

Galaxies in Motion

Clusters of microprocessors in the Laboratory for Computational Science and Engineering give researchers out-of-this-world supercomputing power at a down-to-earth cost.

About the cover: Astronomy professor Paul Woodward (right), director of the Institute of Technology's new Laboratory for Computational Science and Engineering (LCS&E), and Tom Ruwart (left), LCS&E assistant director, are pictured in front of an image generated at 7.6 million-pixel resolution for their PowerWall display. The PowerWall is located in the new laboratory, which is being constructed with support from the National Science Foundation and with equipment support from Silicon Graphics, Ciprico, Seagate Technology, and National Peripherals. The image shows a comparison of two computer simulations (calculated using Woodward's PPM gas dynamics code) of Mach 4 flow of air around a cylinder with a rough surface. The six-foot by eight-foot size of the PowerWall screen allows researchers to study this data in detail together in a natural way, as they might discuss theoretical science at a blackboard.

*Computer image courtesy of LCS&E
Photograph by Rob Levine*



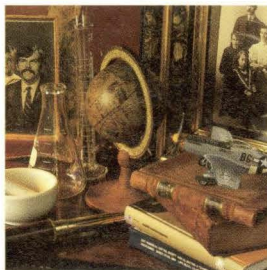
Printed on recycled paper.
Contains 50% recycled material,
10% postconsumer material



FEATURES

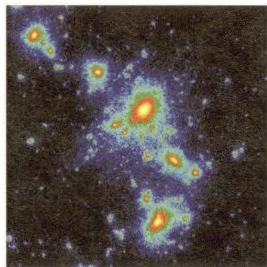
4 ALL IN THE IT FAMILY

Hundreds of families around the country can boast of more than one IT graduate, but the Vurnen Leonard family may hold the record with 10 IT graduates drawn from three generations.



8 GALAXIES IN MOTION

New computer architectures are helping IT researchers stretch the limits of the supercomputing universe without using supercomputers or incurring supercomputer-sized expenses.



13 WORK HARD, PLAY HARD, SHARE THE BOUNTY

Members of the Minnesota Surveyors and Engineers Society work hard to raise money for civil engineering scholarships—but they have more than their share of fun doing it.



DEPARTMENTS

2 NEWS

Aurora II scores again; new head named for IT women's program; plus, ME building capital campaign okayed.

21 ITAS BRIEFS

S & T Day announced; new alumni society president and board of directors introduced.

24 DONOR PROFILE

Johnson Luh (Electrical 1963, Ph.D.) establishes chair in electrical engineering to honor his late wife.

SPECIAL INSERT:
1994-95 University of Minnesota
Institute of Technology Annual Report
(follows page 14)

**Inventing Tomorrow
Fall 1995**

**University of Minnesota
Institute of Technology**

Administration

Willard Miller Jr.
Acting Dean

Peter J. Hudleston
Associate Dean

K. S. P. Kumar
Associate Dean

Linda Bruemmer
Associate to the Dean

Karen M. Wolterstorff
Associate to the Dean

External Relations Staff

Robert V. Hanle
Interim Director

Eric T. Kautzman
Major Gifts Officer

Jon P. Meister
Research & Information Systems

Andrea C. Nelson
Major Gifts Officer

Francis B. Robertson
*Alumni Relations Director and
Development Officer*

Marilyn J. Scapanski
Stewardship & Special Events Director

Tonia T. Stoffregen
Annual & Special Gifts Officer

Mary M. Weekes
Publications and Administration

Alumni Society President

Lorraine I. Clark
Chemical 1977

Inventing Tomorrow

Chuck Benda
Managing Editor

Lynn Marasco
Copy Editor

Stanley Wai
Graphic Designer

Inventing Tomorrow is published three times a year to inform Institute of Technology alumni and friends about news, interesting alumni and faculty, and relevant issues. Send letters to the editor, requests to receive *Inventing Tomorrow*, alumni class notes, and notices of address changes to the Director of External Relations, Institute of Technology, 107 Walter Library, 117 Pleasant St. S.E., University of Minnesota, Minneapolis, MN 55455. Telephone inquiries may be directed to Mary Weekes at 612-624-5537 or 800-241-8001.

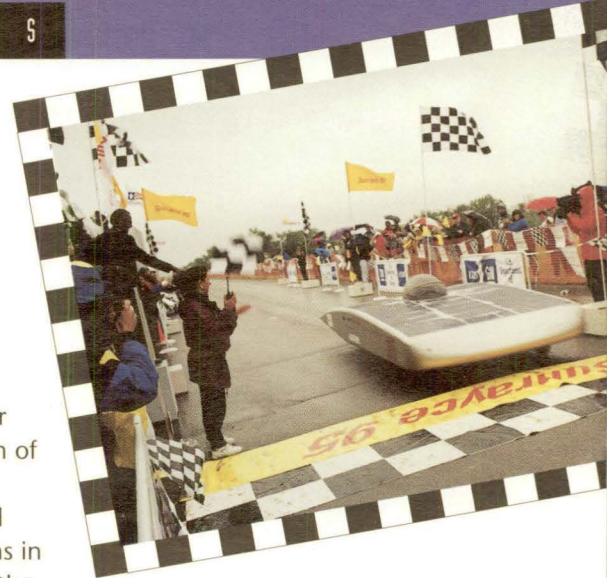
The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

SOLAR CAR BASKS IN WARM GLOW OF SUCCESS

Aurora II, a solar-powered car designed and built by a team of mechanical engineering and other IT students, completed extraordinarily successful runs in two recent competitions. In the Sunrayce 95 competition held in June, *Aurora* finished second out of 38 entries from U.S. colleges and universities. In late July, *Aurora* finished second in its class in the World Solar Car Rallye, an international solar-powered car race held in Akita, Japan.

"Our success in Sunrayce 95 and the World Solar Car Rallye has gained recognition for the University of Minnesota as a 'force' in solar vehicle competition," says mechanical engineering professor Patrick Starr, one of the student team's advisers. "We have been informally invited to return to Japan next year and to participate in the 1996 World Solar Challenge in Australia."

This year's success represents a dramatic improvement over IT's first entry in solar-powered car races in Sunrayce 93. While the team did win first place in design excellence in engineering safety that year, they finished 21st out of 34 competitors. This time around they were just 18 minutes and 49 seconds behind the winning team from MIT (making for the closest finish in Sunrayce history), they set a record for the highest daily average speed of 50.42 miles per hour on day seven of the ten-day competition, and they received the Electronic Data Systems Award for Aerodynamics.



Building on the momentum of Sunrayce 95, the team performed admirably in the World Solar Car Rallye, arguably a much stiffer test. The event drew some 84 solar vehicles, including professional research class vehicles such as the Honda Dream. IT placed second in its class (for vehicles produced by teams—at least one-half students—from educational institutions) and ninth overall.

"Our finish was remarkable, considering the competition," says Starr. "George Washington University took first place in the Junior class. The USA teams finished ahead of all Japanese Junior class teams."

While the mechanical engineering department is the sponsoring department of the IT team, students from aerospace, chemical, electrical, and mechanical engineering, as well as journalism and business students, participated in the project. IT teams will undoubtedly participate in future solar-powered car competitions, Starr says, but for the time being the emphasis is on incorporating the lessons they learned from Sunrayce and in Akita into the design education process.

MARINO TO LEAD IT WOMEN'S PROGRAM

Susan Ellis Marino was named assistant to the dean in August; she will serve as head of the Program for Women in the Institute of Technology. Marino, who earned a bachelor's degree in psychology from New York University and a Ph.D. degree in neurobiology from the University of Pennsylvania, has a wealth of experience in research and teaching, both at the college level and in high school. Most recently, she taught high school biology and physics at Camden-Rockport High School in Camden, Maine. She has also served as a lecturer at the University of Pennsylvania and as a research scientist at Yale University School of Medicine. *Inventing Tomorrow* will introduce Marino more fully in an upcoming issue and take a closer look at the Program for Women.

Other changes to the IT administration staff:

- Linda Bruemmer has returned to her position as associate to the dean after spending a year's leave of absence at the Kennedy School of Government at Harvard, where she received a master's degree in public administration.
- Geology and geophysics professor Peter Hudleston has been named associate dean for undergraduate studies.
- Electrical engineering professor Pat Kumar's administrative position has been retitled associate dean for academic affairs.
- Sharon Kurtt has been named director of placement.

IT GRADUATE PROGRAMS RANK AMONG NATION'S BEST

Seven of IT's graduate programs rank among the top 20 in the country, according to a recent assessment report by the prestigious National Research Council. Furthermore, the University's biomedical engineering program, which has a strong IT component, was also ranked among the top 20 programs nationwide. The council's 1995 ratings report (based on data collected in 1993) is the first since 1982.

Leading the way for IT are chemical engineering, ranked number one in the country, and mechanical engineering, ranked number eight. Also noteworthy are aerospace engineering (unranked in 1982, currently ranked 12) and civil engineering, which climbed from the number 28 spot in 1982 to number 13 currently.

IT's Top Graduate Programs

Graduate Program	1982		1993	
	# Surveyed	Rank	# Surveyed	Rank
Chemical Engineering	79	1	93	1
Mechanical Engineering	82	5	110	8
Aerospace Engineering	—	—	33	12
Civil Engineering	74	28	86	13
Mathematics	115	16	135	14
Materials Science	—	—	62	17
Biomedical Engineering	—	—	38	17.5
Electrical Engineering	91	19	126	18

Source: National Research Council

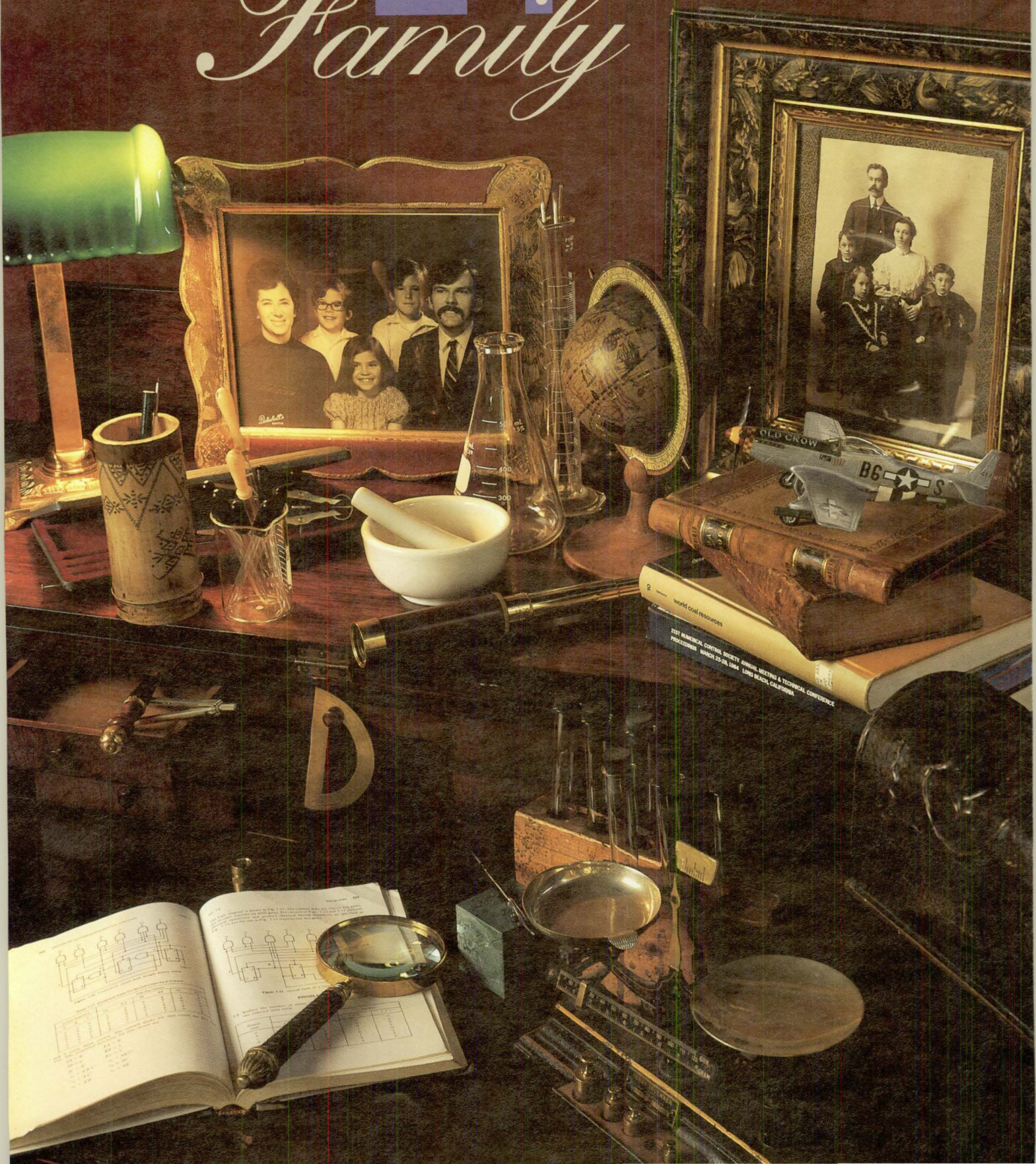
ME CAPITAL CAMPAIGN JUDGED VIABLE

A capital campaign intended to raise some \$9 million for completion of a new mechanical engineering building was heartily endorsed in a recently completed feasibility and planning study. The study, conducted for IT by Grenzeback Glier & Associates, included one-on-one interviews with 42 potential donors and a number of IT and University administrators.

Results from those interviews suggested that both the conditions and the timing are suitable to initiate the capital campaign. The IT development staff is currently working with the University of Minnesota Foundation, Grenzeback Glier, and a cadre of alumni volunteers to plan and initiate the campaign. Monies raised will be used to supplement the \$13 million appropriated by the 1994 legislature to upgrade the outmoded mechanical engineering facilities.

All in the IT Family

By Lisa Billingham



F

ollowing in another's footsteps is great—especially when they provide a solid foundation for creating your own path. An IT education is an example—so much so that many alumni families have several members, some in several generations, who received their degrees here.

Bruce Hosfield (Aeronautical 1970) is a good example. His grandfather, Raleigh, received a civil engineering degree in 1912, well before IT was established in 1935. The oldest family connection reported by *Inventing Tomorrow* readers dates back 94 years. John Roll (Mechanical 1987) relates that his great-grandfather Guy J. Houts graduated from the University in 1901 with a degree in electrical engineering. Roll's father, Peter (though not an alumnus), taught physics at IT from 1966 to 1984.

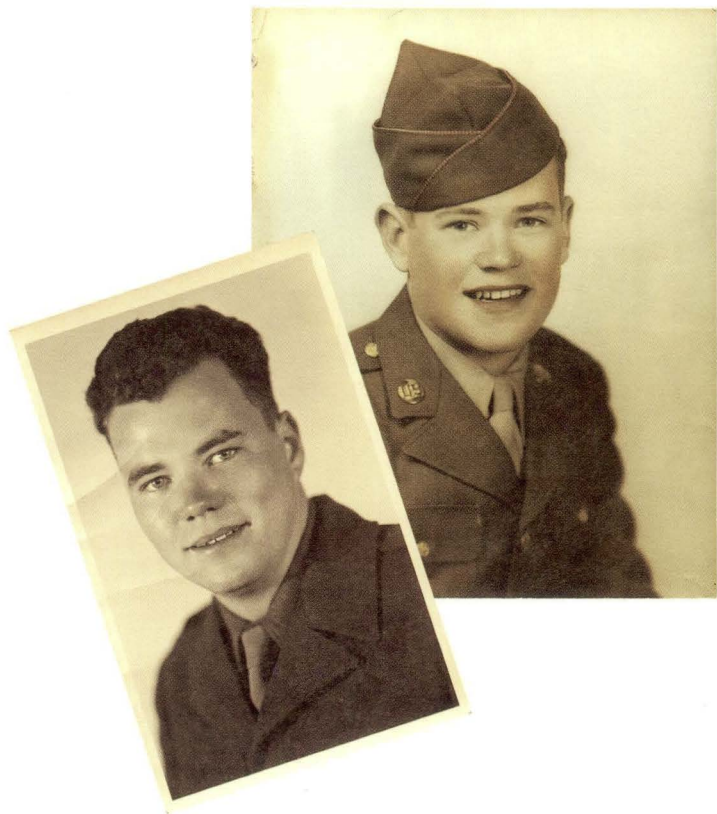
Establishing another multigeneration tradition are George Rodgers (Mechanical 1951, Electrical 1966) and his sons and daughter: David graduated with a physics degree in 1978, Julie in chemical engineering in 1980, Eric in chemical engineering in 1985, and Christopher in mechanical engineering in 1988.

Howard C. Midje (Agricultural 1961) and his family—daughters Heather Midje Larson (Chemical 1988), Ann (Civil 1991), and Dawn (Mechanical 1994) and son-in-law Jeffrey Larson (Mechanical 1989)—also are well on their way to establishing an IT lineage.

Many other families have three and four IT-educated family members, from uncles and cousins to brothers and sisters. Hundreds of families boast two IT graduates.

The Leonards top them all. A large family with roots in the Twin Cities, the Leonards have three generations of IT alumni, with 10 graduates among them. Other family members either attended other colleges at the University of Minnesota or began their educations in IT but finished elsewhere.

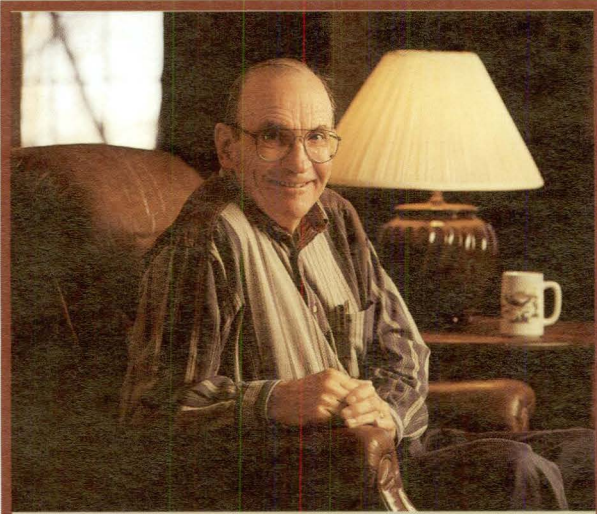
Branches of the Leonard family tree include: (left photo, left to right) Claire, Rich, Barb, Jim, and Arnie Peske; (right photo, left to right) Vurnen, Hazel, Axel, Christina, and Leonard Johnson.



