Fall 1993

ITEMS

UNIVERSITY OF MINNESOTA
INSTITUTE OF TECHNOLOGY

The World in Their Hands

IT Week project brings 10,000 school children to campus.
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Engineering human tissue for transplants.
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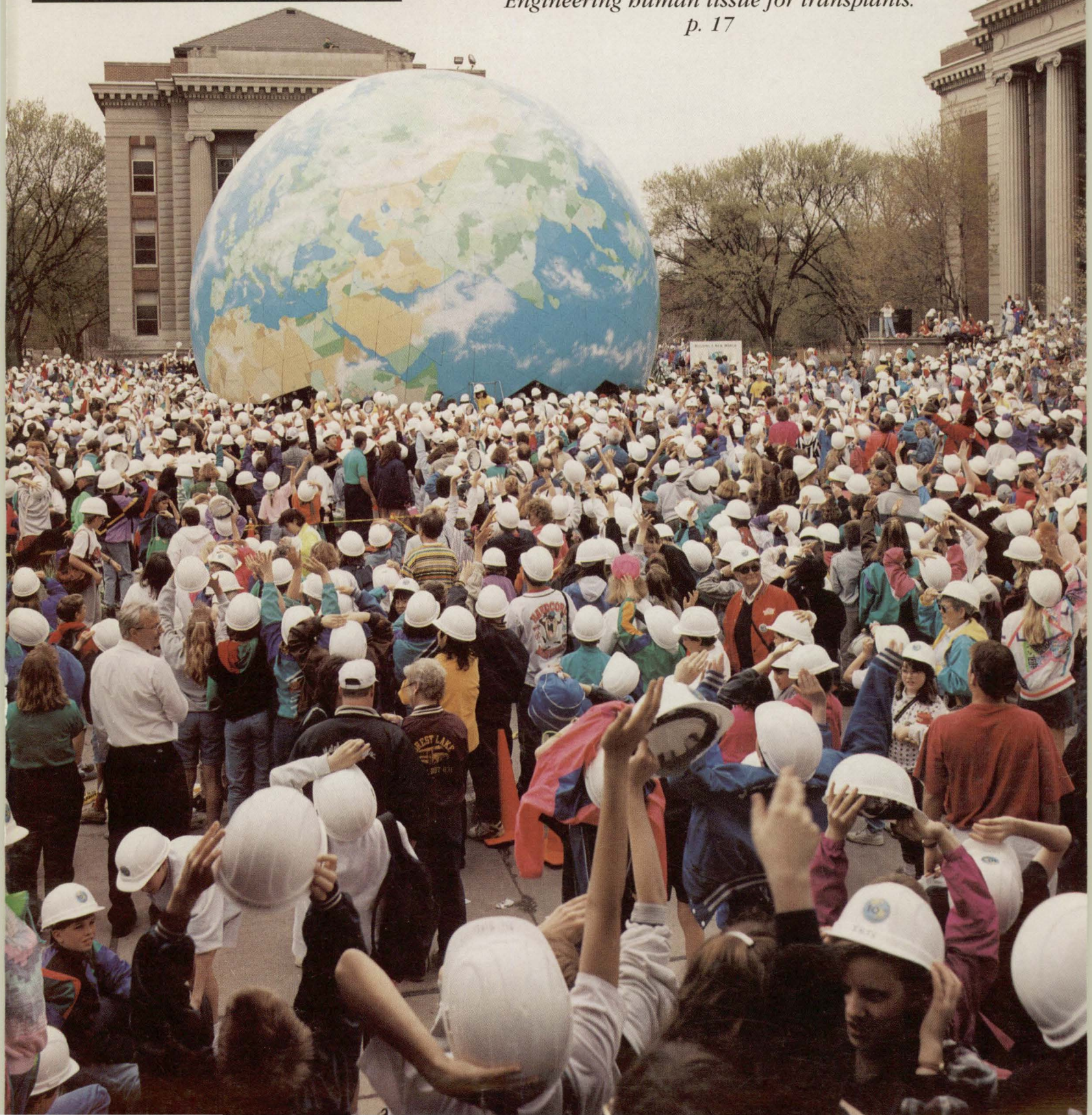

