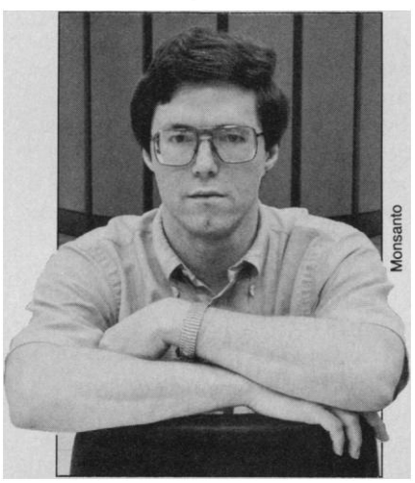
Supercomputer Market Needs Supersalesmen

Researchers have been slow to exploit supercomputers, a reticence that could be hurting U.S. competitiveness

MONSANTO CHEMIST HENRY DAYRINGER says he doesn't normally get nervous making company presentations. But he did the day he went before top corporate officials to convince them to buy a multimillion-dollar supercomputer. Dayringer had good reason to be edgy: he was making a pitch for Monsanto to purchase perhaps the most expensive single piece of nonmanufacturing equipment it had ever bought.

For months, Dayringer had been proselytizing within Monsanto that the costs of a supercomputer, though hefty, would be more than matched by the potential payoffs. In hallway chats and in meetings, Dayringer proclaimed that with such a machine, Monsanto "could do things we couldn't normally do. We could accelerate the better projects and kill the bad ones sooner."



Resistance buster: *Monsanto's Henry Dayringer says, "It was a long process to convince management" to acquire a supercomputer.*

In April, nearly 3 years after Dayringer began his campaign, a Cray X-MP finally rolled into corporate headquarters. Dayringer is delighted, but he remarks, "It was a long process to convince management."

Monsanto's reluctance to take the plunge is all too typical. U.S. companies—and universities, as well—have been slow to adopt supercomputers as a common research tool, and their cautiousness could hobble American competitiveness, according to many experts. "There's an overall malaise in U.S. industry," says Nobel laureate and physicist Ken Wilson of Ohio State University. "The inability to use supercomputers wisely is part of this malaise."

The obvious deterrent to more widespread purchase of supercomputers is their price, many experts say. Supercomputers made by Cray Research, Inc., which produces the world's most sophisticated machines, range from $10 million to $25 million. But insiders say the reasons go deeper. For instance, there is purported to be a serious shortage of researchers trained in numerical simulation, a lack of software, and a sluggishness in the networks used to transmit supercomputer data from one region to another.

The stakes are enormously high, supercomputer proponents say. "The Industrial Revolution came about because of the development of machine tools like the lathe. A supercomputer is the new lathe of today," says Lloyd Thorndyke, the former president of ETA Systems, a supercomputer manufacturer that was folded in June by its parent company, Control Data Systems.

The irony is that the United States has been in the vanguard in developing supercomputers and it continues to lead the world in hardware and software innovation, and yet, as Larry Smarr, director of the National Center for Supercomputer Applications at the University of Illinois, and others assert, it is failing to exploit these supertools to their full advantage. The U.S. supercomputer market "hasn't been good in the past few years," says Gary Smaby, an analyst at Needham and Company in Minneapolis.

Indeed, ETA Systems' demise leaves Cray as the only major U.S. supercomputer manufacturer, which has made federal officials and others nervous about the viability of the supercomputer industry in this country. Cray has installed about 56% of the world's supercomputers, but is now trading at a 52-week low, Smaby says. Cray's revenues were $750 million last year, but the company is seen as potentially vulnerable when stacked up against its Japanese competitors, which are multibillion-dollar, vertically integrated conglomerates that can withstand more losses.

IBM is maneuvering to become an important player in the supercomputer market, but has not yet developed a machine that is competitive with Cray's top-of-the-line models. Vying too are several much smaller companies making parallel processors.