Brothers Vurnen Leonard (Aeronautical 1952, left), and Thomas Leonard (Electrical 1955, right), are the patriarchs of one of the largest "IT families" on record.

Grab a pencil and some paper to chart this. Brothers Vurnen and Thomas Leonard received degrees from IT in the 1950s (Aeronautical 1952, Electrical 1955, respectively), as did their brother-in-law Arnold Peske (Electrical 1960). Before them, an uncle, Vurnen L. Johnson, studied engineering at the University in the early 1920s. Three of Vurnen's eleven children and two sons-in-law graduated from IT: Christina Leonard Schober (Mechanical 1980, M.M.E 1985), Steven Schober (Electrical 1978), Martha Leonard Matern (Mechanical 1983), Mark Matern (Mechanical 1983), and Benjamin Leonard (Mechanical 1993). Peske's son, James, is also an IT alumnus (Electrical 1984).

Why the strong interest in IT among the Leonards? According to Vurnen, whose father did not finish college but wanted his children to, it seemed that engineering would provide a solid foundation for several career options. Vurnen came to IT in spite of, and to a certain degree because of, World War II. A young high school graduate, Vurnen left his Minneapolis home at age 17 to attend the University of Kansas, thanks to the Army Specialized Training Program. When he turned 18 he "took a world tour with [his] rich uncle," he says.



Edward C. Bather Jr. (Civil 1948)

Bather Family

ESTABLISHES SCHOLARSHIP

Eighty years is a lot of history for one family in the Institute of Technology. Since 1916, four generations of the Edward C. Bather family have studied engineering at the University of Minnesota. In recognition of this unique achievement and a deep desire to “give something back,” Edward C. Bather Jr. (Civil 1948) and his wife, Neoma, of Maple Grove, Minnesota, recently established a full-tuition scholarship for IT students. The Bather tradition at the University began before World War I when Edward C. Bather Sr. first enrolled as an engineering student and continues today with his great-grandson, IT sophomore Travis Bather. Travis’s uncle Theodore K. Bather received a degree in agricultural engineering in 1980. The first award of the Bather Family Undergraduate Scholarship will be presented to an entering IT freshman in 1996 and will be annually renewable for up to five years of study.

Photo by Dan Vogel

Thanks to his Uncle Sam, Vurnen landed in Europe with the 11th Armored Division, only two weeks before V-E Day. He stayed with the army for about a year, then found himself back home in Minneapolis. Armed with his credits from the University of Kansas, Vurnen enrolled at IT. “It never occurred to me to go somewhere else once I came home,” he said.

After graduating in 1952, Vurnen accepted a position with Convair (now General Dynamics). He and his wife, Dorothy, also an IT student at the time, moved to Fort Worth, Texas. They returned to Minneapolis with their growing family in 1957 when Vurnen went to work for Honeywell. In the mid-1960s the family moved to Denver, then back to the Twin Cities by the early 1970s. Vurnen taught at Normandale Community College and has worked at 3M for ten years. In the meantime, he and Dorothy raised 11 children, now between the ages of 23 and 43.

Asked what influence Vurnen and Dorothy had on the decisions of their third, fourth, fifth, and ninth children to attend IT, Vurnen responds, “I suppose they figured if the old man can do it, any fool can.”

On a more serious note, Vurnen acknowledges that he and Dorothy always encouraged their kids to read (“It was more important *that* they read than *what* they read,” he says), always had a slide rule—which he admits was sometimes used as a hammer—around the house, and never did anything to discourage their children from getting an education. Each has chosen his or her own direction.

Chris Schober, fourth in the Leonard lineup and the second to attend IT, is a principal development engineer with Honeywell who lives in suburban Minneapolis. Like her father, Chris never really considered any other school. Her older brother, Shawn, attended IT and it seemed natural for Chris to make the same choice.

Chris remembers being the only young woman in several of her classes. “All the groups in physics lab wanted me in their group because I knew how to type and they could get the work done faster,” she recalls. One project that stands out in her IT career was the development of an energy-efficient vehicle that won first place in the hybrid vehicle category in a competition held at the General Motors Proving Ground in 1979. Would she and her husband Steve, an electronics engineer with Honeywell, encourage their children, now seven and eight, to attend IT? “Oh, they’d love it,” says Chris. “They love school, especially science and math. They would get a great

education and still be around [the Twin Cities]."

Martha Matern, number five of the Leonard children and the third to attend IT, worked for a year after high school first. She chose IT primarily because the curriculum allowed her to investigate and develop some of her many and varied interests. She now sees some of the same curiosity and varied interests in her own kids—characteristics she and her husband, Mark, are nurturing.

Martha recalls that she knew how to play chess and use a slide rule at a very early age. She and Mark, a mechanical engineer with Minco Products in Fridley, carry on some of the same traditions with their four children, now ages five to thirteen. Their youngest knows the odds on the roll of a die—which the Materns use to determine cleanup chores after dinner. The six numbers on the fateful cube determine the six family members' responsibilities.

The Materns and several other parents in Blaine, a northern Minneapolis suburb, started a charter school that their children attend. Charter schools receive public funding and are established by the parents of the children who attend. The parents hire the teachers, take care of the building, and are involved in virtually every aspect of their children's educations. Mark was involved in building the school and is a frequent guest speaker, as well as a Cub Scout leader. Martha is chair of the unit studies committee, which determines the themes or units on which all grades in the school focus. She has also coached "Odyssey of the Mind" teams, which challenge children to solve problems creatively, and is trying to start a chess club and a "challenge math" program.

Ben, the ninth child of Vurnen and Dorothy Leonard, is manager of the mechanical testing group at LaserMaster, also in the Twin Cities. As an IT student, Ben worked for FMC in Minneapolis, where he stayed until he moved to LaserMaster in 1993. Pursuing an engineering degree made sense to Ben because he enjoyed math. Once he began to take the application classes, he was hooked.

An example of his enthusiasm for the applications side was being on the winning team for the 17th

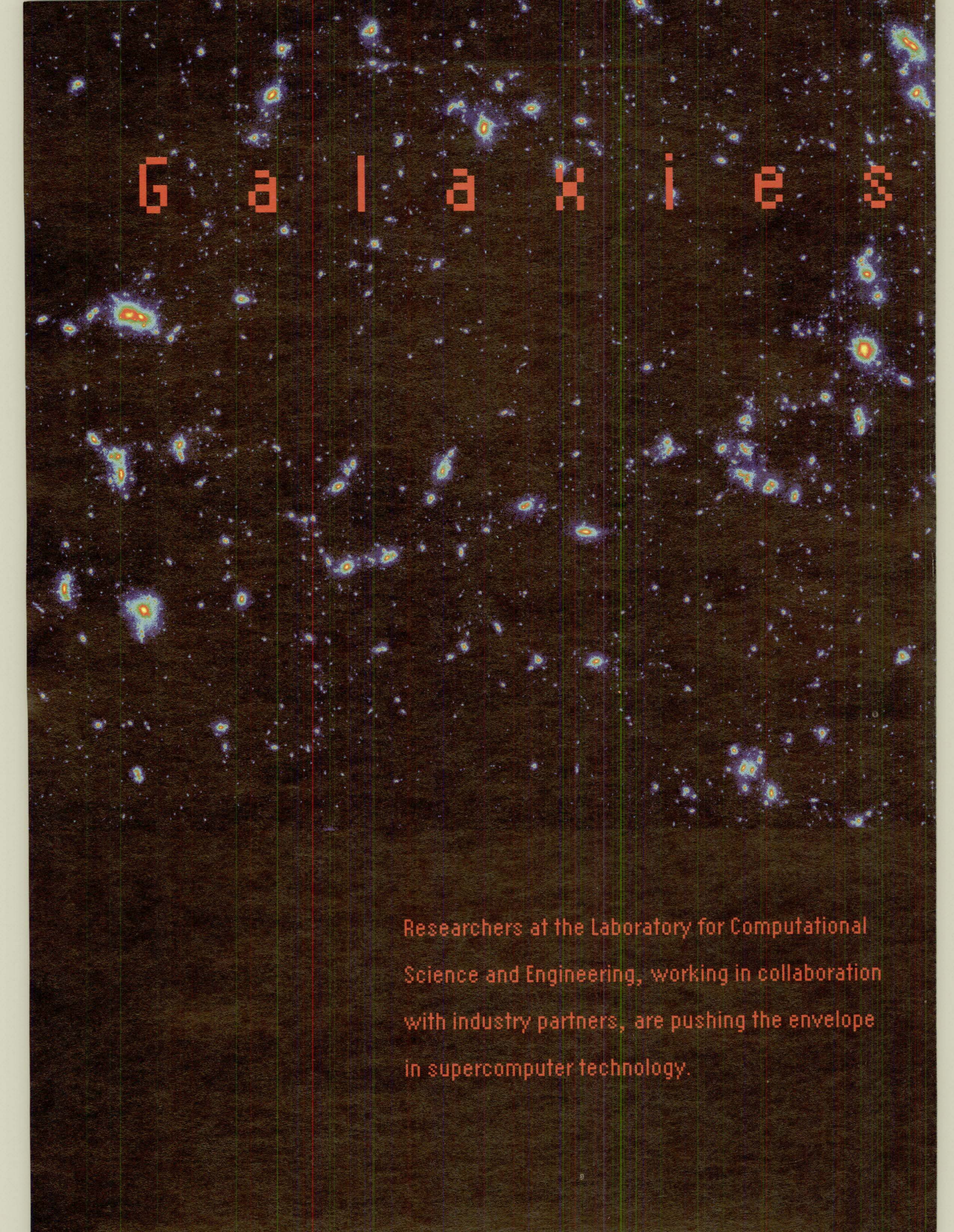
International Human Powered Speed Championships in 1991. The competition "looked pretty neat and I thought we had a chance of winning," Ben recalls. He was right. Ben worked with 17 others and adviser Art Erdman to design, build, and test the human-powered hydrofoil.

"It was a tough project," recalls Erdman, a professor of mechanical engineering. Because the hydrofoil was on the cutting edge, it would need a lot of testing. The team needed a place to work on the project that provided access to water. Ben's grandmother Juletta Leonard, who lives on Prior Lake, about 30 minutes south of



Minneapolis, let the team use her garage, boats, and lakefront to build and test the hydrofoil. Juletta, in what seems typical Leonard fashion, enjoyed having the students around—and even the television crews who came to film the process.

The Leonards have used the foundation provided by IT to pursue a variety of opportunities, demonstrating that an IT education is as relevant as we head into the 21st century as it was in the early years of the 20th.

A field of galaxies, with the word "Galaxies" overlaid in a pixelated font. The galaxies are depicted as bright, multi-colored spots (yellow, orange, red, blue) against a dark background. The text "Galaxies" is written in a large, pixelated, orange-red font across the top of the image.

Galaxies

Researchers at the Laboratory for Computational Science and Engineering, working in collaboration with industry partners, are pushing the envelope in supercomputer technology.

Motion

By Kristi Lee Johnson

It's just seconds after the big bang, and 17 million tiny new galaxies begin to move, swirl, and change color as they build in size and density. It's a sight few have ever seen before. Galaxies in motion. The formation of the universe.

This stunning event is taking place in a smallish, darkened room where the beginning of the universe is being projected onto a high-resolution screen by a series of linked computers and projectors. The system is translating the lengthy mathematical computation into fluid graphics and onto a sophisticated gigapixel-per-second "PowerWall" screen that measures six feet high by eight feet wide. The full-color detail is incredible.

This powerful technology gives life to flat data, taking 17 million bits of information stored in computer memory and turning them into real, moving galaxies that can be viewed on a large screen. The setting is unpretentious, the visual array is stunning, and the way everything has been brought together to achieve this level of supercomputing—minus the supercomputer—is a major achievement.

"We're using a new mode of computing that is inherently cost effective," says Paul Woodward, director of the Institute of Technology's Laboratory for Computational Science and Engineering (LCS&E) and professor of astronomy. "That's why you can find it here in the basement of a university building."

Instead of relying on a single custom supercomputer, until recently the only type of machine that has been able to handle the most complex fluid calculations, the lab uses a new architecture in computing: clusters of multiprocessing machines that can be scaled up to the point of supercomputer capability—without the cost. The concept has put this University lab at the leading edge of technology. It may sound simple, but the machines must all be able to communicate with each other and share information. That requires new thinking and new software.

The Proof Is in the Proof

The highest-resolution fluid dynamics calculation ever done on a supercomputer, a simulation of fluid turbulence on a grid of over a billion mesh points, was successfully carried out by Woodward and the LCS&E team on a system of 16 loosely coupled Silicon Graphics computers.

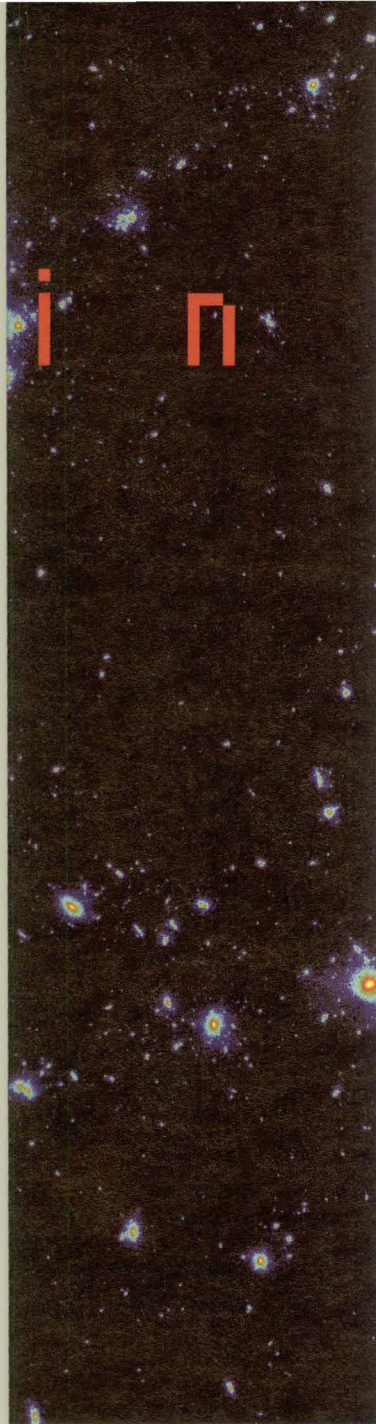


Photo by Rob Levine



Dale Hanson, account manager for Silicon Graphics, one of LCS&E's industry partners

"We did this sort of experiment earlier with three Crays, but we had only two hours to work on the system, and we did not get the calculation going until literally the last minute," says Woodward. "We wanted another shot, but were told the resource was just too valuable to bring back. I guess they thought that Crays were already super-computers, and one of them should be enough.

you want to dig a hole. If it takes one person one hour to dig a single hole, then in theory, it would take 10 people six minutes to dig the same hole. However, if the hole is too small, you bump into each other a lot. Furthermore, how much do these people cost? Is it better to use one person who is much, much faster? Until recently it was. But now economies of scale enter into the picture.

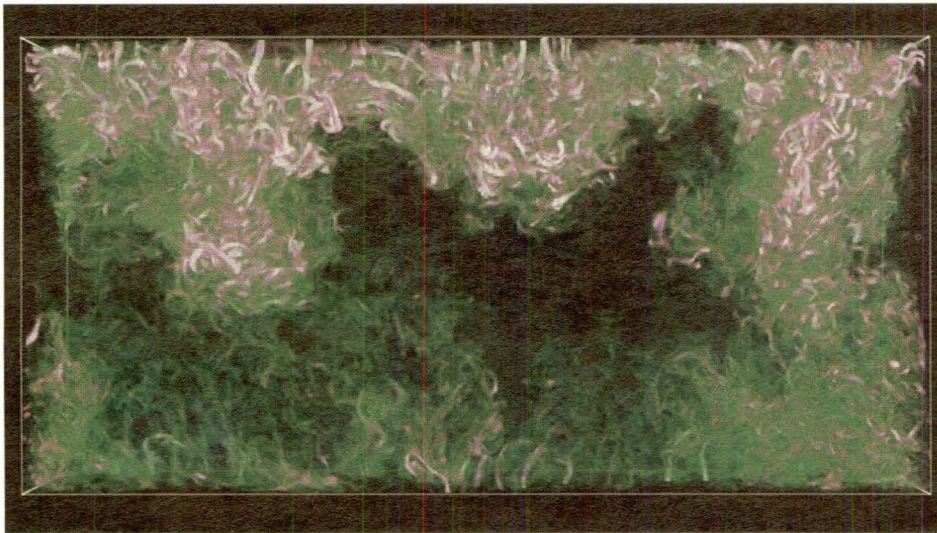
mance by a factor of about six or seven. Microprocessor performance, on the other hand, has been improving by about a factor of two every 18 months, hence by about a factor of eighty in a decade.

"What microprocessor companies like IBM, HP, and SGI have figured out is how to put some number of processors in one box, say 10 or more, and make them work on a single problem in an efficient way, so they aren't stepping on each others' toes" says Ruwart. "And since they can do that inexpensively, we can achieve super-computer performance by putting these boxes together."

But how do they communicate? Back to the analogy of digging the hole.

"Take four groups of people digging a 30-foot-diameter hole. Each group will dig a hole within a 30-foot circle," says Ruwart. "Once you dig those holes, how do you dispose of the soil between the holes? The computer needs to break the problem up, communicate with the other boxes to get that little extra amount of work done. The problem is broken down into grids. You do the big piece of the problem on each machine, and then the little bit of work left over has to be done between them."

This type of technology had antecedents in the artificial intelligence community of the 1980s. The concept was to use a lot of little processors together to mimic the human brain. Obviously, those one-bit processors didn't work fast, but if you put 65,000 of them in one box and made them run, it would be like a lot of ants digging that same hole, to continue the analogy. If there were enough ants, you should be



LCS&E equipment gives life to flat data, allowing researchers to study computer simulations in incredible detail. This is a view looking down from the top of a convectively unstable gaseous layer that is intended to represent a small section of the outer part of the sun.