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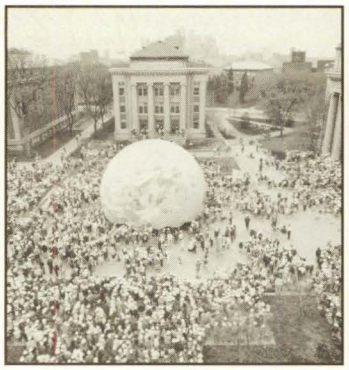

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ITEMS

University of Minnesota
Institute of Technology

Fall 1993

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Russell K. Hobbie . . . . . Associate Dean
Sally Gregory Kohlstedt . . . . . Associate Dean
Walter Johnson . . . . . Associate Dean
Linda B. Bruemmer . . . . . Associate to the Dean
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ITEMS is published three times a year to inform Institute of Technology alumni and friends about news, interesting alumni and faculty, and relevant issues. Letters to the editor, requests to receive *ITEMS*, and notices of address changes should be sent to the IT Dean's Office, Institute of Technology, 107 Walter Library, 117 Pleasant St. S.E., University of Minnesota, Minneapolis, MN 55455, or call Jon Meister, 612/626-1804. *ITEMS* welcomes letters and ideas from all readers.

The University of Minnesota is an equal opportunity educator and employer.

About the Cover: Ten thousand Minnesota school children filled Northrop Mall on May 4, awaiting their turn to put a panel in place, tighten a nut, or ride the bicycle used to raise the globe as it was assembled. Guided by a team of IT alumni and student volunteers, the school children built and erected the entire 42-foot, one-to-1,000,000-scale model of the Earth. Story and more photos begin on p. 12. *Photo by Rob Levine.*

NEWS

Rob Levine

Francis A. Kulacki (1971 Mechanical Ph.D.)

Kulacki Begins Tenure as Dean

Francis A. Kulacki (1971 Mechanical Ph.D.) returned to his alma mater August 2 to assume his new duties as dean of the Institute of Technology. Kulacki, 51, served his first "tour of duty" at IT from 1966 to 1971, when he was a teaching assistant and research assistant while working on his Ph.D. degree. At that time, he was a student in the Heat Transfer Laboratory working under current mechanical engineering Department Head and Regents' Professor Richard J. Goldstein.

Prior to joining IT, Kulacki served as a professor of mechanical engineering and dean of the College of Engineering at Colorado State University. Throughout his professional life, he has forged a distinguished career in teaching, research, scholarship, and academic administration.

A native of Baltimore, Md., Kulacki earned his bachelor's degree in mechanical engineering in 1963 and his master's degree in gas engineering in 1966, both from the Illinois Institute of Technology.

After completing his doctoral studies at IT, Kulacki joined The Ohio State University as an assistant professor of mechanical engineering. He was promoted to associate professor at Ohio State and, in 1980, joined the Department of Mechanical Engineering at the University of Delaware as professor and chair.

At the University of Delaware, Kulacki introduced several major curricular changes in the undergraduate programs and initiated the movement toward computer-aided engineering and design, as well as computer-intensive instruction. He also emphasized the development of laboratory and support facilities for research and instruction. During his tenure as chair, the mechanical engineering department's graduate enrollment and annual research expenditures doubled.

In 1986, Kulacki left the University of Delaware for Colorado State. As dean of the College of Engineering, Kulacki initiated policies and

established new programs that led to significant advances in undergraduate and graduate education, graduate research and scholarship, and alumni and external relations. He established the Office of Undergraduate Studies, the Women & Minority Engineering Program, and the Peer Counseling Program. Under his leadership, sponsored research increased by approximately 70 percent, and graduate enrollment increased 10 percent.