Thorndyke and Smarr trace the supercomputer malaise back two decades. Thorndyke said in an interview that "universities during the 1970s didn't believe they needed big machines." Researchers preferred working with the convenience of departmental computers, though they are slower in speed, rather than sharing time on a supercomputer. With interest dwindling, the National Science Foundation in 1969 began slashing subsidies of academic purchases of the most sophisticated computers then available.

For the next 15 years, U.S. universities did not have ready access to the world's fastest computers. Instead, as the technology advanced, most supercomputers ended up in the military and other federal labs. But NSF was jolted back into action when, in 1983, Japan declared a national project to promote high-speed computing. The next year, after heavy campaigning by Smarr, Wilson, and others, the NSF launched a major program to put the latest machines on campuses and to boost training through the establishment of five supercomputing centers. By the end of this fiscal year, NSF will have plowed nearly $190 million into the program since its inception.

Smarr cites encouraging changes. There are now 10,000 users of the NSF centers. At the same time, about 20 other universities have acquired supercomputers independent of NSF. Dayringer declares, "The NSF centers are essential, critical, vital."

One of the fastest growing areas of use is in biology. Suse Broyde of New York University and Brian Hingerty of Oak Ridge National Laboratory, for example, are using a supercomputer to analyze DNA structure. On an older computer, 500 trials took 3 months of computer time, day and night. Then the Department of Energy offered the researchers time on a supercomputer at Lawrence Livermore Laboratory. Hingerty, the computer expert of the team, redid the applications codes for the supercomputer, so they now whiz through 32,000 trials in 2 days of computing time on a Cray.

For Terrence Lagerlund, a physician and physicist at Mayo Clinic, a supercomputer not only speeds up his research, but allows him to experiment in ways not previously possible. Lagerlund, who is studying how blood oxygen concentrations affect nerve degeneration, says he can develop more accurate and complex models with a supercomputer because he can vary more factors.

Though the supercomputing programs

sponsored by NSF and universities have made important gains, the United States is still recovering from the past scarcity of supercomputers in academia. Kenneth Neves, a top computer specialist at Boeing, Inc., says that many companies still have a hard time finding people well trained in supercomputing. Smarr and others also say that there is a crying need for a broader array of scientists to use supercomputers.

Smarr says, "Our big challenge is to rebuild the pool [of specialists in numerical simulation] and undo the benign neglect of 15 years. We hurt our competitiveness very badly. We ignored education and training for more than a decade."

Smarr is not surprised that U.S. industry has not bought more supercomputers. He says, "If the national manpower pool was back to what it should be, there'd be no question you'd have this equipment."

One way to help broaden supercomputer use is to promote the development of new and better software, Smarr says. The lack of software "is a major barrier," he remarks. William Wulf, assistant director of NSF's computer, information science, and engineering program, said on 26 July at a Senate hearing on software development, "Too often I see biologists and other [non-computer] scientists spending too much time developing software because what they need is not available." The federal government needs to increase its support of software development, Wulf says, because the scientific market isn't big enough to interest software manufacturers.

With better software, John Rollwagen, Cray's chairman and chief executive officer, and others envision that in the future researchers can sit down to an office computer and—without spending a lot of time learning new software, as they have to do now—simply tap into a supercomputer located somewhere else. "Cray has to make a supercomputer feel like a PC," Rollwagen says.

But problems with transmitting data across the nation are looming. NSF manages a network called NSFNet, which is the national electronic backbone linking researchers at universities and government laboratories, who use all sorts of computers, not only supercomputers. Although the network at present is "nowhere near capacity," use of NSFNet is increasing at an "astonishing rate," says Stephen Wolff of NSF.

