high-frequency radio waves cannot travel through water, designers have to rely on acoustics, which are far from ideal; messages must be sent relatively slowly and communication with airborne or orbiting controllers is impossible.

Within the next decade, however, the Navy may have the technology to enable submarines deep beneath the waves to communicate with satellites or airplanes. Laser light in the blue-green region of the spectrum penetrates seawater much better than other colors of laser light. The Navy no longer discusses its work in blue-green laser communications, but the Defense Advanced Research Projects Agency in Arlington, Va., began working on a blue-green laser system two years ago, according to a Pentagon report issued at the time. The system was to be tested this year.

Effective Surveillance System

An unmanned vehicle equipped with a blue-green laser and a sophisticated controller would make an effective surveillance system, Navy contractors say. Released in Scandinavian waters, for instance, it could keep tabs on Soviet submarines, identifying them from the unique sound their propellers make.

A surveillance vehicle might follow a Soviet sub, using sonar to determine its class, speed and bearing. Then, with the blue-green laser, it could beam the data to an orbiting satellite that in an instant would relay the Soviet sub's location, course and identification to naval intelligence in Washington.

Based on an article in the *Boston Globe,* Oct. 19, 1987.

Ω

Brand – *Continued from page 26*

tools can always do the right thing about the roster of technological futures being offered at any time: invent better ones.

Workers of the world, fan out. ...

Editor's Note: Copies of this interesting book are available from the publisher, care of Dept. CMR-CPML.

Ω

CACBOL – *Continued from page 28*

The LAN and Wide Area Networks (WANS)
- Integration of LAN and WAN
- Software concerns/Internet protocols

Network Design Considerations
- Wire and cable distribution practices
- Coordination and planning
- Management requirements
- Configuration of the various servers

Planning and Integration -- Case Studies
- Multiple building
- Multiple media -- baseband/broadband hybrid systems
- Multiple media -- baseband/fiber optic design
- PABX decisions vs. LAN

Trends and Issues
- Status of standards of development
- The twisted wire LAN -- is it a reality?
- Successful LAN management
- Security issues

LAN Product Comparisons

(Source: Catalog of Seminars and Conferences, November 1987 through March 1988, issued by Digital Consulting, Inc., 6 Windsor St., Andover, MA 01810)

Ω

Newsletter – *Continued from page 24*

When the steel sheets are stacked vertically, the corrugations line up to form long hexagonal channels. Each channel holds a 1-meter-long, hollow "drift tube," 1.6 centimeters in diameter and made of a special plastic called Hytrel. Two hundred forty steel sheets are stacked to a height of 2.5 meters to form a module weighing about 5 metric tons and containing 7,600 drift tubes. The full-sized detector will comprise 256 of these modules.

Ω

The Computer Almanac and Computer Book of Lists — Instalment 57

Neil Macdonald, Assistant Editor

60 TOPICS IN A SEMINAR "LOCAL AREA NETWORKS: SELECTION AND IMPLEMENTATION" (List 880101)

The Evolution to LANS (local area networks)

Data Communications Basics
- Communications systems
- Techniques and systems
- Switching concepts

Local Area Networks and the User
- The rapid growth of LANS
  - The 1980s: The decade of the LAN
  - a review of the major players
- Inhibiting forces
  - the controversy -- baseband, broadband or twisting pair cabling
  - PBX vs. LAN
- The stages of LAN implementation
  - design approaches
  - integration of systems
  - practical cabling aspects
  - system requirements -- planned approach
  - establishing objectives and planning your system
- The server

Technology and Design Issues
- Topology discussions
- Media
- Frequency allocation and media
  - twisted pair wiring plans -- IBS & AT&T
  - baseband coaxial systems
  - fiber optic implementations
  - hybrid systems
- The control and access techniques/token passing techniques
  - the IBM token passing systems
  - MAP (manufacturing automation protocol), TOP (technical office protocol)
  - Carrier Sense Multiple Access (CSMA)
  - Ethernet and comparable techniques

Switch-Based Networks -- A Review
- Data switches
- PABXs and LANs
- Voice/data integration and PABX

Local Area Network Applications
- Office automation
- Information distribution
- Factory automation
- Personal computers

(please turn to page 27)

Games and Puzzles for Nimble Minds and Computers

Neil Macdonald
Assistant Editor

NUMBLE

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away, and a second one in the digit cipher. The problem is to solve for the digits. Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, expressed in numerical digits, is to be translated using the same key, and possibly puns or other simple tricks.

NUMBLE 8801

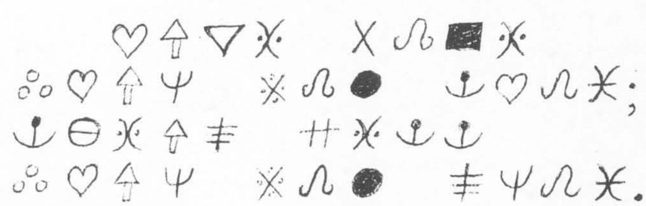
```
          H A L F
      *     T H E
      -----------
        R E N L G          N = U
      L S I T E            G = O
    F L F F I              S = R
    -------------
    T E R I E A O
```

4609 26134 70516 754827

MAXIMDIDGE

In this kind of puzzle, a maxim (common saying, proverb, some good advice, etc.) using 14 or fewer different letters is enciphered (using a simple substitution cipher) into the 10 decimal digits or equivalent signs, plus a few more signs. The spaces between words are kept. Puns or other simple tricks (like KS for X) may be used.

MAXIMDIDGE 8801



SOLUTIONS

NUMBLE 8711: People are complicated.

MAXIMDIDGE 8711: He who is small for the big is big for the small.

Our thanks to the following people for sending us solutions: Leon Davidson, White Plains, NY– Numble 8711, Maximdidge 8711; T.P. Finn, Indianapolis, IN – Numble 8711, Maximdidge 8711.