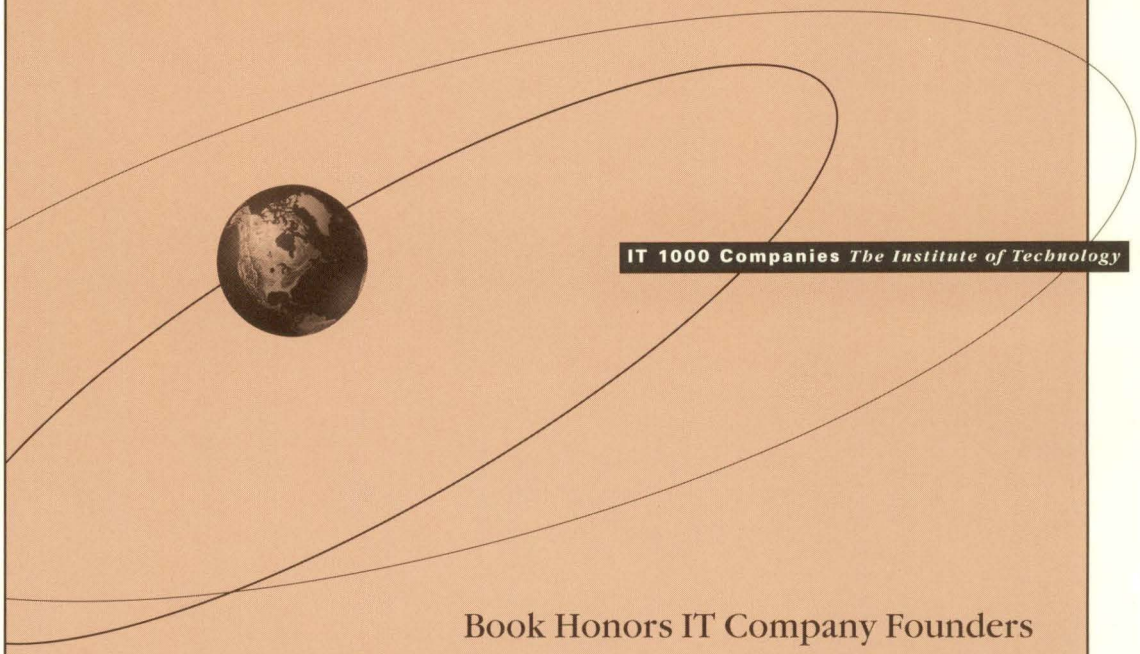
The college's water resources research and education program and its space civil engineering and space life sciences curricula, both of which were developed under Kulacki, were named state programs of excellence by the Colorado Commission on Higher Education. Kulacki also expanded the scope of activities of the college's Office of Development, leading to significant increases in alumni giving and corporate/foundation donations.

Kulacki's research and scholarly writing has centered on problems in thermal convection. His best known work concerns heat transfer in buoyancy-driven flows where the driving force comes from volumetric energy generation within the fluid. He has published more than 100 articles in archival journals and conference proceedings, given more than 100 presentations and invited lectures, and served as a major professor to 12 doctoral students and 18 master's students. Kulacki is a fellow of both the American Society of Mechanical Engineers and the American Association for the Advancement of Science.

The IT Alumni Society has scheduled a welcome reception for Dean Kulacki on August 27 at the Campus Club in Coffman Memorial Union. For more information, contact the IT Office of External Relations at 612/626-1804.

The next issue of *ITEMS* will present a closer look at Kulacki's assessment of the challenges confronting IT. I

Design by Malka E. Michelson



IT 1000 Companies *The Institute of Technology*

Book Honors IT Company Founders

The IT Dean's Office has published a book titled *IT 1000* to honor the achievements of IT alumni and faculty members who, in all, have founded more than 1,000 companies.