"The Silicon Graphics machines use microprocessor chip technology. They are more like commodity computers," continues Woodward. "That's why we got a whole month to work on a demonstration with this technology. After the setup, we were left with an entire week to compute.

"For the same cost we can do a lot more science with this technology. Clustering can be scaled up so that the cluster becomes a major computing resource."

Tom Ruwart, assistant director of the LCS&E, explains the cluster concept in simple terms: "Say

"Today, one microprocessor has the processing power of the Cray-1 made around 1980," Ruwart continues. "That Cray cost on the order of \$10 million and it had only 8 megabytes of memory. Today, for a few tens of thousands of dollars you can buy a processor that has 10 times as much memory as that \$10 million machine and the same processing speed."

Chip technology has been driving the market, and dropping costs, while leaps in super-computing speed have not kept pace. Over the decade of the 1980s, vector supercomputer processors improved in perfor-

able to get the job done quickly. The difficulty of communication between the processors proved to be the critical limitation. "Unless programs were very carefully written, there was so much information moving around that the machine became constipated," says Ruwart. Only a few carefully structured applications codes were able to exploit more than about one-tenth of the potential computing power of these "massively parallel" machines.

Now that individual microprocessors are much faster and can be programmed together in groups sharing a common memory, only a small number—8, 16, or 32—of these groups need to be ganged together to achieve super-computer performance. Each processor group is a separate machine, called a shared memory multiprocessor, or SMP. The shared memory of each SMP permits easy and effective balancing of the computing loads on the individual processors. On a global level the simplicity of the network of only 8 or 16 SMPs makes load balancing feasible. The result is a system that is suitable to a wide range of applications. The LCS&E is beginning to explore this range with its industrial, National Science Foundation, and U.S. Department of Energy partners.

Forming Partnership Clusters

As Woodward explains, the same "clustering" and sharing concept put to use in the lab has been the driving force behind forming a structure of grants, funding, and partnerships to equip and run it.

The LCS&E facility, formally opened at a ribbon-cutting ceremony in June, is the home of joint research and development efforts between industry, government, and IT students, faculty,

and staff. Built around state-of-the-art equipment for scientific computation and visualization, it is supported by Silicon Graphics, Seagate Technology, Ciprico, and National Peripherals. In addition, the lab has been named a regional computing research center in the Metacenter Regional Alliance Program funded by the National Science Foundation.

That brings the University into the same program with the four major NSF centers at the University of Illinois, the Pittsburgh Super-computer Center, the Cornell Theory Center, and the San Diego Supercomputer Center. The LCS&E facility will receive an operating grant of \$1.2 million over three years from this program, along with a mandate of new community outreach.

"That helps pay a lot of people," says Ruwart. "And it will be invaluable to many graduate students and researchers in electrical engineering, computer science, mathematics, physics, and astronomy. It will also pay the salaries of two high school teachers to work side by side with us for the summer." The teachers will be able to go back to their schools in the fall and each set up a computer lab with state-of-the-art Silicon Graphics workstations that they have used at the LCS&E.

"I really like the community outreach aspect," says Ruwart.

Working with Industry

Woodward and Ruwart have a knack for outreach and putting together partnerships. And working with innovative businesses can be a mutually rewarding relationship: alliances with business help both parties stay ahead in the fastest game on earth.

Dale Hanson, an IT alumnus and account manager for Silicon Graphics, says his company's tie with the University has been invaluable. Silicon Graphics provides the LCS&E with an eight-processor Power Onyx with 2 gigabytes of memory, three Indigo-2 workstations, and three Indy workstations. Woodward's research group also operates a Silicon Graphics Power Challenge machine, with 12 processors and 2 gigabytes of memory, provided by the Army Research Laboratory at Aberdeen, Maryland, where eight more of these machines are interconnected in an array.

In contrast to federal grant programs, which impose a time requirement of three to five years for purchasing and working with a new piece of computer technology (and make trade-ins difficult), collaboration with industry makes for quick turnaround of the equipment. Industry contacts keenly realize that lost time can kill research.

"Three years is a lifetime in the computer business," says Hanson. New technology can find itself obsolete within the course of a year.

"We are swapping our equipment at the lab with our newest model every nine months," says Hanson. "We resell the former model as used equipment, sometimes to private business and occasionally to the University."

Woodward, meanwhile, explores the reaches of the new computer systems, occasionally taking them in a direction not conceived by their manufacturer.

"Our direction is set by the demands of our scientific research," explains Woodward, "but we keep the needs of our industrial

and government partners constantly in mind." By putting together complementary technologies from their industrial partners in the lab, the LCS&E team is able to create new capabilities, like the PowerWall system, which would not happen otherwise. The results enhance the research of all the lab's users and benefit the industrial partners as well.

Woodward has several of his own calculations running on the lab's computing systems. He is working on turbulence simulations and was recently selected to receive the Sydney Fernbach Award in Large Scale Computing from the Institute of Electrical and Electronics Engineers (IEEE) Computer Society.

The society honored him for "work in developing new algorithmic techniques in fluid dynamics, and . . . relentless and innovative pursuit of the hardware and software capabilities to carry out and visualize in real time the largest turbulence simulations." The Fernbach Award honors the memory of Sydney Fernbach, one of the pioneers in the development and application of high-performance computers for the solution of large computational problems.

Ahead of the Game

Two years ago Woodward and his team completed the first proof-of-concept using 16 Silicon Graphics computers to handle the most complex fluid calculation yet done on a computer. That demonstration helped convince Silicon Graphics to enter the super-computer market using the SMP cluster architecture.

Now that the SMP cluster concept has been demonstrated, the LCS&E is concentrating on writing

the advanced software that will allow the processors to communicate more swiftly and efficiently.

"We have two years of experience with this so far," says Ruwart.

"We are on the leading edge of computing right now, and it makes this facility very attractive to top graduate students and researchers."

CAVEs vs. Windows

The same cluster concept used to create a new, cost-effective computing architecture is also used to create the PowerWall. Here, four 1600-pixel by 1200-pixel resolution Electrohome video projectors display movie images in full color on a six-foot by eight-foot screen. The images come from two interconnected Silicon Graphics Onyx computers, each streaming image data from Ciprico disk arrays with large storage capacity. The PowerWall system was first demonstrated at the Supercomputing 94 exhibit in collaboration with Silicon Graphics, Ciprico, and IBM Storage Products Division.

The PowerWall differs from graphic displays of computer-generated images used at other facilities. A well-known example is the "CAVE" developed by Thomas DeFanti and collaborators at the University of Illinois, Chicago. In this construct, the viewer wears a headset and is surrounded by three screens in a darkened room (the CAVE concept) to simulate depth. The CAVE display is more immersive than the PowerWall, but it may not be the most efficient or cost effective way to display calculations like the big bang or turbulence simulations of the sun's surface. CAVE simulations are good for "virtual testing" of large new pieces of machinery when

the illusion of reality and three dimensions is important. Caterpillar, for instance, has a new backhoe that can be "driven" in virtual reality in the CAVE.

In contrast, the PowerWall is an "out the window" visualization device, Woodward says. Researchers look at their data through a window into the virtual world, and by manipulating a mouse or by typing on the keyboard they can control the view through that window. The software permits panning and zooming, but the researchers are not immersed in the image. "The PowerWall provides much better resolution than most helmet-enhanced virtual-reality techniques," Woodward explains, "and you don't have to be surrounded by an image to find it very real. Just take a look out the window."

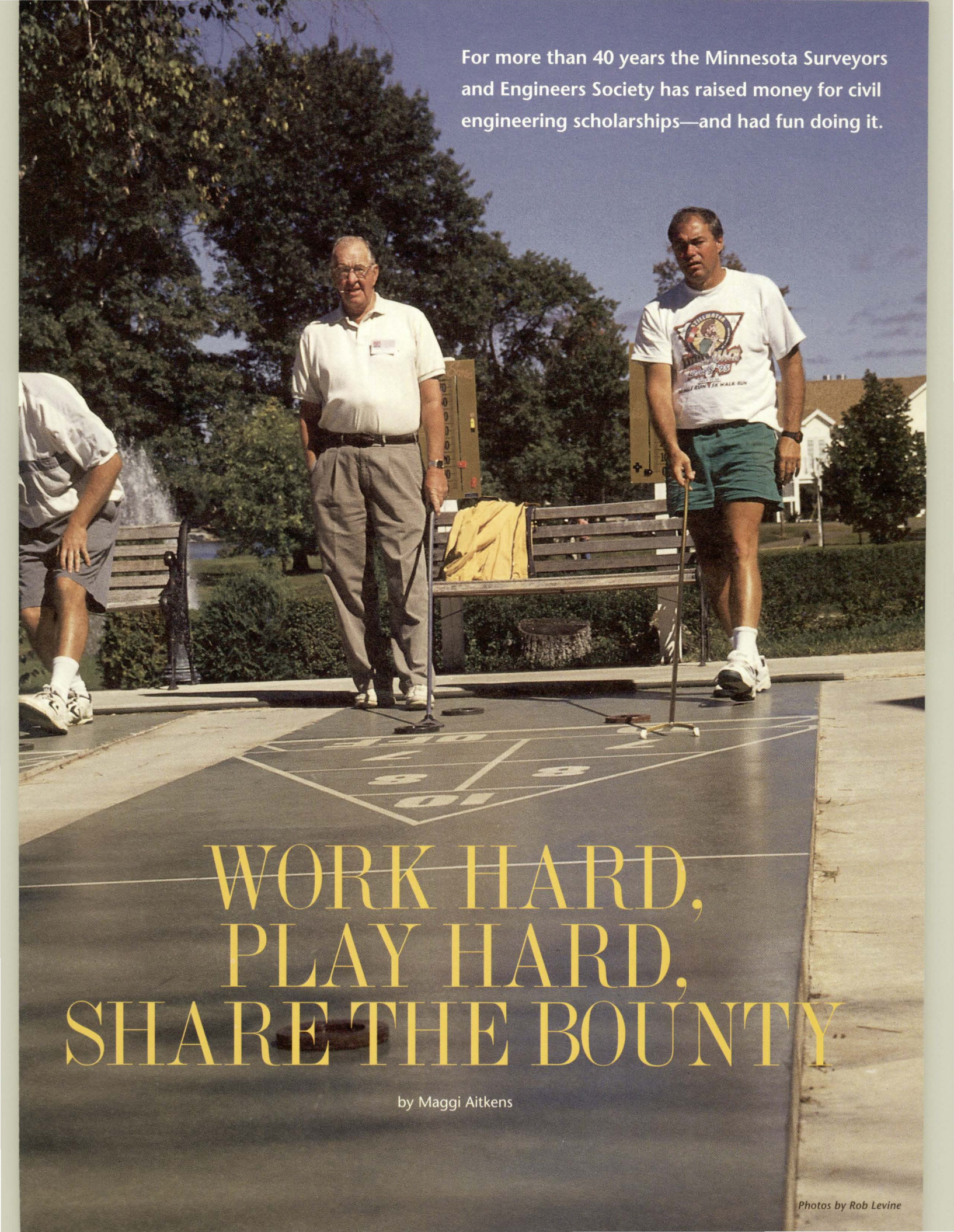
Back to the Big Bang

Michael Warren from Cal Tech, who helped with the original calculations on the formation of galaxies after the big bang, saw his work as a fluid, moving image of space in its entirety for the first time on the PowerWall.

"We brought the PowerWall to the supercomputing conference in Washington, D.C., last year and demonstrated it," says Silicon Graphics' Hanson. "I think it also demonstrated what our industrial partnership has yielded. A professor can walk right up to that screen and actually see his results.

"Michael Warren from Cal Tech, the guy who had done the simulation of how the galaxy was formed after the big bang, stood in front of the PowerWall just watching the loop run over and over.

"I think he was in awe."



For more than 40 years the Minnesota Surveyors and Engineers Society has raised money for civil engineering scholarships—and had fun doing it.

WORK HARD, PLAY HARD, SHARE THE BOUNTY

by Maggi Aitkens

Photos by Rob Levine

Oh, those good old college days. Life was so easy back then. Work hard. Study hard. Play hard. Party. Get to class. Your only concerns.

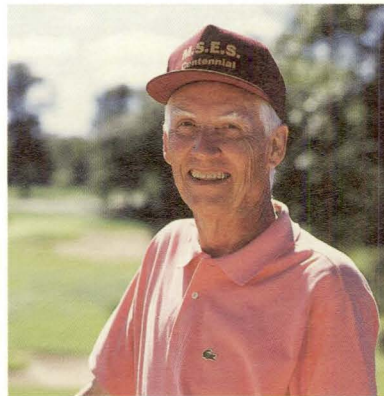
How quickly we forget. Among the most persistent challenges confronting students down through the years is trying to pay for a college education. No matter what your resources, inflation can make the cost of tuition downright discouraging. To some students it might seem like no one understands their plight.

Unless, of course, they're undergraduate civil engineering students at the University of Minnesota who have an interest in the transportation industry. In that case, they have an entire organization looking out not only for their future but also for that of the transportation industry. A significant scholarship program geared to assist students with their studies is the primary *raison d'être* of the Minnesota Surveyors and Engineers Society (MSES), one of the oldest engineering organizations in the state.

"The MSES scholarship program is the second-largest scholarship program available to students in our department," says Steven L. Crouch, professor and head of the Department of Civil Engineering. "And we're fortunate to have such a generous benefactor. While tuition continues to increase at a fierce rate, this organization has taken it upon itself to identify and support students who demonstrate interest and accomplishments in any aspect of civil engineering that relates to transportation. They're not only helping our

students, they're helping the entire industry."

Formed in 1895, MSES began raising funds for scholarships in 1953, at the start of the largest public works project in the nation's history—construction of the interstate highway system. Recognizing the need for more engineers and surveyors to meet the workload, MSES initiated a scholarship program to attract more students to the field by helping them with the cost of their education. With a current membership of more than 1,200, they continue toward that end today. The only requirements for application are that the student be a Minnesota resident enrolled in civil engineering at the University of Minnesota with an interest in transportation.

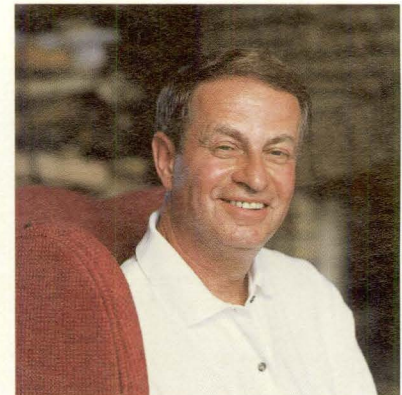


Leo A. Korth (Civil 1948), former MSES president

"The demand became great for engineers, as well as other related professions, at the start of the interstate system," recalls Leo A. Korth, who was MSES president in 1975 and recently retired from the Minnesota Department of Transportation after 43 years. "To attract more people to this profession, the society started the scholarship program and placed its emphasis on raising money to give financial assistance so more students could go to school."

Three scholarships totaling \$1,250 were awarded in 1953. As funds permitted, the amount and number of scholarships grew over the years—to 31 scholarships totaling \$24,000 this year. In all, MSES has granted 698 scholarships for a grand total of \$467,532.

But that is only the tip of the iceberg. In celebration of its 100th anniversary, the organization is hoping to raise more than that amount in one fell swoop to endow its scholarship fund. Thus far, MSES has received more than \$300,000 in pledges to be paid over a five-year period (all of which will go directly into the scholarship trust fund) toward its goal of \$500,000.



Darrel H. Berkowitz (Civil 1961), MSES president

"The earnings on these funds will ensure that MSES has an outstanding scholarship program for many years into the future," says Darrel H. Berkowitz, current MSES president and vice president of Toltz, King, Duvall, Anderson and Associates in St. Paul. "Although we realize that raising an additional \$500,000 is probably a somewhat ambitious goal, we're hoping to come close to achieving it through the generous and dedicated efforts of our members and those interested in not only our students, but also the transportation industry."

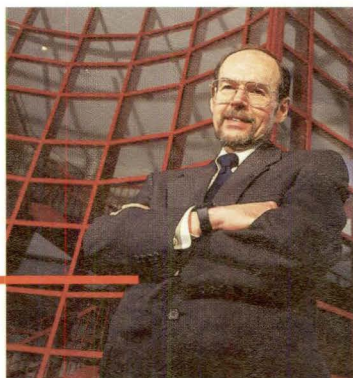


INSTITUTE OF TECHNOLOGY ANNUAL REPORT

UNIVERSITY OF MINNESOTA

1994-95

A LETTER TO ALUMNI



**Acting Dean
Willard Miller Jr.**

This has been a year of transition for the Institute of Technology, and also one of continued achievement. The most significant transitions occurred in the dean's office. Frank Kulacki resigned as dean of the college effective July 1, 1995, and has joined the mechanical engineering faculty. Richard Schleicher has stepped down as director of development. Provost W. Phillips Shively asked me to serve as acting dean while a search for a permanent dean proceeds. With my background of 30 years on the IT faculty and 16 years of administrative experience, the last year as associate dean hired by Dean Kulacki, I am intent on providing continuity of leadership during this interim period. The search is entering its final stages with a number of excellent candidates, and I expect that Provost Shively will be announcing the appointment of a new dean in the near future. A search for a new director of development has also been launched. In the interim, Bob Hanle, vice president for development in the University of Minnesota Foundation and a former IT director of development, has taken over as acting director.

Achievement by IT faculty, students, and alumni continues unabated. In 1994-95, IT awarded 987 bachelor's degrees, an increase of more than 9 percent over the previous year, and 505 graduate degrees. Of the 405 IT faculty members, six are Regents' Professors, 20 hold endowed chair professorships, 12 hold named professorships supported in part by private funds, and 12 are IT Professors. Nineteen professors and professors emeriti are members of the National Academy of Engineering and six belong to the National Academy of Sciences. Externally sponsored research, which accounts for most of the support of our graduate programs, held steady this year at \$76.7 million. The tables accompanying this letter give a quick overview of our degree productivity and financial support.