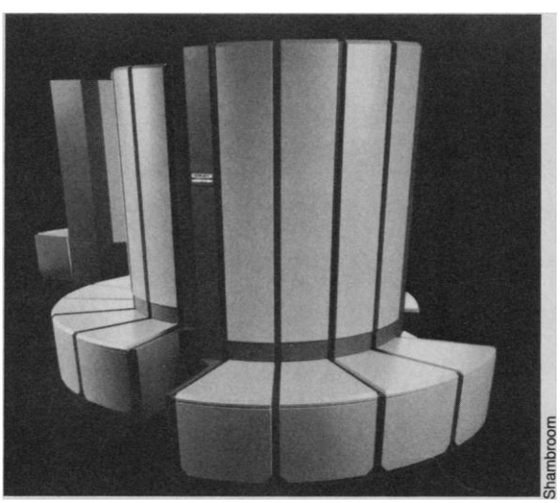
Network use has jumped 20 to 30% a month during the past year, Wolff says. Part of the reason is that the federal government is phasing out another network, ARPANet, which is technologically antiquated. ARPANet was set up 20 years ago by the Defense Department to link the nation's research centers. The network is crowded also because new users are rapidly hooking up to the network as they discover its usefulness.

For supercomputer users, NSFNet is already becoming a bottleneck. Its present bandwidth is not big enough to transmit quickly huge quantities of data associated with supercomputer use, such as weather forecasting information. According to Thorndyke, some frustrated researchers have found the waiting time to get on the network so long and the transmission time so slow they have opted instead to fly to a supercomputing center with data tapes. Sometimes NSFNet is "like trying to get onto the subway at rush hour," Broyde says.

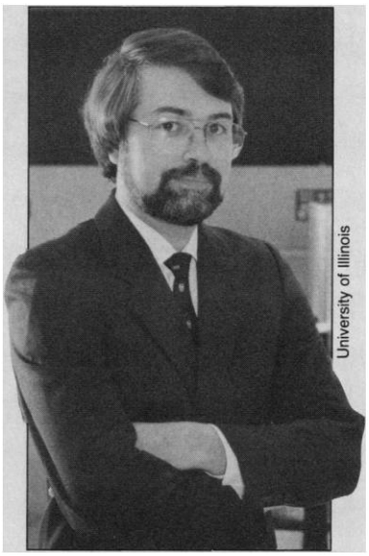
In light of some of these problems, Senator Albert Gore (D–TN) recently introduced a major bill that would authorize $1.75 billion over several years to expand a national high-speed computer network and promote research in high-speed computing in several ways. Under the legislation, NSFNet would be expanded by 1996 so it could transmit up to 3 billion bits of data per second, more than a 60-fold increase from the 45-million bit network that NSF expects to phase in by the end of fiscal year 1990.

The network proposal has strong backing. Presidential science adviser Allan Bromley said recently that it would provide the most effective way to improve the productivity of American researchers. To Dayringer of Monsanto, "A nationwide high-speed network is essential to getting business done."

The Gore bill would also authorize $650 million over a 4-year period to expand research in software and supercomputing technology, $150 million for training and education in supercomputers in NSF programs, and $450 million to the Office of Science and Technology Policy for federal research in computational science.



Underemployed genius: *Supermachine Cray X-MP, an underused giant in the United States.*



Supercomputer guru: *University of Illinois' Larry Smarr says, "Our big challenge is to. . .undo the benign neglect of 15 years."*

It's too early to predict how the bill will fare in Congress. Gore, chairman of the Senate science subcommittee of the Committee on Commerce, Science, and Transportation, has already garnered strong bipartisan support among fellow subcommittee members. But a counterpart in the House was introduced only last week by Representative Doug Walgren (D–PA).

The Bush Administration itself has requested for fiscal year 1990 an increase of 28% or $15 million for NSF's supercomputing centers. The money would be used to maintain an NSF center at Princeton University, which has an ETA machine, upgrade facilities, and broaden educational activities. Congress is now debating NSF's appropriations.

But Gore's bill goes far beyond the Administration's request. When asked how this project stacks up against other costly science projects, such as the Superconducting Super Collider and the space station, Gore told *Science* that his proposal "is not inconsistent with any other big science projects. It makes all of them easier to accomplish. I've said that the Mission to Planet Earth project is the single most important space project. Its biggest problem will be data management. The network is the only way to solve that." To Gore, the computing legislation "is the single highest priority for science across the board." Smarr and others are hoping more of Gore's congressional colleagues feel the same way. ■ **MARJORIE SUN**