"These companies employ more than 140,000 people and generate annual sales in excess of $18.3 billion," says Gordon Beavers, who headed the team of development staff members that produced the book. "And, they have a tremendous impact on the quality of life in Minnesota and beyond. The success of these companies is a tribute to the Institute of Technology, its faculty, alumni, friends, and supporters."

The book, which profiles 16 of the founders, grew out of a study initiated in the summer of 1990. Through a series of surveys and interviews, the staff of the IT development office began tracking down companies founded by IT alumni and faculty members. By the summer of 1991, the list had grown to some 400 companies. A special issue of *ITEMS* published that summer helped promote the search, and a second survey yielded an additional 600 companies. All companies included in *IT 1,000* have one or more IT founders and are still in business (although, in some cases, under new ownership and/or a new name).

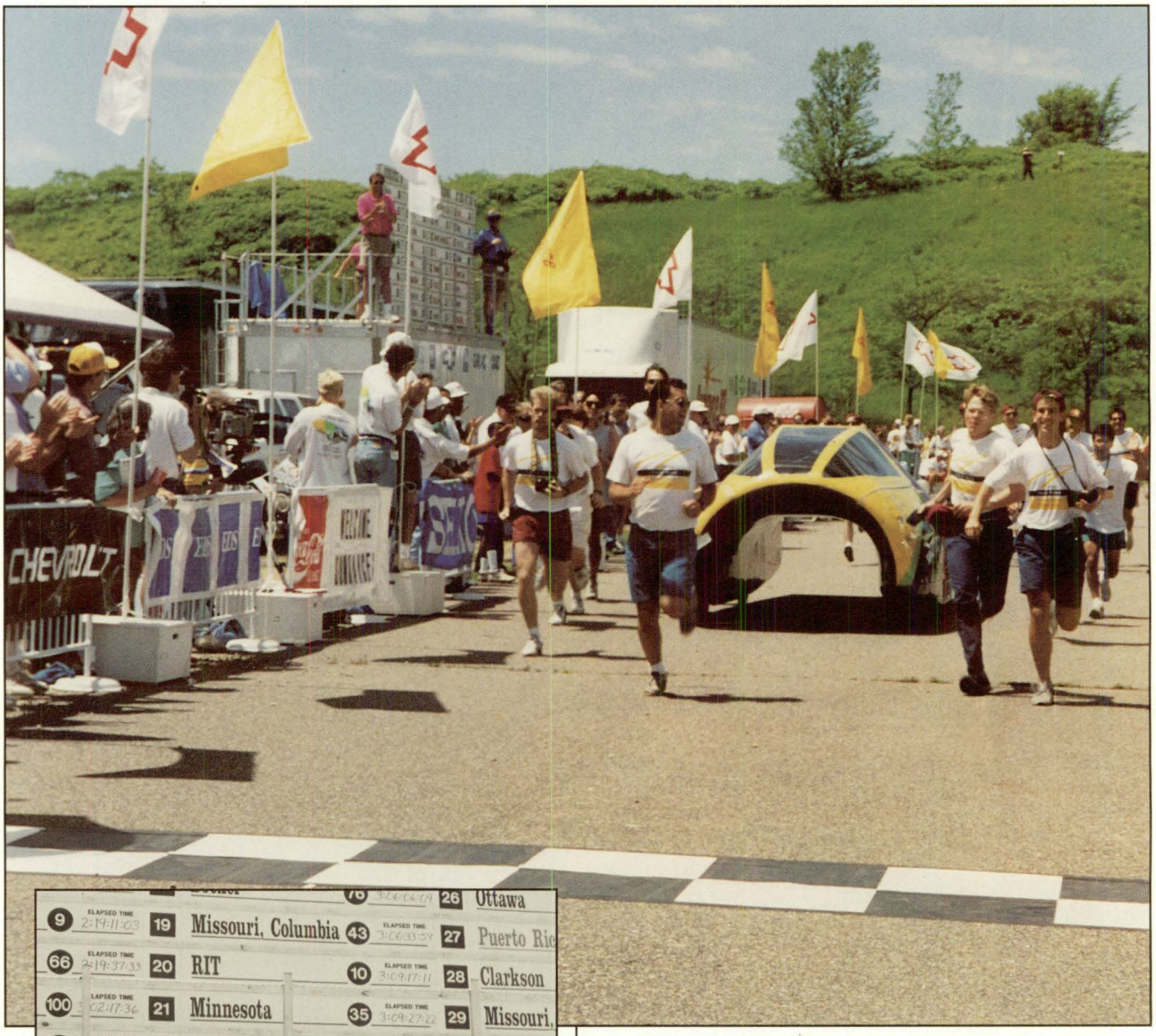
The entrepreneurial endeavors of IT faculty and alumni began roughly a century ago when Charles Chalmers (1894 Electrical) and C. T. Hibbard (1897 Electrical) founded Electrical Machinery, now Dresser-Rand Company. From golf clubs (Tech-Line Corporation, Frank Werner, 1948 Aeronautical), to luggage carts (Smarte Carte Inc., James Muellner, 1965 Mechanical), to pacemakers (Medtronic Inc., Earl E. Bakken, 1948 Electrical), to rockets and space vehicles (Orbital Sciences Corp., Scott Webster, 1974 Mechanical), IT-founded companies run the gamut in terms of the products and services they provide.