Rankings of research-doctorate programs

The recent National Survey of Graduate Faculty, prepared by the National Research Council, provides compelling evidence of the quality of IT research and graduate training. This survey and ranking of graduate programs, issued once each decade, was released in September 1995. It is the most careful, most scholarly evaluation of graduate programs available. This latest study, done over four years, involved 3,634 academic programs at 274 institutions. I am pleased to say that the average quality scores for the IT faculty are even higher than they were in 1982, the last time the survey was issued. The chemical engineering program has maintained its ranking as the number one graduate program in its field nationwide. Moreover, all seven of the IT engineering programs were ranked among the top 20 in their fields. In addition to chemical engineering, they are mechanical engineering (8), aerospace engineering (12), civil engineering (13, up from 26!), materials science (17), biomedical engineering (17.5), and electrical engineering (18). Our large science departments each moved up about two positions in the rankings and improved their quality scores: mathematics (14), chemistry (21), physics (22.5). Geosciences was ranked 31 with an improved quality score. Astronomy was ranked 24.

A disappointment, however understandable, was the computer science ranking (47). Unfortunately, the survey results were compiled in 1992-93, immediately following a period of internal strife in the department during which there was no head and the dean's office was obligated to exert direct control. Since then, with the new leadership of Ahmed Sameh, the department has surged forward. Research grants to the department have increased by a factor of five from the early 1990s, and instructional quality and responsiveness also have improved. A dramatic example of this increase in stature occurred this summer when a National Science Foundation panel recommended funding of two "Grand Challenge" program grants to IT research teams. One team is led by Linda Petzold and J. Ben Rosen (emeritus) of computer science and Robert Tranquillo of chemical engineering and materials science; the other is led by Ahmed Sameh of computer science and Dan Joseph of aerospace engineering and mechanics. Both projects in this multidisciplinary program are multiyear, multi-million-dollar efforts that involve subcontracts to other universities. Of 317 preproposals and 78 full proposals solicited by NSF, just 12 were selected for funding. Minnesota is the only university to have more than one proposal selected! In addition, the computer science department was just awarded a \$2 million NSF Infrastructure grant in conjunction

with the Minnesota Supercomputer Institute.

The solar car

Probably the most exciting and exhilarating event of the year was the performance of *Aurora II* in Sunrayce 95 in June. In this 10-day, 1,150-mile highly selective solar car competition for the nation's top 40 technical universities, the IT car finished second to MIT by just 18 minutes 49 seconds, the closest second-place finish in Sunrayce history. A team of 16 IT undergraduates participated in Sunrayce 95, with faculty advisers Virgil Marple and Patrick Starr of mechanical engineering. Numerous other students participated in the two-year design and building process, and an executive advisory committee of 10 alumni provided guidance and support. In July the team topped off its performance by finishing second in its class (educational institutions) and ninth overall (against professionally built cars) at the 1995 World Solar Car Rallye in Akita, Japan.

Alumni, corporate, and foundation support

I am very pleased to report that support for IT from alumni, friends, corporations, and foundations continues to grow. Donations to the institute increased from \$5.2 million in 1993-94 to almost \$7.5 million this year. Our principal target for private support in the next three years is \$9 million to complete the Mechanical Engineering Building project. A second major effort is devoted to raising \$1.75 million for the endowment of the Biomedical Engineering Center, matching funds from the Medtronic Foundation. Both of these projects are well under way and showing steady progress. We also plan to begin raising \$3 million for a new molecular materials laboratory in the chemical engineering and materials science department. The college has critical needs for modernized facilities and equipment, endowed scholarships and fellowships, endowed chairs and professorships. We can meet some of these needs through careful management of state and federal support, but we must also rely on private support to maintain the quality of our programs.

The IT Alumni Society (ITAS) continues to increase its long-term support of the institute through sponsorship of programs and activities. Lester Krogh served as chair of the executive board this year, and he deserves our special thanks. I am pleased to welcome Lorraine I. Clark (Chemical Engineering 1977), who will serve as chair for 1995-96.

The contribution of time, energy, and support by ITAS members was absolutely outstanding this year. For example, 290 students and alumni participated

in the IT Mentor Program, an all-time high. This ITAS program matches IT students with alumni/friend volunteers to broaden the students' experience and assist them in making academic and career plans. In recognition of the performance of the society, the University of Minnesota Alumni Association named ITAS the Outstanding Alumni Society for 1995.

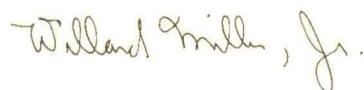
An especially large number of IT alumni returned to campus for IT Week in May 1995. The theme was "A Grateful Nation Remembers: IT in World War II and 50 Years of Progress in Science and Technology," and the focus was on the contributions of alumni and faculty during the war and the technology that resulted from wartime research. More than 400 alumni and spouses attended the IT-sponsored reunion of the WWII Navy V-12 and Naval ROTC programs.

Positioning for the future

We are continuing our planning and restructuring within the framework of "U2000," the University's strategic planning process. We have developed goals, and are acting on them, in six key areas: research and discovery, undergraduate education, graduate and professional education, outreach, user friendliness, and diversity.

As a result of the constriction of state support for instruction and research, we have been forced to make some difficult budget reductions (almost \$2.7 million) and reallocations this year. The most painful was the closing of the Underground Space Center. In the process, we sought to protect the core faculty teaching and research strengths of the departments, along with funds for teaching assistants and instructional equipment, even as we reduced faculty size and, especially, administrative support and some service functions. In line with the six key areas of U2000, we have reallocated funds into instructional computing and initiated programs such as the Minnesota Center for Industrial Mathematics, the Biomedical Engineering Institute, and the Laboratory for Computational Science and Engineering. Some of these programs are discussed elsewhere in this issue of *Inventing Tomorrow*.

We are positioning ourselves to respond to, and anticipate, changes in society. It is a difficult but exciting process. I look forward to continuing the process with the faculty, the staff, and the new dean.



Willard Miller Jr.
Professor of Mathematics and Acting Dean

ENROLLMENT AND DEGREES CONFERRED

	1993-94	1994-95
Undergraduate Enrollment	4,500	4,296
Graduate Enrollment		
Master's Degree Students	770	692
Doctoral Degree Students	1,167	1,137
Degrees Conferred		
Bachelor's	902	987
Master's	290	300
Doctoral	208	205

FINANCIAL SUMMARY

	1993-94	1994-95
State Funds	\$ 48,290,891	\$ 52,175,821
State Special Funds	2,911,000	3,021,000
Research Support*	5,665,441	4,089,631
Sponsored Research Expenditures**	76,719,000	76,749,393
Donations	5,244,739	7,452,396
Total Operating Budget	\$ 138,831,071	\$ 143,488,241

*Research support comprises nonrecurring funds from the University to the institute.

**Sponsored research expenditures comprise federal and industrial funds, including grants in aid of research.

DEGREE-GRANTING DEPARTMENTS AND OTHER PROGRAMS

Physical Sciences and Mathematics

- Astronomy
- Chemistry
- Geology and Geophysics
- Mathematics
- Physics

Engineering

- Aerospace Engineering and Mechanics
- Biosystems and Agricultural Engineering
- Chemical Engineering and Materials Science
- Civil Engineering
- Computer Science
- Electrical Engineering
- Mechanical Engineering

OTHER DEGREE-GRANTING PROGRAMS

- History of Science and Technology

OTHER PROGRAMS

- Minnesota Talented Youth Mathematics Project (School of Mathematics)

RESEARCH CENTERS

INSTITUTE CENTERS

- Army High Performance Computing Research Center
- Charles Babbage Institute for the History of Information Processing
- Center for the Development of Technological Leadership
- Center for Interfacial Engineering
- Institute for Mathematics and Its Applications
- Microtechnology Laboratory
- NSF Center for the Computation and Visualization of Geometric Structures

DEPARTMENTAL CENTERS

- **Astronomy/Computer Science/Electrical Engineering**
- Laboratory for Computational Science and Engineering

Chemical Engineering and Materials Science

- Corrosion Research Center
- Surface Analysis Center

Civil Engineering

- St. Anthony Falls Laboratory
- Underground Space Center (closed as of 7/1/95)

Electrical Engineering

- Control Science and Dynamical Systems
- Magnetics and Information Technologies

Mathematics

- Minnesota Center for Industrial Mathematics

Winchell School of Earth Sciences

- Limnology Research Center
- Minnesota Geological Survey
- Rock Magnetism Institute

Mechanical Engineering

- Center for Advanced Manufacturing, Design, and Control
- Center for Plasma-Aided Manufacturing (with the University of Wisconsin at Madison)
- Filtration Research Center
- Particle Technology Laboratory

Physics

- Theoretical Physics Institute

INTERCOLLEGIATE CENTERS

- Biomedical Engineering Institute (with the University of Minnesota Medical School)
- Bioprocessing Technology Center (with the University of Minnesota College of Biological Sciences and the Medical School)

AEROSPACE ENGINEERING AND MECHANICS



Department head
William Garrard

Faculty

Regents' Professor Daniel Joseph was selected to receive the 1995 Timoshenko Medal for his fundamental contributions to energy-stability theory, bifurcation theory, rheological flows, and two-phase flows and for his illuminating books on these subjects. The medal will be presented at the International Mechanical Engineering Congress in November 1995.

Back on campus, Associate Professor Perry Leo took over as director of undergraduate studies when Professor William Warner retired in June after 40 years of service to the University. Assistant Professor Scott Abrahamson was named best aerospace engineering and mechanics instructor by the Institute of Technology Student Board for the fourth year in a row.

Professor Corneliu Balan of the Department of Hydraulics at Polytechnica University of Bucharest, Romania, arrived in September 1994 for nine months as a Fulbright Visiting Scholar. He worked with Professor Roger Fosdick on a project titled "The Yield Stress Fluid Concept: Theory and Experiment."

Professor Grigory Barenblatt, a graduate of Moscow University and an internationally acclaimed

leader in similarity theory, fracture mechanics, turbulence theory, flows in porous media, and the mechanics of nonclassical deformable solids, spent fall quarter 1994 in the department as a Hill Visiting Professor.

Research

The U.S. Army's decision to award the second phase of the Army High Performance Computing Research Center to the University of Minnesota was a departmental milestone. Funding for the center, which is directed by Professor Tayfun Tezduyar, is \$7 million annually.

Alumni

Among many noteworthy alumni achievements are those of Paul Rubbert and Paul Dye. Rubbert, a pioneer in the field of computational fluid dynamics who led the revolution from wind-tunnel-based airplane design processes to processes that rely on advanced computational capabilities, received the University's highest alumni honor, the Outstanding Achievement Award.

Dye was named flight director for space shuttle operations at NASA's Johnson Space Center. In this prestigious position, he will work with the rendezvous and docking with the Russian space station *Mir*.

Students

Aerospace engineering students were supported during the year by a wide variety of benefactors. Recipients of 1994-95 undergraduate scholarships and internships include the following: Kortney Rivard and Todd Krinke, Boeing Scholarship; Kortney Rivard and Sarah Braasch, Boeing Summer Internship; Andres Mediavilla and Michael M. Ondrey, R. Minkin Aerospace Engineering Scholarship; Paul

Mattson and Derek Grefroh, Institute of Technology Undergraduate Assistantship/Chester Gaskell Aeronautical Engineering Scholarship; Steven Sherman, Institute of Technology Undergraduate Assistantship/Minnesota Space Grant Consortium Scholarship.

Laura Sachi participated in the NASA Summer Academy and was one of two undergraduates to receive an NSF Graduate Fellowship; the other was Dawn Hastreiter.

Recipients of 1994-95 graduate fellowships include Andrew Wissink, NASA Graduate Fellowship; Darren Mason, NSF Fellowship; Wendy Grebner, Graduate School Fellowship; Jing-Tao Feng, Graduate School Doctoral Dissertation Fellowship; Ramon Cajina, Kim Marsh, Darren Mason, and Laura Weyer, Minnesota Space Grant Consortium Fellowship; Huseyin Hakan Fer, Control Science and Dynamical Systems Fellowship; Jim Buffington, U.S. Air Force Palace Knight Fellowship/Wright-Patterson Air Force Base and U.S. Air Force Foulis Award for 1993 Scientific Research/Wright-Patterson Air Force Base; Greg Weirs, Southeastern Center for Electrical Engineering Education Fellowship.

Other highlights

● Professor Gordon Beavers was selected to receive the George W. Taylor/IT Alumni Society Service Award.

● Professor Richard James is an at-large member of the U.S. National Committee on Theoretical and Applied Mechanics of the National Research Council.

● Professor Tayfun Tezduyar was elected a fellow of the American Society of Mechanical Engineers.

ASTRONOMY



Department chair
Thomas W. Jones

Facilities

The astronomy department outfitted its first cooperative learning group recitation room as a home for two new courses for nonmajors. Six small tables encourage small-group discussion, and six computer stations support exercises in simulated orbital dynamics and the expansion of the universe.

A ribbon-cutting ceremony was held in June for the new Laboratory for Computational Science and Engineering. Demonstrations of state-of-the-art computer graphics, manufacturing simulation, and scientific and engineering computation followed the event. Silicon Graphics (SGI) has loaned equipment to support research in high-performance computing, scientific visualization, and high-performance file serving and data mining on SGI platforms; the equipment will be updated every nine to twelve months. Other major gifts to the lab come from Seagate Technology, Ciprico, and National Peripherals. Innovative hardware and system software solutions to problems in computational science and engineering will be tested and applied in the new laboratory.

The department became a member of the Association of Universities for Research in

Astronomy (AURA), which operates world-class observatories known as AURA Centers. Its members are 23 universities in the United States and three foreign affiliates. Under cooperative agreements with the National Science Foundation, AURA operates ground-based observatories for nighttime astronomy in Arizona and Chile; solar research facilities in Arizona and New Mexico; and a joint project of Argentina, Brazil, Canada, Chile, the United Kingdom, and the United States to provide eight-meter telescopes in Hawaii and Chile.

Faculty

Professor Wayne Stein, who joined the department in 1969 as part of its effort to establish a program in the nascent field of infrared astronomy, retired this year. He became widely known as an expert on the nature of active galactic nuclei, a phenomenon that includes quasars, the most energetic objects in our universe. A popular teacher in both physics and astronomy, Professor Stein is a University of Minnesota alumnus.

Professor Emeritus Willem Luyten died in 1994. His first observations of variable stars with field glasses and a small refracting telescope led to his becoming a charter member of the American Association of Variable Star Observers at the age of 15. Over the course of his distinguished career he determined the motion of 544,000 stars, including more than 6,000 of the dying stars known as white dwarfs (a colleague referred to him as the "stellar mortician"). He joined the department in 1930 and retired in 1967.

Professor Paul Woodward received the Sydney Fernbach Award in Large Scale Computing from the IEEE Computer Society for work in "developing new

algorithmic techniques in fluid dynamics and relentless and innovative pursuit of the hardware and software capabilities to carry out and visualize in real time the largest turbulence simulations." The award honors a pioneer in the development and application of high-performance computers for the solution of large computational problems.

Students

Fulbright Scholar Tracey Lavezzi conducted research in Australia beginning in October 1994. Henry (Chip) Kobulnicky, John Mergen, and Jonathan Keohane began their work as participants in the NASA Graduate Student Researchers' Program. Debora Katz-Stone was awarded a 1994-95 doctoral dissertation fellowship for her work on the evolution of relativistic particles and the structure of the magnetic field in extragalactic radio sources.

Other highlights

- Professors Lawrence Rudnick and Leonard Kuhi are working with the Minneapolis schools to help plan long-term reform of science teaching. The American Physical Society, the National Science Foundation, and the National Academy of Science's Project RISE (Regional Initiatives in Science Education) are all involved in a national effort to improve instruction in science.

- Professor John Dickey was a member of an International Astronomical Union commission on designations and nomenclature.

- Professor Roberta Humphreys was a member of the Publications of the Astronomical Society of the Pacific board of editors, chair of the American Astronomical Society's Tinsley Prize Committee, and a member of a NASA review panel on new mission concepts in astrophysics.

BIOSYSTEMS AND AGRICULTURAL ENGINEERING



Department head
R. Vance Morey

The name of the department was changed during the year (from agricultural engineering) to better reflect the scope of its work.

Research

At the intersection of engineering with agriculture and agriculture-related industries, researchers study such things as heat and mass transfer during cheese cooling and torque data gathered during dough mixing. The department's many research projects can be divided into areas including bioprocessing, animal systems, crop storage and processing, food engineering (the cheese cooling and dough mixing studies, for example), safety, waste management, and water quality.

A sampling of some current research projects:

- Development of processes to make microfibrillated cellulose—a new form of cellulose made by homogenizing wood cellulose—from fibrous agricultural waste materials such as soybean hulls, corn husks and cobs, and sugar beet pulp.
- Development of a machine that would reduce the likelihood of fecal contamination during poultry processing.
- A study of techniques and

materials used in constructing livestock buildings that is aimed at reducing costs. (Buildings and equipment can account for 40 percent of the annual cost of producing meat and milk.)

- A study of drying strategies and air quality in flooded homes.
- A study of injuries to race horses at four Midwestern racetracks.
- Development of plans to harvest, handle, store, and transport alfalfa hay to be used to generate electricity. This project is part of a larger biomass energy feasibility study involving representatives of several University departments, Northern States Power Company, and several state agencies and private organizations. NSP has a conventional coal-fired power plant in southwestern Minnesota, where many farmers are using a corn-soybean rotation that requires large amounts of nitrogen fertilizer and herbicides, causes soil erosion, and produces low profits. Replacing coal from the western United States with locally grown alfalfa to fuel the plant would encourage farmers to grow a crop that causes less erosion and reduces use of chemicals.
- Exploration of ways to store carrots for up to nine months to enable Minnesota producers to become year-round suppliers.
- Development of tractor and tillage implements using artificial intelligence. "Smart machines" would automatically adapt to soil conditions.
- Several studies of the impact of agricultural waste on water quality.

Facilities

A number of new laboratories

were created by dividing rooms in the Agricultural Engineering Building: A land and water modeling laboratory is used for geographical information systems research and for surface and subsurface flow modeling. A computer laboratory offers undergraduate and graduate students access to both Macintosh and PC-compatible computers and to the Internet. A new teaching laboratory is equipped for instruction in animal waste management, principles of soil-plant-water relationships, and bioprocessing. A bioprocessing research laboratory incorporates an upgraded fume hood and an upgraded water purification system with a new hood for venting heat and odors from ovens and a new electric autoclave.

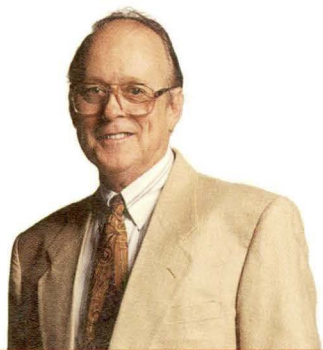
In the basement, electrical utilities were upgraded in all of the laboratories, and sinks were added in labs that did not have them. The basement labs are used for research in indoor air quality; structures and environment; grain quality; crop processing; process and machine control; hydraulics; water quality; and food engineering.

Painting the remodeled areas and the hallways and stairwells greatly improved the appearance of the building—and boosted student, faculty, and staff morale.

Other highlights

- Professor Kevin Janni was named the department's best instructor of 1995 by the Institute of Technology Student Board.
- John Nieber was promoted to the rank of professor.
- Professor Cletus Schertz, who specialized in machinery systems, including the safety of agricultural machines, retired in May after 28 years on the faculty.

CHEMICAL ENGINEERING AND MATERIALS SCIENCE



Department head
H. Ted Davis

Research

Thirty thousand Americans now die of hepatic failure every year, but it may be far fewer in the future, thanks to the work of department faculty members and others. Professor Wei-Shou Hu and Dean Frank Cerra of the Medical School and their research team are working on a bioartificial liver; they have received FDA permission for Phase I clinical trials. Working on the assumption that a combination of viable liver cells with mechanical support is more likely to succeed than is a purely mechanical device, Hu designed a synthetic device with a colony of pig liver cells (hepatocytes) to provide liver functions temporarily: until a replacement liver can be found, or to allow a failing liver time to recover. The cells must have a structure to which they can attach, and they must be exposed to the bloodstream but protected from the immune system. The team's strategy is to place the cells in collagen, the fibrous material of tendons and cartilage, and then pump this mixture into a thin tube. As the collagen hardens, it contracts to roughly the diameter of spaghetti, leaving space between the collagen and the inside wall of the tube. Blood flows across the outer porous surface to the tube while nutrients that feed the hepatocytes circulate inside. The

individual tubes are bundled together in a container that controls the flow of blood, nutrients, and waste.

The Corrosion Center was awarded an Army Research Office/Multidisciplinary University Research Initiative grant of \$1.06 million a year for five years to identify novel polymer electrolytes and electrode catalysis for fuel cells. The polymer electrolyte fuel cell study will concentrate on liquid and gaseous methanol and gaseous hydrogen. The focus is on small, portable heart and lung bypass machines, portable physiological monitors, and other biomedical and consumer applications. The research team includes Professors William Smyrl, Edward Cussler, and David Shores and Adjunct Professor Boone Owens, along with Professor Kent Mann of chemistry and four collaborators from outside the University. This award parallels Corrosion Center research on lithium batteries that is funded at over \$1 million a year.

The work of Erica Lilleodden, an undergraduate materials science student, and John Nelson, a postdoctoral associate, allowed Professor William Gerberich's research group to become one of perhaps three in the world to produce directly imaged nanoscale indentations, independently and precisely knowing the force to produce them. The group worked with Hysitron, a local company that produces nanoscale sensors. The implications for microelectronic interconnects, magnetic recording, and the field of tribology are considerable.

Faculty

Professor James Chelikowky received a Guggenheim Fellowship. Assistant Professor

Prodromos Daoutidis received a McKnight Land-Grant Professorship and a Shell Faculty Career Initiation Award.

The department welcomed two visiting professors from Germany during the year: Reinhard Strey, a research scientist at the University of Göttingen, and Hermann Schmalzried, director of the Institute for Physical Chemistry at the University of Hanover.

Other highlights

- Professor Christopher Macosko has published a new rheology textbook.
- Professor William Smyrl received the H. H. Uhlig Award for Corrosion Research from the Electrochemical Society.
- Professor John Weaver is president of the American Vacuum Society.
- Professor Matthew Tirrell received the Professional Progress Award for Outstanding Progress in Chemical Engineering from the American Institute of Chemical Engineers.
- The National Research Council recently ranked the department's graduate program first nationally, and *U.S. News & World Report*, in its biannual review of engineering programs, ranked the University of Minnesota third nationally among chemical engineering departments.



Department chair
W. Ronald Gentry

Academic program

As a result of a two-year redesign of the department's undergraduate curriculum, chemistry students now have more course options as they pursue their diverse career plans. A premed student, for example, might take biology while a chemical engineering student opted for engineering courses. The focus during the year was on laboratory development in each of the specialty areas. Unfortunately, this work will be undone by the University's plan to switch from the quarter system to semesters.

In a survey of graduate programs conducted and published by *U.S. News & World Report*, chemistry at Minnesota tied for 19th place with Texas A&M and Penn State. Among public universities, Minnesota ranked ninth, in a tie with Texas A&M and Indiana.

Research

The Center for Metals in Biocatalysis was established with University support in 1994 to foster collaborations between groups of established investigators in the Institute of Technology, the Medical School, and the College of Biological Sciences and to increase the national and international visibility of Minnesota as a leader in metallo-biochemistry research. The

research groups currently study the biological, physical, chemical, and kinetic properties of metalloenzymes and biomimetic chemical analogs. Professor Lawrence Que Jr. is co-director with Professor John Lipscomb of the biochemistry department in the Medical School. Other chemistry faculty members involved are Professor Marian Stankovich and Assistant Professor William Tolman.

Faculty

Professor Paul Barbara is the 3M-Alumni Distinguished Professor of Chemistry for the period 1995-2000. He chairs the American Chemical Society's Division of Physical Chemistry.

The late Professor Emeritus I. M. Kolthoff was honored at symposium held in November 1994 at the University of Utrecht in the Netherlands. A plaque dedicated to Kolthoff was installed next to one that honors his mentor.

Essie Kariv Miller, who became the department's first female professor in 1987, retired this year. Born in Sofia, Bulgaria, she emigrated in 1949 to Israel, where she served in the army and then trained as a scientist. She came to the United States in 1975 and to the University of Minnesota in 1981. A leading figure in organic electrochemistry, Miller led an active, well-funded research group; her research is an unusual interdisciplinary combination of organic chemistry, electrochemistry, and materials chemistry. She taught organic chemistry, and she helped change the way that women are viewed and treated within the University.

Other highlights

● Major gifts (\$1,000 or more) came to the department from a

number of individuals and the following companies: Air Products & Chemicals, Alfred Benson Foundation, Dow Chemical, Eastman Chemical, Eli Lilly, Rohm & Haas, 3M, Union Carbide, and Zeneca Pharmaceutical.

● Professor Louis Pignolet was named best chemistry instructor of 1995 by the Institute of Technology Student Board.

● Professor Timothy Lodge was a 1994-95 fellow of the University's Hubert H. Humphrey Institute of Public Affairs Policy Forum.

● Student Bac Hoang held a Lloyd W. Goerke Scholarship and received the J. Lewis Maynard Memorial Prize in Advanced Inorganic Chemistry for outstanding scholastic achievement.

● Laboratory services coordinator John McCarron, who ran chemistry laboratory sections on the St. Paul campus for many years, retired.

CIVIL ENGINEERING



Department head
Steven L. Crouch

Research

The department is participating in a number of interesting research endeavors. Among them are the Minnesota Road Research Project and a study intended to prevent earthquake damage to steel frames.

State and federal agencies, the University, and state asphalt and concrete paving associations are collaborating to study the effects of traffic loads and cold weather on an experimental stretch of highway 40 miles northwest of the Twin Cities. Traffic is diverted from highway I-94 to a two-lane, three-mile road with sensors embedded in the pavement to measure stress, strain, and deflection as well as traffic volume, weights, and speeds. An automated weather station collects data on wind speed and direction, air and ground temperature, humidity, precipitation, and barometric pressure. On a second test road, repeated passes of trucks with known loads will yield information on the effects of overloaded vehicles and unique tire pressures and axle configurations. Associate Professor David Newcomb has been closely associated with the project.

Assistant Professor Jerome Hajjar and a Georgia Institute of

Technology faculty member are principal investigators for a study of steel-frame structures inspired by the Northridge, California, earthquake of January 17, 1994. Since the earthquake, building officials in many seismic zones have been reluctant to authorize steel construction until the origin of fractures caused by the earthquake has been determined. Researchers are subjecting several full-scale beam-to-ceiling subassemblages to simulated earthquakes and are studying a four-story steel-frame structure that was severely damaged during the earthquake. The National Science Foundation is funding the project, which is scheduled to run from September 1994 to August 1996.

Funding for the Underground Space Center—including seed money from the state legislature—was no longer able to keep up with its needs, and the center closed its doors during the 1994-95 academic year.

Students

Seniors Ted Campbell, Tony Turek, and Steve Homar were among the 20 civil engineering students who designed and built a concrete canoe that won first place in an American Society of Civil Engineers regional competition in Platteville, Wisconsin. The 110-pound canoe is wider in the middle than a normal canoe (the broad base makes for easy turning). Design work began in November and construction in January. The lightweight concrete used by the students is a mix of cement, limestone, silica fume, flyash, Microlite, and other chemicals. Assistant Professors Jerome Hajjar and Mark Snyder acted as advisers on the project, and corporate sponsors helped with the expenses.

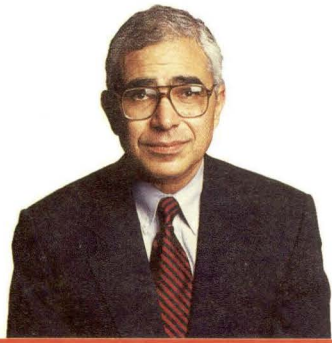
Faculty

Longtime faculty member Ladislav Cerny, who came to the University of Minnesota as a visiting associate professor in 1969, retired. Since he joined the civil engineering faculty as an associate professor in 1973, Cerny has taught courses in reinforced and prestressed concrete and structural masonry for a generation of students and for practicing structural engineers. A native of Czechoslovakia, he brought extensive practical experience in research and design to the classroom.

Other highlights

- Gary Davis was promoted to the rank of associate professor.
- Assistant Professor Carol Shield received a 1995-97 McKnight Land-Grant Professorship and a Bonestroo, Rosene, Anderlik and Associates Undergraduate Faculty Award.
- Assistant Professor Jerome F. Hajjar was named 1995 Young Engineer of the Year by the Minnesota Federation of Engineering Societies.
- Associate Professor Catherine E. French was elected a fellow of the American Concrete Institute and was named to its code committee.
- Students Bryan Dueval and David Weihing received the Claire and Simon Benson Memorial Award for Outstanding Undergraduate Performance.

COMPUTER SCIENCE



Department head
Ahmed Sameh

Research

Grants awarded to computer science faculty members in 1994-95 totaled \$5.29 million. The largest grant is \$1.5 million awarded jointly to the department and the Supercomputer Institute by the National Science Foundation for development of a prototype distributed computing, storage, and scientific visualization facility for the National Information Infrastructure (NII). The University is providing an additional \$600,000. Professor David Du is project director; Professor Pen-Chung Yew and Associate Professor Vipin Kumar are principal investigators along with Du and Professor Paul Woodward of the Supercomputer Institute. The objectives of the pilot project are to support existing and future NII applications and to study enabling technologies that range from distributed application development and systems integration to high-speed network interoperability and connectivity. The prototype environment will be constructed over high-speed local and wide area networks.

Faculty

Assistant Professors Zhiyuan Li, Nikolaos Papanikolopoulos, and Shang-Hua Teng received 1995 National Science Foundation Career Awards; Papanikolopoulos also was awarded a McKnight

Land-Grant Professorship. Associate Professor John Carlis, director of undergraduate studies, was named best computer science instructor by the Institute of Technology Student Board for the third consecutive year. Professor Emeritus J. Ben Rosen continues research on three large-scale computational problems.

In addition to their teaching and research commitments, faculty members served on numerous editorial and advisory boards and helped plan a number of professional meetings.

Academic program

Undergraduate enrollment in computer science courses increased approximately 15 percent in the 1994-95 academic year.

In connection with the U2000 plan for the future of the University, the department undertook a complete revision of its instructional program. Some courses have been dropped and others have been revised; new courses have been added at all levels of the curriculum. Another change is greater use of late-afternoon hours for 5000-level and 8000-level courses; one section of 5000-level courses that are offered more than once a year will meet once a week in the evening, as if it were an evening course.

The faculty decided to hold the written preliminary examination for Ph.D. candidates twice a year rather than once, and to impose strict deadlines for students to pass the exam. The amount of material students are examined on in each area has been standardized by requiring the same number of preparatory courses.

The new master's degree in computer and information sciences ("the coursework-only master's") has been joined by the bachelor of information networking, another new business-

oriented degree. The B.I.N. is offered and administered through Continuing Education and Extension; the computer science department provides instructors for several of the courses and maintains a laboratory at North Hennepin Community College.

Students

Graduate student Anshul Gupta and his adviser, Associate Professor Vipin Kumar, received the Outstanding Student Paper Award at the Supercomputing 94 conference for "A Parallel Scalable Algorithm for Sparse Matrix Factorization." Graduate student Brenda Faber received a National Physical Science Consortium Fellowship for 1993-99; she came to the University's Twin Cities campus after earning a bachelor's degree on its Morris campus. Donald Stimpoul and Joko Suharyono, both graduates of technological institutes in Bandung, Indonesia, are supported by the Pertamina/Production Sharing Contractors Training Consortium; they will be employed by Pertamina when they finish their studies.

Other highlights

- Undergraduate students Ahna Girshick, Scott Krieger, Renee Maheshwari, Dafna Nathanson, Kirk Schloegel, Alexander Sourov, Tuyethang Trinh, Yanina Ugorets, Jeffrey Weier, and Dawn Werner were supported during the year by Landau scholarship funds.

- The National Science Foundation awarded \$550,000 to Professor Ahmed Sameh, head of the department, for acquisition of a workstation for research in high-performance computing.

- The student chapter of the Association for Computing Machinery is maintaining and enhancing a World Wide Web server for the department.



Department head
Mostafa Kaveh

Academic program

Three major initiatives in the academic program were undertaken during the year. In cooperation with the Department of Independent Study, the department will offer a bachelor's degree through "distance education": students based in industry will be able to learn by videotape. Another new program is a degree option in computer engineering.

A new first circuits laboratory was introduced, giving students significantly more hands-on exploratory experience under direct faculty guidance. This is the first of a sequence of four sophomore and junior circuits and electronics laboratories that are going through fundamental change in both content and mode of instruction.

Research

The department continues major research programs in a broad spectrum of specialties. The quantum magnetic disk invented by Professor Stephen Chou and his group is one of the research breakthroughs that has gained national attention.

An interdisciplinary effort on integrated diagnostics involving six electrical engineering engineering faculty members, three

mechanical engineering faculty members, and two materials science faculty members is under way.

Expenditures on research increased by 25 percent during the year, the third year of increase at this level, and there are more research assistantships than at any time in the past 25 years.

Faculty

An active, involved faculty is the heart of any academic department. Recognition of our faculty members' accomplishments came in many forms during the year. Assistant Professors Andrew Teel and Bapiraju Vinnakota received National Science Foundation Career Awards. Associate Professor James Leger was elected a fellow of the Optical Society of America. Professor Philip Cohen was elected a fellow of the American Physical Society. Faculty members who received IBM Partnership Awards were Associate Professors Jay Moon, Gerald Sobelman, and Jiang-Gang Zhu. Keshab Parhi, Dennis Polla, and Paul Ruden were promoted to the rank of professor, and Ted Higman and Jay Moon were promoted to the rank of associate professor with tenure. Laurie Nelson, who holds a Ph.D. from Princeton University, joined the department as an assistant professor.

Professor Vernon Albertson, who has been associate head of the department since 1988, stepped down from that position. Professor Larry Kinney took over as associate head and director of undergraduate studies. Professor Anand Gopinath completed his term as director of the Microelectronics Laboratory for Research and Education; Professor David Polla assumed the directorship.

Other highlights

- Gifts to the department came from Data Sciences International, Ford Motor Company, Honeywell, IBM, McDonnell Douglas, Motorola, the Schlumberger Foundation, and the Schott Foundation.

- Associate Professor Keshab Parhi and Assistant Professor Ramesh Harjani are associate editors for the Institute of Electrical and Electronics Engineers (IEEE) Circuits and Systems Society.

- Anthony Yezzi received an AT&T Graduate Fellowship.

- David Engebretsen and Steve VanderWeil received IBM Graduate Fellowships.

- Marvin Cook retired after 25 years as the department's electronics specialist.

GEOLOGY AND GEOPHYSICS



Department head
William Seyfried

Faculty

The geology and geophysics faculty is significantly more interdisciplinary than it was just five or six years ago, and it is using a much wider and more sophisticated array of computational (modeling) and analytical approaches. Among the reasons for these developments are national priorities in the areas of the environment and global climate change; greater emphasis on the role of fluids in geologic processes; new experimental approaches for investigating problems in the field; and acquisition of new analytical equipment. Faculty research and teaching activities can be grouped into four areas: geophysics/structure, hydrogeology, earth history/environment, and geochemistry/petrology.

Professor Subir Banerjee was asked to deliver the prestigious Cox Lecture at the 1994 annual meeting of the American Geophysical Union; he was also named an IT Professor. Professor E. Calvin Alexander Jr. was on sabbatical leave—with a Bush Sabbatical Award—at the University of Auckland in New Zealand. Associate Professor Bruce Moskowitz was named best geology/geophysics instructor of the year by the Institute of Technology Student Board. Departmental teaching assistant

awards went to Douglas Allen and Carol Ormand.

Kent Kirkby, who holds a Ph.D. from the University of Wisconsin at Madison, joined the department as a lecturer and introductory geology coordinator.