The book is divided into eight chapters covering the following sectors of the business community:

- Biomedical and biotechnical
- Computer software, hardware, and semiconductors
- Consulting and professional services
- Contracting, construction, and structural engineering
- Instruments, controls, and electronics
- Manufacturing, industrial, and agribusiness
- Research, testing, and environmental planning
- Services, sales, and distribution.

Each chapter contains a general overview of the companies represented, profiles of two founders from that sector, and a chart depicting all of the companies in that sector and their founders. An alphabetical index lists each of the 1,000 companies, the IT founder or founders, the city in which the company is based, and the company telephone number.

For more information or to purchase a copy of *IT 1000*, call Jon Meister at 612/626-1804. I



Top: **Sunrayce '93 team members ran across the finish line with Aurora, the solar-powered car they designed, built, and raced.**
Bottom: **The IT team's middle-of-the-pack finish was offset by a first-place prize for Design Excellence in Engineering Safety.**

IT Student Team Wins Award in Sunrayce 93

Aurora—the solar-powered car designed, built, and driven by a team of IT students at Sunrayce '93—won first place in "Design Excellence in Engineering Safety." Sunrayce '93, a seven-day, 1,000 mile cross-country car race that began in Arlington, Texas, on June 20, showcased the talents of engineering students nationwide with respect to solar-powered vehicles.

Although the IT team's performance in the race was perhaps less impressive than their design (they finished 21st out of 34 cars, well behind first-place finisher, the University of Michigan), team members and advisers alike termed IT's first-ever entry in the race a rousing success.

"It was a fantastic program," says mechanical engineering Professor Virgil Marple, who, along with mechanical engineering Professor Patrick Starr, served as a team adviser. "Taking

first place in Design Excellence in Engineering Safety was a very prestigious award for them to win, especially for the first entry ever from IT."

"The team effort that resulted from the race was good to see," says University President Nils Hasselmo, who greeted team members at the finish line at the Minnesota Zoo in Apple Valley on June 27.

According to Marple, it took a tremendous amount of teamwork just to get Aurora ready to race. "It was a huge project," he says. "Everything from the basic design to solar arrays had to be done for the first time. It was entirely student conceived, built, and run."

Starting from scratch made life a bit more difficult for the IT team. According to Marple, the team completed the car just in time for the race's time trials, leaving little room for error and no time to "debug" Aurora if necessary. It wasn't until the race began that the team discovered the car didn't handle very well in crosswinds.