Academic program

There have been important changes in the curriculum. The undergraduate core curriculum is now more quantitative and process oriented; it serves as a model for geology departments throughout the world. One of its final new components, the geodynamics laboratory, was largely completed this year. The lab will allow students to perform computer simulations of complex geologic processes and conduct experiments that emphasize the application of basic physical principles to earth science problems. The curriculum now includes courses in geochemistry, geodynamics, and earth system science; field workshops; and an optional hydrogeology field camp that complements the more traditional, required geologic field camp.

The department developed guidelines for a new coursework-only master's degree for nontraditional graduate students who are not able to take classes during the day and is working on a number of outreach approaches for offering courses for the degree.

Professor V. Rama Murthy has been instrumental in acquiring funding and developing new techniques to enhance the understanding and application of science by nonscience students at the University of Minnesota. Faculty members are playing an increasingly active role in teaching interdisciplinary science education.

Students

The quality and diversity of the graduate student body continue to increase. The number of applications for admission, the background and quality of the applicants, and the number of women in the graduate program are at recent record highs. The percentage of women in the graduate program is approaching 50 percent, in part as a result of a recruiting strategy that provides an assistantship to a woman graduate student who coordinates visits to the department by students who have been accepted for admission.

The National Science Foundation graduate research and training program in crustal scale hydrology (GEOFLUIDS), now in its second year, continues to play an important role in attracting outstanding students and in galvanizing faculty study of the influence of fluid circulation in the earth on a wide range of geologic processes. Director of the program is Professor Mark Person, who holds the George and Orpha Gibson Chair in Hydrogeology; he also held a McKnight Land-Grant Professorship during the year.

Other highlights

- Faculty and research staff were unusually successful in attracting research support from state and federal sources, continuing an upward trend in research funding established over the past five to ten years. Outside funding for the year exceeded \$3.4 million—the equivalent of about \$200,000 per faculty member.
- Michelle Markley, a second-year doctoral student, received a Fulbright Fellowship.
- Geology and geophysics ranks fifth in the University in the percentage of alumni who contribute to their departments.



Department head
Naresh Jain

Academic program

A new course, Computational Methods in Elementary Geometry, offers access to the facilities of the Geometry Center, promoting cooperation between the center and the School of Mathematics and the College of Education. The class attracts both K-12 teachers and teachers in training.

The School of Mathematics proposes to fundamentally change calculus instruction and subsequent coursework through a new model for planning the curriculum and instruction methods in its calculus courses for science and engineering students. The National Science Foundation awarded \$49,874 for planning in August 1994, and a full five-year proposal for \$3.26 million was submitted in June 1995. The model will reform nearly all of the key aspects of calculus instruction and create opportunities to include interdisciplinary materials. The large lecture/small recitation section format currently in use at many public research universities will be reconfigured to allow increased interaction between faculty and students, encourage more student-centered pedagogy, and make use of a variety of technologies. Interdisciplinary cooperation in both curriculum

development and instruction will introduce mathematics materials and curricular approaches into other disciplines and offer mathematics students curriculum modules involving significant applications from other disciplines. Software, videos, and animated simulations will complement a teaching environment that supports workshops, labs, and project-based activities.

Faculty

Regents' Professor James Serrin, whose specialty is ordinary and partial differential equations and foundations of thermodynamics and continuum mechanics, retired in June. Also retiring were Professor Robert Ellis and Associate Professor Charlotte Striebel.

Assistant Professor John Lowengrub held both a McKnight Land-Grant Professorship and a Sloan Fellowship during the year; his specialty is numerical analysis and computational fluid dynamics.

Three new faculty members were hired this year. Maury Bramson (Ph.D., Cornell) will join the department in September 1996 as a full professor with tenure; his specialty is probability. Claudia Neuhauser (Ph.D., Cornell), also a specialist in probability, will arrive at the same time as an associate professor with tenure. The Minnesota Center for Industrial Mathematics will have a new associate director when Fadil Santosa (Ph.D., University of Illinois at Urbana) joins the faculty in September 1995 as a full professor with tenure. His specialties are numerical methods for partial differential equations, and scientific computing and numerical modeling of physical phenomena.

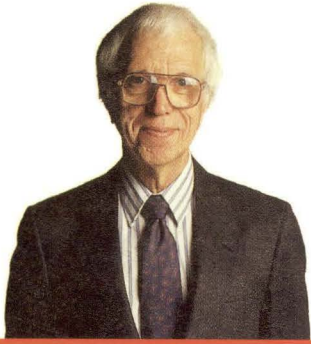
Students

A team of Twin Cities campus University of Minnesota students placed 20th among 284 participating teams from Canada and the United States in the 55th Putnam Mathematics Competition. Five Minnesota undergraduates ranked among the top 20 percent of the 2,314 contestants.

Other highlights

- Professor Willard Miller was appointed acting dean of the Institute of Technology effective July 1, 1995.
- Associate Professor David Frank received the 1994-95 Outstanding Faculty Award given by the College of Liberal Arts Student Board.
- Associate Professor Chester Miracle was named best mathematics instructor by the Institute of Technology Student Board for the third time.
- The opening of the Minnesota Center for Industrial Mathematics, headed by Professor Avner Friedman, was celebrated in October 1994.
- *U.S. News & World Report* ranked the University of Minnesota School of Mathematics 16th in the nation, tied with Brown University and Rutgers University at New Brunswick.

MECHANICAL ENGINEERING



Department head
Richard J. Goldstein

Students/Research

The solar vehicle team finished second against stiff competition in Sunrayce 95, a 1,150-mile race from Indianapolis to Golden, Colorado, in June—only 18 minutes behind the winning Massachusetts Institute of Technology team and more than three hours ahead of third-place California State Polytechnic University of Pomona. Thirty-eight colleges and universities competed. The Minnesota team won an EDS Corporation award for best use of aerodynamic design and also set a Sunrayce daily speed record—50.4 miles per hour—in a 166-mile leg of the race. They went on to the World Solar Car Rallye in Akita, Japan, in July, where they finished second in their class and ninth overall among 84 entrants in three classes.

Although the solar vehicle team includes expertise from other University departments, it is based in mechanical engineering: Professors Virgil Marple and Patrick Starr are the advisers, and more than 30 undergraduate mechanical engineering students have been involved in design, construction, and fund-raising. Students logged more than 500 hours in the undergraduate shop in winter 1995, making parts and constructing the chassis. Contrib-

uting to the success of the Minnesota team is the safe, reliable, and simple but elegant design of the chassis and suspension, which can be attributed to the strength of the mechanical engineering undergraduate design program.

Another vehicle designed and built by mechanical engineering undergraduates—eight students logged 900 hours in the shop during spring quarter—competed in the 1995 Society of Automotive Engineers Midwest Mini-Baja event at the Transportation Research Center in Ohio June 2-4. Nearly 70 teams entered the event but only 50 competed, underscoring the achievement of a team of undergraduates who manage to design and build a vehicle in only six months. Overall score for the event is based on many elements, including design and cost reports, static vehicle assessments (serviceability, structural integrity, mass production possibilities, ergonomics, originality, appearance), and dynamic assessments (ride and handling, acceleration, top speed, braking, skid pull, hill climbing). The main event is a three-hour endurance race—in which the Minnesota vehicle was hit from the rear in the first lap; damage to the carburetor slowed the vehicle considerably. After another collision in the final half hour, the team finished 21st in the race but a notable 10th overall.

Students also have their sights set on the women's world speed record for water craft. The University of Minnesota has had many successes with its human-powered hydrofoils: overall best vehicle winner at the 17th annual International Human-Powered Speed Championships in 1991 and first in every event of the competition in 1993.

Major modifications to the vehicle, which is overdesigned for a female rider, are under way.

Other highlights

- Steven Girshick was promoted to the rank of professor, effective September 1995.
- Regents' Professor Emeritus Ernst Eckert received an honorary doctor of science degree from the University of Minnesota in June.
- Professor Emeritus Richard Springer died in September 1994.
- Associate Professor Thomas Chase was named best mechanical engineering instructor of the year by the Institute of Technology Student Board.
- Professor Peter McMurry was 1994-95 president of the American Association for Aerosol Research.
- Professor David Pui was named director of the University of Minnesota China Center.



Department head
Marvin L. Marshak

Research

The Magnetic Microscopy Center was created with a grant from the Office of Naval Research. Its purpose is threefold: to develop magnetic imaging techniques on submicron-length scales; to use the imaging techniques to solve micromagnetic and physics questions; and to provide a resource for the scientific community. Professors Dan Dahlberg and Charles Campbell, along with Associate Professor Jiang-Gang Zhu of electrical engineering and a faculty member from St. Olaf College in Northfield, Minnesota, lead the center.

Elementary particle physicists at the University of Minnesota have joined with scientists from 14 other institutions in the United States, the United Kingdom, and Russia to propose an experiment to measure the mass of the neutrino. Neutrino mass may be crucial to explaining the cosmological development of the universe and achieving an understanding of the fundamental interactions. The proposed experiment, which would cost \$100 million, would send a beam of neutrinos from Fermi National Laboratory near Chicago through the earth to the University of Minnesota laboratory in Soudan, in northern Minnesota. A new detector at Soudan would determine whether the type of

neutrinos had changed between Illinois and Minnesota. If a change occurred, it would be a clear sign of neutrino mass. A U.S. Department of Energy panel has unanimously endorsed the experiment.

Academic program

The department continues to develop active learning techniques to improve the effectiveness of physics instruction. Students work together in small groups both in problem sessions and in labs.

A five-year cycle of laboratory experiment revision for the introductory labs has begun, and the department is updating its labs to include computer control and data acquisition techniques.

Faculty

Anatoly Larkin of the Landau Institute of Theoretical Physics in Moscow has been selected to fill the William I. Fine Theoretical Physics Land Grant Chair II. He will become a tenured member of the faculty.

Cynthia Cattell joined the faculty in fall 1994 as an associate professor, and John Wygant comes to the department in fall 1995 as an assistant professor. Both hold Ph.D.'s from the University of California at Berkeley, and both specialize in space physics. Cattell, a member of the National Academy of Sciences solar terrestrial research committee, is project leader for the International Auroral Study, an international collaborative program. Professor Konrad Mauersberger left the department to accept the position of director of atmospheric physics at the Max Planck Institute in Heidelberg, Germany.

Departmental activities

The 18th and 19th Abigail and John Van Vleck Lectures were held

in fall 1994 and spring 1995. Lecturers were Professor Robert Laughlin of Stanford University and Professor Paul Chu of the University of Houston, director of the Texas Center for Superconductivity.

The first Phyllis St. Cyr Freier Lecture was presented in November 1994 in honor of Professor Freier's contributions to physics and astrophysics and her substantial accomplishments as a scientist, an educator, and an example for young people. She died in 1992 after 42 years in the department. The first lecturer was Professor Fay Ajzenberg-Selove of the University of Pennsylvania, widely known for her experimental work in nuclear spectroscopy and for her books and articles on the energy levels of light nuclei.

Other highlights

- Professor Charles Campbell was elected a fellow of the American Physical Society.

- Professor Russell Hobbie received the George Taylor Award for Distinguished Teaching.

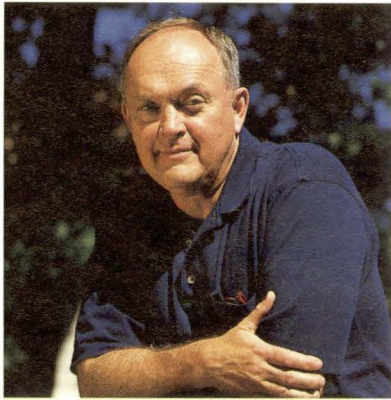
- Associate Professor Roger Jones received the Horace T. Morse-Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education.

- Professor Dan Dahlberg's research was featured in an April 1995 *Physics Today* cover story.

- A local radio station named Associate Professor James Kakalios its "official rocket scientist."

- The University of Minnesota physics program ranked 23rd in the country in a *U.S. News & World Report* poll.

- Physics department supporter Bonnie Hagstrum was inaugurated into the University of Minnesota Foundation Presidents Club.



Larry Molsather (Civil 1963), MSES Scholarship Committee chair

"We hope that we can raise the scholarship amounts in accordance with tuition increases with these additional funds, as well as expand our program perhaps to include graduate students and other colleges and universities throughout the state," says Larry Molsather, chair of the MSES Scholarship Committee and vice president of Barr Engineering in Bloomington, Minnesota. The society has set some lofty fund-raising goals, but the members haven't lost sight of the low-key approach that has worked so well for them in the past.

"We haven't gotten so carried away with fund-raising that we could lose the joy of doing this," says Molsather. "We've kept it personable, enjoyable, and fun—not to mention worthwhile."

MSES raises funds for its scholarship program through membership dues, donations, memorials, and, last but not least, its fall outing, held every year in the second week of September, usually at Madden's Resort near Brainerd, Minnesota. That's when the society's diverse membership comes together to socialize, to network, and most of all to play.

Golf, fishing contests, raffles, croquet, tennis, jarts, bocce ball,

horseshoes, cribbage tournaments, shuffleboard, and trapshooting are only some of the activities held during this three-day event, all for a small registration fee.

"Golf, which is free for those who stay at Madden's, is the big one," says Korth. "Everyone gets out just to have fun and socialize. Let's just say it's not the pro tour."

"The spirit of the society over the years is wrapped up in the pleasure everyone gets out of it," says Miles Kersten, who retired in 1978 as a professor of civil engineering. He taught at the University for 42 years and is a past president of MSES. "They'll decide they want to raise a certain number of dollars for the scholarship fund and then come up with an idea that's fun and won't cost anybody very much to participate—like letting the golfers buy a chance on whether or not they'll put their golf ball on the green. And the idea that all of it is going to the scholarship fund seems to be a real thrill to everyone who's participating.

"It's a very devoted group of individuals," Kersten continues. "You hardly even have to recruit volunteers—the people just do the work and everything gets done."

For Molsather, the fun and joy of the fall outing are surpassed by only one other MSES event, which he manages as chair of the Scholarship Committee—awarding the scholarships. "That's by far the most enjoyable thing that we do because the students are just terrific," he says. "There are some amazing and very focused, hardworking young people among our recipients, many of whom are working 20 to

30 hours a week and carrying a GPA of 3.5 or higher. It's very uplifting for me to get to meet these students who are so anxious to contribute positively to society."

One such student is senior Jill Ovik, a recipient of a 1995-96 MSES scholarship.

"I was really happy when I found out that I received the MSES scholarship," says Ovik, 22. "And it couldn't have come at a better time. Tuition increased again this year, and the amount of the scholarship—\$1,000—was just enough to offset the difference. It helped a lot to know that I didn't have to come up with the extra money."

Ovik graduated from a suburban Twin Cities high school in 1991 and went straight into college, largely using the money she saved during the summer and with a little help from her folks. During the past three years, she has attended school full time and worked part time, initially as a receptionist on campus and, beginning in 1994, as a research assistant in the Construction Materials Laboratory with Associate Professor David Newcomb.

"I was nervous after I interviewed with the people from MSES for the scholarship," Ovik recalls. "My GPA was only 3.2, so I wasn't sure I would qualify. I think the big influence could have been the work I've done with Professor Newcomb, [which] showed my interest in the transportation industry."

Ovik may very well be right. In the late 1980s, MSES helped fund an endowed chair in pavement engineering. The group's fund-raising activities resulted in a

contribution of \$3,000 a year over 10 years for a total of \$30,000—a sum combined with contributions from other organizations and matched by the University's capital campaign. Newcomb is the first and current holder of the Minnesota Surveyors and Engineers Society Miles Kersten Land Grant Chair in Civil Engineering.

Given the significance of Newcomb's work in pavement engineering and all the learning opportunities it presents, Ovik has returned to the Construction Materials Laboratory this year after completing a six-month internship as a soils technician at American Engineering Testing. In the spring, she will begin looking for employment opportunities, most likely in the private sector, in Minnesota.

"It's nice to know that there are people out there who understand how difficult it is to pay for college and who take the time and provide the means to help us," says Ovik. "I'm impressed that an organization like this is taking such an interest in the people who are coming up behind them—the future generation."

While Ovik acknowledges that the scholarship did not make the difference between whether or not she would be able to complete her studies, the situation was quite different for Curtis Eastlund when he was awarded an MSES scholarship as a senior in 1989.

Married, with three kids, and 32 years old, Eastlund knew he had to finish his degree quickly when he transferred from Inver Hills Community College to the University in 1987. He also knew that he didn't have the financial

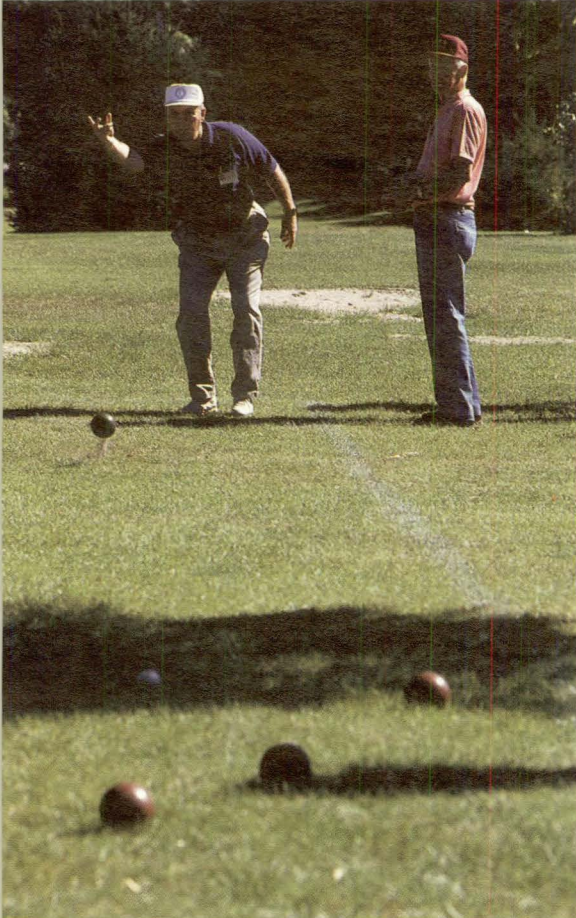
means to do it. He worked full time while he was going to school full time, but his income just wouldn't stretch far enough to cover both family expenses and tuition.