In addition to crosswinds, the race was also plagued by a lack of sunshine. The race, which was run in seven legs, began each day at 9:00 a.m. and ended at 6:30 p.m. Cars that were unable to complete a leg in that time each day were trailored to the finish line with team members penalized four minutes for every mile they were unable to complete. With the lack of sunshine throughout much of the race, strategy sometimes called for trailoring the car ahead to a sunnier location and accepting the penalty. In that way, the batteries might stand a better chance of staying highly charged for a longer period of time.

Marple expects IT's entry in the next Sunrayce, Sunrayce '95, to fare even better, thanks to lessons learned from its maiden voyage.

"This year's team has already begun to pass along the knowledge they gained to the students who will comprise the team for 1995," he says. "They will have a vehicle for test driving, and they can play with different coatings for the solar array.

"Everybody tries to win," Marple continues, "but winning the race isn't that important. Students who get into a program like this learn so much more than they could ever learn in the classroom. I was very pleased by the effort they put in and the results."

If anything, Marple adds, the students put too much time into the project. "Even though their grades may have suffered a bit," he says, "their education was enhanced." I

By Chuck Benda

Final Honeywell Chair Named for Renier

The James J. Renier Land Grant Chair, the last of four endowed chairs given by Honeywell Inc. to the University, was formally named at a ceremony held June 16 at Eastcliff, the home of the University president. The chair will be filled during 1993-94 by Aaron J. Shenhar, a visiting professor from Tel Aviv University.

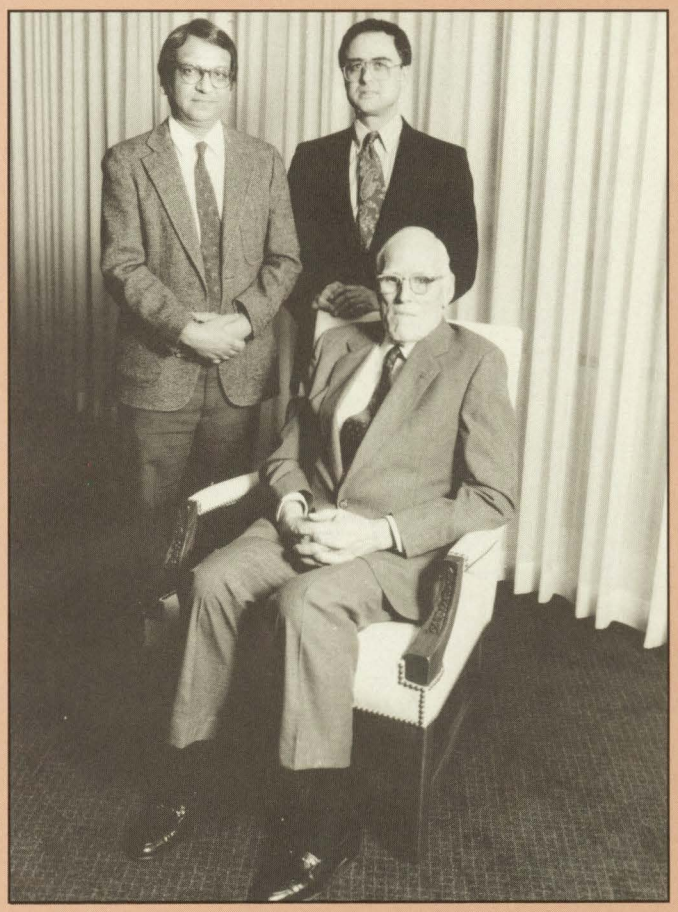
Born in Duluth, James J. Renier was formerly chair and chief executive officer at Honeywell. He received a bachelor's degree in chemistry from the University of St. Thomas and a doctorate in physical chemistry from Iowa State University.

Renier joined Honeywell in 1956 as a senior research scientist and, in 1964, began a career in management. In 1987, he became CEO of the company and was appointed chair of the board in 1988. Renier is currently chair of Honeywell's Executive Committee, a position he has held since April.