"Receiving the MSES scholarship really helped me out," says Eastlund, who is now a preliminary design engineer with the Minnesota Department of Transportation in Brainerd. "When I went to the University, I applied for every scholarship and grant I could. For me, it made the difference between being able to go to school or not. If I continued the way I had been going—taking a couple of classes per quarter at night—I would have been in school another 10 years.

"I was the fifth out of six kids in my family, and there just wasn't enough money to send us all to college," Eastlund continues. "My mother worked in a store and my father worked road construction. Some people say 'Work hard. Do it on your own.' I did work hard, but without the scholarships, it still wouldn't have been possible. Even with them, I left college with approximately \$15,000 in loans. Scholarships make it possible for a lot more people."

As it is, Eastlund completed his studies as a member of Chi Epsilon and Tau Beta Pi Engineering Honors Societies and, thanks to the scholarship, even found time to volunteer for a project that involved designing and building a wooden footbridge in the Boundary Waters Canoe Area Wilderness. Today, he is managing some 40 projects for the Minnesota Department of Transportation and is eager to move up the ladder—and not just for the prestige of a grander title.

"Actually, it coincides with two of





my most immediate goals," Eastlund says. "That is, to move up the ladder high enough so that I can put my kids through college and be able to give something back." With respect to the latter goal, Eastlund recently joined MSES.

"Giving something back" was one of the primary reasons current MSES president Berkowitz joined the society years ago. "When I was asked to be the secretary/treasurer of the organization several years ago, I told the person who nominated me that I would be honored to have a chance to show all of the gratitude I feel toward this organization," he says.

Berkowitz's involvement in MSES began about 35 years ago when, as a student, he was awarded a \$350 MSES scholarship. The sum covered tuition and books for his last year of study.

"I was 21 years old and married at the time," recalls Berkowitz. "My wife and I were trying to live on her income, which was about \$200 a month, and the scholarship made all of the difference in the world. The commitment to go to school is tremendous. You're taking an average of 50 credits a year for five years, along with the lab work. Then, as now, I thought that if I ever had a chance to give something back, I would. I feel dedicated to repaying all I was given by both the society and the University."

The adage that those who give also receive once again holds true. MSES members have found that by volunteering their time, energy, and money they're still on the receiving side of the equation in terms of both their careers and friendships.

"Being involved in this organization has made my work much

more enjoyable," says Molsather. "When you get to know people through an organization like this, you gain respect, confidence, and trust in those people, and, obviously, it's a lot more fun to do your job in that kind of an environment. This gives us a chance to come together and focus on something beyond ourselves, and in doing that, it helps us build relationships with each other. That's been the most rewarding aspect of being involved with MSES—the friendships I've developed throughout the many years I've been involved."

"A variety of people from different parts of the industry are represented in our membership," says Berkowitz, "including men and women who are engineers, designers, surveyors, planners, technicians, administrators, sales representatives, contractors, materials suppliers, engineering

professors, and other personnel working in or interested in the transportation field. By getting to know these people, you can't help but gain a better understanding of everybody's needs and concerns and what it takes to pull all of the various parts together. The result is that you're able to work more effectively and, in the end, put out a better product."

"There is a feeling among us that we owe something to the future," Molsather says. "We need to keep improving the state and the country, and we think engineering is one of the things that is going to make that happen. Given new financial constraints, we have to learn how to do things better, at less cost, and find ways to increase the value and duration of what we build. These things take bright, young, creative minds like those of the enthusiastic students we meet through our scholarship program."

While the intent of MSES is clearly altruistic, Molsather is quick to point out that it's the members—or at least their companies—who benefit in the long run. "As one of the principals in a private consulting company, I hire these students—many from the University. The fact that we have good prospects coming from the institution is good for us. It ensures that we will have the best engineers and scientists from which to choose for our companies."

And that's the beauty of MSES—its work benefits the industry, related companies, students, and, last but not least, the Department of Civil Engineering. "Anything that helps our students be successful helps our department," says Crouch. "And,

clearly, funding their studies does that by making study in this area possible and attractive to more students. It also allows them to participate in special projects and lab work that might not otherwise be possible if they had to work long hours at a job to finance their studies.

"In short, It gives us a chance to open the doors to this field and show students the myriad opportunities and cultivate their interests so that, in the end, we have the best and the brightest going into this field.

"MSES is a very dedicated group of professionals who do a lot for the University and for civil engineering as a profession. And they've done all of it without ever being asked or even asking if they should. They just keep on giving."

MSES members meet two times a year—at the fall outing in mid-September and at a winter banquet and annual meeting in February. Membership dues are \$20 a year—a portion of which is deposited directly in the scholarship fund. To learn more about MSES, join the society, or donate to the scholarship fund, write to MSES, 555 Park Street, Suite 130, St. Paul, MN 55103, or call 612-292-8860.

1995-96 MSES Scholarship Recipients

*David Anderson, Minneapolis
Julie Bearden, Minneapolis
Tim Becker, Brownton
Michael Brandvold,
Minnetonka
Jon Chiglo, Caledonia
Gregg Curtis, Rochester
Eric Embacher, New Ulm
Sonny James Fite, Forest Lake
Wojciech Gromczynski,
Minneapolis
Jeanne Hansen, Duluth
Scott Hedlund, Bloomington
William Keegan, Eden Prairie
Carolyn Koepf, Burnsville
Jason Krantz, Plymouth
Angela Krueger, St. Bonifacius
Mike Mendiola, Brooklyn Park
Brian Nelson, Chatfield
Jill Ovik, Blaine
Joseph Palen, Caledonia
Paul Pilarski, Delano
Patrick Qualley, Minneapolis
Melissa Schifsky, Stillwater
Victoria Sievert, Carlton
Kyle Skov, Hayfield
Mike Sondag, Rosemount
Paul Strege, Lake Elmo
Julie Sullivan, West St. Paul
Derek Sunstrom, Richfield
Paul Wallick, New Brighton
Jeff Weyandt, St. Paul
Grant Wyffels, Marshall*


 UPDATES

● **Aerospace Engineering and Mechanics.** Daniel D. Joseph, the Russell J. Penrose Professor of Aerospace Engineering and Mechanics, and Professor Ahmed Sameh, head of the computer science department, have been awarded a three-year, \$1.6 million grant for a research project titled "Direct Simulation of the Motion of Particles in Flowing Liquids."

● **Biosystems and Agricultural Engineering.** The department's name, along with the names of the graduate and undergraduate programs, has been changed from Agricultural Engineering to Biosystems and Agricultural Engineering.

- Professor Fred Bergsrud was named a Soil and Water Conservation Society Fellow at the group's 50th-anniversary meeting. He was honored for his leadership and accomplishments in research and education for the development and adoption of practices that conserve the soil and provide clean, safe water for humans and livestock.
- Professor Phil Goodrich was awarded a single-quarter leave for summer 1995. He spent part of his time in Australia, studying distance education.
- Professor Kevin Janni was named the department's best 1995 instructor by the IT Student Board; the award is based on a vote by students.
- John Nieber has been promoted to professor.
- Professor Cletus Schertz, a member of the department since 1967, retired in May. Schertz specialized in machinery systems. His research involved harvesting of crops, harvesting and processing of biomass for energy, and safety of agricultural machines.

● **Civil Engineering.** Professor Steven Crouch has been re-appointed head of the department for a five-year term beginning July 1, 1995.

- Gary Davis has been promoted to the rank of associate professor with tenure.
- Professor Emmanuel Detournay received a Grant-in-Aid of Research, Artistry, and Scholarship effective July 1995 through December 1996 for research on poroelastic mechanisms for deviating hydraulic fractures.
- Professor Cesar Farrell received a National Science Foundation grant for a research project on atmospheric boundary layer simulation techniques in large wind tunnel facilities and the effects of generated turbulence characteristics on the results of model studies.
- Professor Catherine French has been awarded a Fulbright grant to visit the University of Canterbury in New Zealand.
- Professor Kenneth J. Reid was the invited chair of the comminution fundamentals session at the 19th International Mineral Processing Congress, held in San Francisco in October.

● **Computer Science.** Ding Shu-Du, Vipin Kumar, Arthur Lawrence Norberg, and Wei-Tek Tsai were promoted to the rank of professor.

- Assistant Professors Joseph Konstan and John Riedl, Associate Professor Jaideep Srivastava, and Professor Ahmed Sameh, head of the department, received a National Science Foundation grant to support a graduate research traineeship program.
- Professor Linda Petzold, Professor Emeritus Ben Rosen, and Professor Robert Tranquillo were awarded a \$2.2 million grant in the NSF Grand Challenge program.
- Professor Emeritus Ben Rosen and Associate Professor Haesun Park received a three-year grant

from the NSF computer science division. • Shashi Shekhar was promoted to the rank of associate professor with tenure.

● **Electrical Engineering.**

Professor Vladimir Cherbassky chaired a session on statistics and neural networks and presented an invited talk at the World Congress on Neural Networks in Washington, D.C., in July.

• Professor Philip I. Cohen presented an invited talk at the International Conference on Surface Science in Hong Kong in June. • Assistant Professor Shantanu Dutt presented invited seminars at the University of Illinois, Carnegie-Mellon University, the University of Texas, and Texas A & M in September. Dutt also had a paper honored as one of the most influential papers published in conference proceedings during the past 25 years.

• Associate Professor James Leger was elected a fellow of the Optical Society of America. He was cited for "distinguished service for his pioneering contributions to diffractive optical element design, fabrication, and application to novel diode laser resonators." • Associate Professor Jaekyun Moon received an IBM Partnership award. • Assistant Professor Laurie Nelson was selected to participate in the National Science Foundation-sponsored faculty enhancement program "Wireless Communication Systems Laboratory." The program, which took place in June at the Long Island campus of Polytechnic University, is designed to foster development of wireless communications laboratories at the participants' home institutions. • Professor Dennis Polla was appointed to the U.S. Defense Science Board and participated in its 1995 summer study titled "Investments for 21st Century Military Superi-

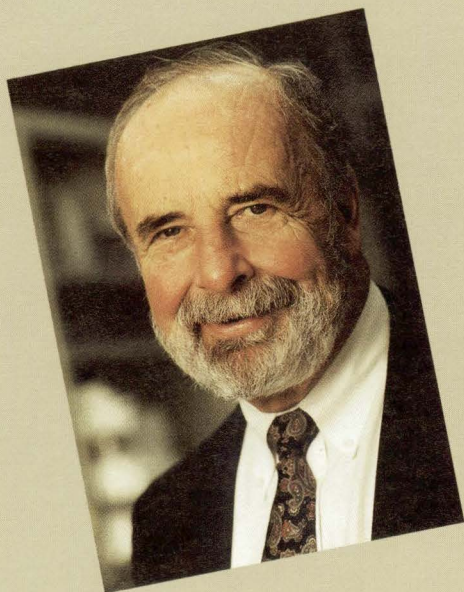
ority." Polla was part of a team that briefed Secretary of Defense William Perry and Undersecretary Paul Kaminsky. • Assistant Professor Andrew R. Teel received a faculty early career development award from the National Science Foundation. He conducted a minicourse at the 1995 European Control Conference in Rome in September.

● **Geology and Geophysics.**

Professor Shun-ichiro Karato received the Humboldt Research Award for Senior U.S. Scientists in recognition of his research achievements. The award offers an extended research stay in Germany.

● **Mathematics.** Associate Professor David Frank received the 1994-95 Outstanding Faculty Award from the College of Liberal Arts Student Board. • Professor Naresh Jain was appointed head of the School of Mathematics, effective in July. He replaces Professor Eugene Fabes, who has returned to full-time teaching. • John Lowengrub was promoted to the rank of associate professor with tenure, and Gennady Lyubeznik was promoted to the rank of professor. • Associate Professor Chester Miracle received the 1995 Best Instructor Award from the IT Student Board. • Professor George R. Sell served as the principal lecturer at the National Science Foundation regional conference titled "Approximation Dynamics: With Applications to Numerical Analysis."

ITAS BRIEFS



**George B. Rathmann,
chairman, president, and
CEO of ICOS Corporation**

JOIN US AT SCIENCE AND TECHNOLOGY DAY BANQUET FEBRUARY 20

A Science and Technology Day banquet will be held at the Minneapolis Marriott City Center hotel on Tuesday, February 20, 1996. George B. Rathmann, an internationally recognized leader in the biotechnology industry, will be the keynote speaker. Rathmann is currently chairman, president, and CEO of ICOS Corporation and chairman emeritus of Amgen. He was chairman, president, and CEO at Amgen from its inception in 1980 to 1988 and chairman from 1988 to 1990. Before joining Amgen, he was vice president for research and development in the diagnostics division of Abbott Laboratories, which he joined in 1975. He also worked for Litton Industries, where he served as president of Litton Medical Systems, and for 3M. Rathmann is a member of the National Academy of Engineering, the American Association for the Advancement of Science, the American Chemical Society, and the Biotechnology Industry Organization.

Two University of Minnesota Outstanding Achievement Awards will be presented at the event.

Invitations to S&T Day will be mailed to all Twin Cities metro area alumni. If you live outside the area and would like an invitation, please contact the dean's office at 612-624-2006 or 800-241-8001.

ITAS RECOGNIZED AS OUTSTANDING ALUMNI SOCIETY FOR 1995

The Institute of Technology Alumni Society was honored by the University of Minnesota Alumni Association (UMAA) on September 16 as the 1995 Outstanding Alumni Society. Of the 17 UMAA collegiate alumni societies, ITAS was singled out for its many contributions to the University, its students, and its alumni over the past year. The award was presented at the annual UMAA Leadership Day luncheon by Linda Mona, UMAA national president, and Margaret Carlson, UMAA executive director. ITAS President Lori Clark accepted the award on behalf of the 4,300-member organization. Also recognized was ITAS board member Bob Rosene, who was one of three finalists for the UMAA National Volunteer of the Year Award for his leadership of the highly successful Navy V-12/NROTC World War II Reunion Committee. In addition, computer science senior Todd Nemoir, former president of the IT Student Board and ITAS student representative, was one of several students honored with the President's Student Leadership Award for 1995. University of Minnesota President Nils Hasselmo and WCCO radio personality Dave Mona also attended the event, which was held in the Great Hall of Coffman Memorial Union.

ITAS INSTALLS 1995-96 BOARD AND OFFICERS

The Institute of Technology Alumni Society (ITAS) Board of Directors installed its new officers and board members at a dinner meeting on July 13.

Assuming the presidency of ITAS was Lorraine I. (Lori) Clark (Chemical 1977). Clark, who lives in Stillwater, Minnesota, with her husband, Jeff, and three sons, has been active in several ITAS activities and programs, serving as a volunteer during the "Building a New World" project in 1993, as co-chair of the 1994 Business and Technology Day, and most recently as ITAS vice president for corporate and institutional relations. She earned a master of science degree in chemical engineering from Washington University in St. Louis in 1979 and worked as an engineer and manager with St. Jude Medical and Optical Sensors before becoming an independent consultant in the Twin Cities area.

Willard Miller Jr., acting dean of IT, addressed the gathering. University of Minnesota Alumni Association executive director Margaret Carlson recognized Les Krogh, departing ITAS president. The board also bid farewell to four members, Sheriff Ahmed (Mechanical 1981), Theodore K. Bather (Agricultural 1980), Frank E. King (Electrical 1960), and James J. Wade (Chemistry 1972, Ph.D.), and to former IT student representative Todd J. Nemoir.

Ten past presidents of ITAS attended the event.

1995-96 ITAS BOARD OF DIRECTORS

President	Lorraine I. Clark	Chemical 1977
Vice President, Finance	Richard P. Daly	Electrical 1949
Vice President, Alumni	Joanne E. Kleinhenz	Mechanical 1976, M.S. 1986
Vice President, Corporate	James A. McLinn	Physics 1974, M.S.
Vice President, Students	Harold G. White	Agricultural 1985, Industrial 1986, M.S.
UMAA National Board Rep	Anthony F. Yapel	Chemistry 1967, Ph.D.
Immediate Past President	Lester C. Krogh	Chemistry 1952, Ph.D.
Member	John L. Borowicz	Computer Science 1980
Member	Richard J. Hedger	Electrical 1962, M.S. 1968
Member	Heather Midje Larson	Chemical 1988
Member	James C. Murray	Mechanical 1990
Member	Richard G. Newell	Chemistry 1975, Ph.D.
Member	Robert W. Rosene	Civil 1945, M.S. 1948
Member	Jerome G. Sosinske	Electrical 1978
Member	Victor Tao Tong	Physics 1993
Member	Mark R. Wikelius	Civil 1969
IT Faculty Representative	David L. Frank	Department of Mathematics
IT Student Representative	Patrick A. Pederson	President, IT Student Board



**Lorraine I. Clark (Chemical 1977),
new president of ITAS**

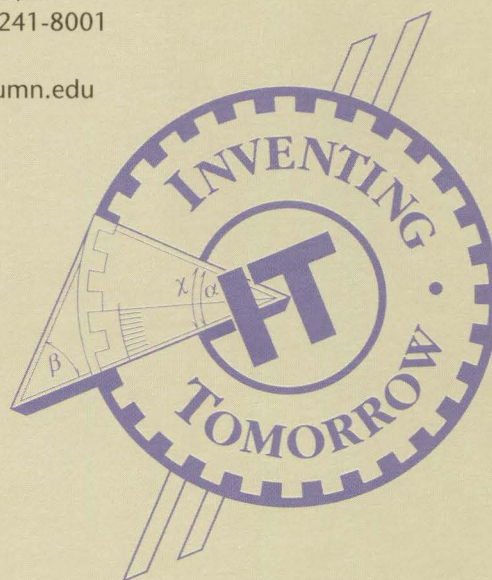
photo by Dan Vogel

ITAS SCHOLARSHIP SUPPORT AGAIN TOTALS \$10,000

For the second consecutive year, scholarship support to Institute of Technology students in the name of the IT Alumni Society totaled \$10,000. The support comes in the form of three \$2,000 scholarships to upper-division students drawn from the IT Alumni Society Scholarship Fund endowment and two \$2,000 freshman scholarships appropriated from the annual ITAS budget and made possible, in part, by proceeds from the 1994 Business and Technology Day. In addition to the funds raised through major events, ITAS receives an annual allocation from the University of Minnesota Alumni Association that is derived from a portion of each member's annual membership dues. The ITAS budget is also used to fund the IT Mentor Program and a variety of other student and alumni-related activities.