Educated in Israel and at Stanford University, Shenhar established the Management of Technology Graduate Program and the Systems Engineering Executive Program at Tel Aviv University. This year, Shenhar joined IT's Center for the Development of Technological Leadership, where he teaches innovation management and advanced project management.

The four Honeywell chairs were made possible by a $2.5 million contribution from Honeywell to the Minnesota Campaign. The other chairs are named for Harold W. Sweatt, former president and chair of Honeywell; William R. Sweatt, founder and former president and CEO of Honeywell; and Edson W. Spencer, former CEO and chair of Honeywell. I

James J. Renier, former CEO and chair, Honeywell Inc.



On March 9, 1993, IT commemorated the establishment of the Oscar A. Schott Professorship in Power Electronics Systems. The professorship was made possible by an endowment from Oscar A. Schott (1934 Electrical), founder of the Schott Corporation. Electrical engineering Professor Ned Mohan (far left) was selected to be the first holder of the professorship. Also pictured are electrical engineering Professor and Department Head Mostafa Kaveh and Schott (seated).

VIEWPOINT

Global Leadership in a Technological World

By Michael R. Bonsignore
CEO and Chair
Honeywell Inc.

Editor's note: ***Michael R. Bonsignore is an electrical engineering graduate of the U.S. Naval Academy and is renown for his expertise on global competitiveness and leadership. This article has been adapted from Bonsignore's opening address on May 6 to participants in IT's Leadership in a Technological World Conference held during IT Week 1993.***

The other day I was in an airport club, and the television was tuned to one of those entertainment tonight-type programs. While I listened, I heard something I couldn't believe. In a blast of hyperbole, the commentator remarked that Madonna's book was one of the most influential and controversial books of the decade and, perhaps, even the century.

I don't think so.

Which books have been controversial? Influential? Changed the course of history and of commerce? Well, aside from the *Bible,* I probably would nominate Darwin's *Origins of Species,* Adam Smith's *Wealth of Nations,* and *The Travels of Marco Polo.*

When Marco Polo returned from his visit to the Far East, he brought tales of a world that no one suspected even existed. The previous suspicions of a dark, shadowy, primitive world were replaced with tales of one that held untold riches—a civilization beyond expectations, complete with new products and wealth never before dreamed of.

Polo's illustrated book was a sensation. Europeans were stimulated to find new ways to ship their products to the Far East and bring new products home. They found new methods of preserving meats, as well as new methods of land transportation. All of these developments were

accelerated by the expanding vision of the world and the need for new technology.

An expanding global vision and commensurate technology is still of vital importance today. To understand its significance, first, I would like to talk about what's happening globally—specifically, the extensive globalization of heretofore national and regional economies—and the role technology plays in a global economy. I will also define the meaning of globalization, using Honeywell as an example, and identify some barriers to globalization that I see looming on the horizon. Finally, I have a few suggestions as to what America, companies like Honeywell, and institutions like the Institute of Technology need to do to thrive and prosper in a global environment.

Globalization of Economies

The world is changing faster than ever before. Not since the Industrial Revolution have the pace and extent of change been as swift and as sweeping as they are today. We are living in what future historians no doubt will consider a momentous era of change.

Cultural and economic values and behaviors around the world are becoming more similar. Witness the appetite for Western-style democracy and market-driven economies in the Third World and the Eastern Bloc.

New industrial powers and regional trading blocs are emerging in Asia, Europe, and North America. Trade barriers are being dismantled, competition is intensifying, and the European Community is trying to displace the U.S. as the world's largest industrialized market.

The flow of capital worldwide has become more fluid. We now have 24-hour stock markets, and countries worldwide now have major investments in each other's currencies and economies.

Instant, worldwide communications are making our sense and experience of time more similar. The world, in a sense, is measuring time by the same clock. And beating that clock is viewed the world over as having the competitive edge.