ITAS SEEKS NEW MEMBERS

IT Alumni Society membership is on the rise, increasing by 25 percent over the past 12 months. Members of ITAS are also members of the University of Minnesota Alumni Association and are entitled to all UMAA benefits, including reduced-rate Internet access, a subscription to the bimonthly *Minnesota* magazine, and invitations to alumni events. ITAS is committed to enhancing the experience of IT students through mentoring and scholarship initiatives; to strengthening the relationship between IT and the business community through events like Science & Technology Day and the IT Forums; and to providing alumni with professional development opportunities through activities such as the IT Technical Seminars. The ITAS Board of Directors encourages all alumni and friends of IT to become active members of the society by completing and mailing the form at the back of the magazine. Questions about ITAS and UMAA membership? Contact Frank Robertson, IT alumni relations director, at 612-626-8282 or 800-241-8001 or e-mail: rober038@maroon.tc.umn.edu



JOHNSON LUH

Electrical, Ph.D. 1963

When Johnson Luh enrolled at IT in 1958 to work toward a Ph.D. degree, he had to start over in many ways. Although he had earned a bachelor's degree in electrical engineering from La Universitato Utopia in Shanghai, China, in 1947 and a master's degree in electrical engineering from Harvard University in 1950, he found himself auditing many undergraduate courses.

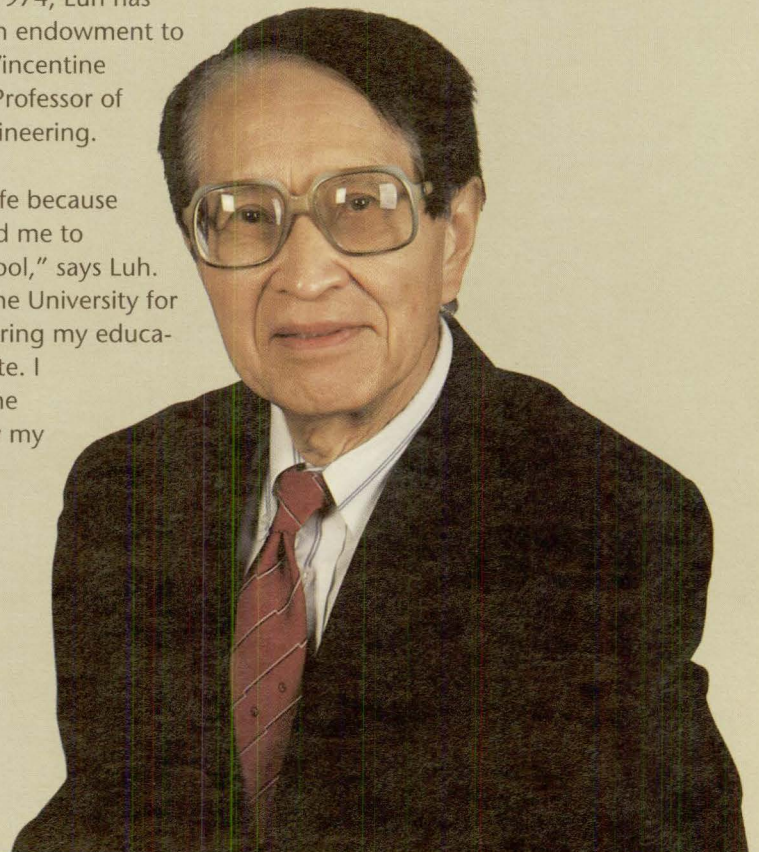
"I got my education based on the post-World War II curriculum," Luh says. "When I got to the University of Minnesota, the technology had all changed. I had to build my background up from scratch."

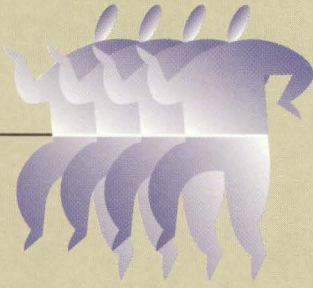
Before Luh enrolled at IT, his wife, a co-worker at IBM in Rochester, Minn., saw that he was unhappy doing production work in the manufacturing facility there and convinced him to go back to school. It was a turning point in his life.

After earning a Ph.D. degree in electrical engineering in 1963, Luh rose through the ranks to become a national leader in robotics and automation research and development. Among his ground-breaking achievements was the development of the Newton-Euler formulation of joint torque—a computational algorithm that makes it possible for robotic devices to compute torque in real time. Today, Luh is the McQueen Quattlebaum Professor of Electrical Engineering at Clemson University in Clemson, South Carolina.

In memory of his wife, Vincentine, who died in 1974, Luh has established an endowment to support the Vincentine Hermes-Luh Professor of Electrical Engineering.

"I owe my wife because she convinced me to return to school," says Luh. "And I owe the University for helping me bring my education up to date. I established the chair to show my gratitude."

**Vincentine Hermes-Luh**



1910s

William G. Dow

Electrical 1917

Professor William Dow of Ann Arbor, Mich., celebrated his 100th birthday September 30. A former faculty member and chairman of the electrical engineering department at the University of Michigan (1929-65), he received the University of Minnesota Outstanding Achievement Award in 1961.

1930s

Robert B. Rhode

Civil 1937

Robert Rhode, PE, FASCE, of Duluth, Minn., is retired after serving as chief engineer with the Duluth, Missabe & Iron Range Railway Company. He has served on the national board of the American Society of Civil Engineers and keeps busy with volunteer work, golfing, fishing, traveling, and consulting work for railroads.

1940s

Morris Fine

Metallurgical 1940, M.S. 1942, Ph.D. 1943

Professor Emeritus Morris Fine of the Department of Materials Science and Engineering at Northwestern University in Evanston, Ill., will receive the TMS Institute of Metals/Robert Franklin Mehl Award at the 125th AIME and TMS Annual Meeting in Anaheim, Calif., on February 7, 1996. He will also present a lecture titled "Phase Transformations in Condensed Systems Revisited; Industrial Applications."

Omer W. Blodgett

Metallurgical 1941, Mechanical 1974



Omer Blodgett, PE, senior design consultant with the Lincoln Electric Company in Cleveland, received an honorary doctor of science degree from LeTourneau University in Longview, Tex., at spring commencement in May 1995 for his many contributions in the fields of welding and engineering. He has conducted design seminars around the world and is the author of numerous books and articles, including the textbooks *Design of Weldments* and *Design of Welded Structures*.

Harry S. Brenner

Aeronautical 1945



Harry Brenner, president of Almay Research and Testing in Los Angeles, was named a winner of the American Society for Testing and Materials Award of Merit in May 1995. He was cited for his distinguished leadership in developing fastener standards and for promoting quality and safety in the fastener industry.

Robert V. Burton

Mechanical 1948

Bob Burton retired as business development manager at Honeywell in 1981 and from the Sundstrand-Sauer Company in 1989. He is currently involved in servohydraulic systems consulting; is a member of U.S. TAG to ISO TC131/SC8; is a contributing *Hydraulics and Pneumatics Magazine* author; and is active in the IT Mentor Program.

1950s

Clark E. Dahlman

Petroleum 1950

Clark Dahlman, PE, is a resident engineer with the U.S. Army Corps of Engineers in Fort Worth, Tex. He and his wife, Sumiko, who is also a Minnesota graduate (Nursing Education), have four children and nine grandchildren.

Richard E. Johnson

Chemistry 1955

Richard Johnson is retired from Anderson-Clayton Foods. He lives in Cross Lake, Minn.

1960s

Ronald Bennett

Metallurgical 1967 M.S., Mineral 1971 Ph.D.

Ronald Bennett was recently appointed director of the Department of Manufacturing Systems and Engineering at the University of St. Thomas. A 3M Fellow, he

has been a member of the engineering faculty since 1986 and has more than 30 years of experience in industry with such firms as Buckbee-Mears, Cardiac Pacemakers, and Teltec Resource Network.

Thomas A. Rasmussen

Electrical 1969

Thomas Rasmussen, a senior sales engineer with General Electric Supply in Tucson, Ariz., is lead sales engineer for the mining industry in Arizona.

1970s

Shyam P. Murarka

Metallurgical 1970 Ph.D.

Shyam Murarka is director of the Center for Integrated Electronics and Electronics Manufacturing and professor of materials science and engineering at Rensselaer Polytechnic Institute in Troy, N.Y. He is internationally known for his research in the area of electronic materials; is the author of three books and over 200 papers; has received numerous awards; and is a fellow of ASMI, AVS, and IEEE.

James V. Waskiewicz

Civil 1971 M.S.

James Waskiewicz of Hereford, Ariz., retired in May 1995 after 35 years of active duty in the commissioned corps of the U.S. Public Health Service.

Robert J. Struve

Civil 1973

Robert Struve of Coon Rapids, Minn., has been named president and CEO of E & V Consultants and Construction Managers of Minneapolis. He will direct the operations of E & V offices in Minneapolis, Madison, Wisc., and Holland, Mich. E & V is currently providing consulting and construction management services

for the Minneapolis College of Art and Design, 3M, H. B. Fuller, Pillsbury, the city of Eagan, and numerous public schools.

Angela Ngozi Nwaneri

Chemical 1978

Angela Ngozi Nwaneri has been named division patent counsel for Corning Inc. in Corning, N.Y.

Roger Johnson

Mathematics 1979

Roger Johnson, assistant professor of mathematics at Carleton College in Northfield, Minn., recently published an article titled "How Many Fish in the Pond?" in the British journal *Teaching Statistics*. The article illustrates the capture/recapture method of estimating the size of animal populations.

1980s

Frederick C. Eichmiller

1981 Mechanical/D.D.S.

Frederick Eichmiller, who has been chief clinical research scientist at the American Dental Association Health Foundation's Paffenbarger Research Center since 1986, has been named director of the dental materials research program at the National Institute of Standards and Technology in Gaithersburg, Md.

Bruce Brandeland

Electrical 1984

Bruce Brandeland of Plano, Tex., is a sales representative for Cardiac Pacemakers Inc. His earlier positions with CPI included test engineer and field clinical representative.

J. P. Little

Computer Science 1984

J. P. Little of Minneapolis recently was named director of the advanced technology department at the Minnetonka-based United Health Care Corporation.

Michael T. Reher

Chemical 1984

After receiving six patents—including one for the power eye marine battery that is in Wal-Marts across the country—while at Johnson Controls Inc., Reher has moved to a new position at General Thermo Dynamics as manufacturing engineer manager.

Patrick A. Thomas

Chemical 1984

Patrick Thomas was recently promoted to research specialist at 3M in St. Paul, where he works in the corporate research laboratories on liquid crystal display development. He received his second patent along with a corporate technical excellence award in 1995.

Matthew G. Pedersen

Mechanical 1985

Matt Pedersen of Seattle has taken a position as senior project engineer with Fiori Product Development, a mechanical engineering and industrial design firm in Snohomish, Wash. Prior to that he was senior mechanical engineer for Physio-Control Corporation, a manufacturer of cardiac defibrillators.

Phillip E. Decker

Mechanical 1986

Phillip Decker, PE, of Concord, N.H., graduated from the Franklin Pierce Law Center with a J.D. degree in May 1995. He now serves as chief intellectual property counsel at Zero Emissions Technology, specializing in patents and trademarks.

Mark Erie

Mechanical and Agricultural 1986

Mark Erie is working as a process engineer at the Ford Motor Company assembly plant in St. Paul. He received an M.B.A. degree from the University of St. Thomas in St. Paul in 1992.

Bonnie Holte Bennett

Computer Science 1987, Ph.D. 1992



Bonnie Bennett is one of only nine people worldwide to earn certification as a Level 5 developer. Level 5 is an advanced, knowledge-based software product with more than 10,000 installations worldwide and a market share of 70 percent. She is on the faculty of the Graduate Programs in Software at the University of St. Thomas in St. Paul.

Jong-Shenq Guo

Mathematics 1989 Ph.D.

Jong-Shenq Guo moved from National Tsing Hua University to National Taiwan Normal University in Taipei in August 1995. He is a professor of mathematics.

Farzad Mahmoodi

Industrial 1989 Ph.D.

Farzad Mahmoodi was recently granted tenure and promoted to associate professor in the School of Business at Clarkson University in Potsdam, N.Y. He received Clarkson's Outstanding Research Award in 1995.

Yubo Miao

Computer Science 1989

Yubo Miao is a software engineer with Loral Corporation in Hoffman Estates, Ill.

1990s**Troy Marusich**

1990 Mechanical

Troy Marusich of Maplewood, Minn., received a Ph.D. in engineering from Brown University in June 1995. He has taken a position as research engineer for Third Wave Systems in Minneapolis, where he specializes in computational modeling of industrial fabrication processes.

Mohamed E. Fayad

Computer Science 1993 M.S., 1994 Ph.D.

Professor Mohamed Fayad of the University of Nevada is editor-in-chief of the IEEE Computer Society Press Activities Editorial Board for Practices in Computer Science and Engineering and is associate editor of *The Communications of ACM*.

Yung-Jen L. Guo

Mathematics 1993 Ph.D.

Yung-Jen Guo moved from National Tsing Hua University to National Taiwan Normal University in Taipei in August 1995. She is an associate professor of mathematics.

Kurt A. Koppi

Chemical 1993 Ph.D.

Kurt Koppi recently accepted a new position as senior research engineer in the Styrenic Copolymer Group of the Designed Thermoplastics Research Laboratory at Dow Chemical in Midland, Mich. His wife, Dolores, recently gave birth to their first child, Spencer James.

Wade P. Johnson

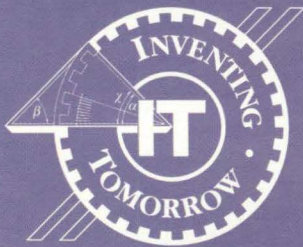
Civil 1994

Wade Johnson is a project manager with Amcon Corporation in Burnsville, Minn. His wife, Melissa Johnson, a graduate of Northwest College, teaches in Shakopee, Minn.



UNIVERSITY OF MINNESOTA ALUMNI ASSOCIATION

Your Membership Makes a DIFFERENCE



The Institute of Technology Alumni Society

The Institute of Technology Alumni Society (ITAS) is the oldest collegiate alumni society in the University of Minnesota Alumni Association. First organized in 1954, it has been serving the Institute of Technology and its alumni and friends for more than 40 years. One of 17 such societies, ITAS recently was honored as the outstanding alumni society for 1995 by the UMAA.

ITAS and UMAA sponsor programs that reconnect alumni to the University and help make the Institute of Technology and the University of Minnesota stronger. These include:

- **The IT Mentor Program** — which last year provided mentors for 145 IT students.
- **IT Alumni Society Scholarships** — which provided \$10,000 in scholarship assistance to six IT students last year.
- **Alumni and Corporate Special Events** — such as Science & Technology Day, IT Forum luncheons with the dean, and IT Technical Seminars throughout the year.

In addition, ITAS members receive all of the benefits of UMAA membership, including a subscription to the bimonthly *Minnesota* magazine, low-cost Internet access, Twin Cities campus library privileges, and discounts in other special programs. To join, simply complete and cut out the form below and mail it in the envelope provided inside the magazine.

ITAS/UMAA Membership Application

Please enroll me as a member of the Institute of Technology Alumni Society and UMAA!
Indicate your membership category*:

- Annual Single: \$30
- Annual Dual/Family Second Member: \$40

*Special 3-year and life memberships are also available.

Payment method:

- Check enclosed (payable to University of Minnesota Alumni Association)
- Visa MasterCard

Card #: _____

Exp. Date: / / _____

Signature: _____

NAME: _____

ADDRESS: _____

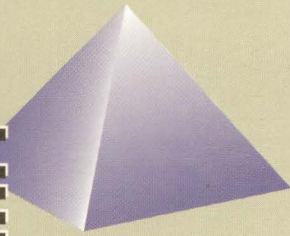
CITY/STATE/ZIP: _____

Please call 612-624-2006 or 800-241-8001 for more information about ITAS membership.

Return to:
Inventing Tomorrow
Office of External Relations
Institute of Technology
105 Walter Library, 117 Pleasant St. S.E.
University of Minnesota
Minneapolis, MN 55455

PM Code: SP/SJ 23

IN MEMORIAM



1940s

John A. Olsen
Mechanical 1940
Wilmington, N.C., March 23,
1995

D. Wray Schorr
Metallurgical 1942
St. Louis Park, Minn., July 1995

Richard Dean Anderson
Chemical 1943
Fairfield, Conn., January 24, 1995

Walter J. Hansen
Aeronautical 1943
Woodland Hills, Calif., April 27,
1995

Erling O. Brandon
Electrical 1949
Framingham, Mass., May 22,
1995

1950s

Vernon R. Witthans
Electrical 1950
Springdale, Ark., March 22, 1995

George P. Bergem
Mining 1951
Underwood, Minn., June 28, 1994

Robert D. Bidne
Electrical 1951
Baltimore, 1995

Paul K. Allison
Electrical, 1957
Glendale, Ariz., May 12, 1995

1960s

Mark F. Kottrich
Mathematics 1967
San Antonio, 1995

1990s

Gary H. Kroll
Materials Science 1992, M.S.
Minneapolis, October 10, 1994

NEWS ABOUT YOU

Name			
Address		City	State
Graduation Year	Degree	Department	
Employer	City	Title	
Other News			

Return to: *Inventing Tomorrow*, Office of External Relations, Institute of Technology,
105 Walter Library, 117 Pleasant St. S.E., University of Minnesota, Minneapolis, MN 55455



University of Minnesota
Institute of Technology
105 Walter Library
117 Pleasant St. S.E.
Minneapolis, MN 55455

Address Correction Requested

Nonprofit Org.
U.S. Postage

PAID

Minneapolis, MN
Permit No. 155