Incomes around the world are increasing, as well as expectations for further increases, especially in the developing world.

Finally, for the first time in history, economic principles now often prevail over political ideologies. The former Soviet Union is an obvious example. So, too, are Korea and Vietnam. We see the same shift occurring in China.

The trend toward economic globalization is having quite an impact on American corporations, such as Honeywell. There are numerous examples that illustrate that impact and where the U.S. stands overall on the global business stage.

Statistics on exports from 1960 to 1991 show that, in dollar volume, Europe is pulling away from the U.S. and Japan. Although the U.S. gross national product (GNP) was greater than that of the European Community and Japan combined in 1960, the spread reversed itself in 1970 and worsened in the 1980s. By 1990, the disparity was $3.5 trillion.

Another way to look at this "reversal of fortune" is in terms of annual growth rates. Since 1971, America's gross domestic product (GDP) has either lagged or merely kept pace with our major competitors, while Japan's GDP has taken off.

Our current trade deficit with Japan illustrates how we are mortgaging our future by assuming, incorrectly, that we can sustain our economic health by consuming more than we produce. If this deficit continues, America's standard of living will become dangerously dependent on someone else's technology and manufacturing output.

In 1992, only 54 percent of patents issued in the U.S. went to U.S. inventors. And, this was the highest percentage level Americans have achieved since 1986. Of the remaining 46 percent issued to foreigners, half went to Japanese inventors. In fact, four of the top five corporate U.S. patentees were Japanese: Canon, Toshiba, Mitsubishi, and Hitachi. General Electric was the only American company in the top five.

Measures of U.S. manufacturing productivity tell a similar story. For the four decades following World War II, we were preoccupied with battling the forces of communism. Now, quite suddenly, we're up against a far more potent force—capitalism.

The U.S. spends more on R&D than any other country. That's the good news. The bad news is that, as a percent of GNP, American R&D falls below that of both Germany and Japan. And, while U.S. spending began to fall, investments in Japan and Europe continued to rise.

The other bad news is that a third of our R&D spending went to defense. Japan, West Germany, the United Kingdom, and France combined are spending 12 times more than we are on non-defense-related R&D. For the past 10 years, America's non-defense R&D spending has hovered around 1.9 percent of GNP, while Japan's has passed three percent.

Even more to the point, Japanese corporations (which fund two-thirds of Japan's research) have increased R&D spending at triple the rate of U.S. firms. By 1989, U.S. industry's increase in R&D spending no longer kept pace with infla-

Our current trade deficit with Japan illustrates how we are mortgaging our future by assuming, incorrectly, that we can sustain our economic health by consuming more than we produce.

Patrick O'Leary

If we continue to walk down the service-only road, the European and Asian economies will eat our lunch. Our economic prosperity must be founded on a strong engineering and manufacturing base.

tion. And between 1989 and 1990, spending on R&D declined by a billion dollars—the biggest drop in three decades.

The advances we're seeing in American research are largely in academic fields—like earth sciences and environmental studies. On the other hand, America's relative leadership in technologies that are key to our industrial vigor—such as engineering, computer science, electronics, communications, robotics—have declined.

The Council on Competitiveness recently reviewed America's position in 94 technologies judged to be critical over the next decade—94 technologies in which a decade ago we were *the* leader. In one-third of those critical technologies—including advanced metals, robotics, and optical storage—the Council concluded that America was so far behind that we either were no longer a contender in world markets or were so weak that we would fall hopelessly behind over the next five years.

These examples drive home two points. First, like it or not, we're competing in a global economy amid rapid, constant, and unpredictable change. Second, the U.S. is no longer the undisputed economic leader it once was. Our days of post-World War II economic supremacy are over.

Technology's Role in the Global Economy

Technology and, in particular, the technology of instant communications is both driving and being driven by globalization.

Cellular telephones are now being used all over the world, and the Personal Communicator® will have an even greater impact on our ability to communicate instantly with one another. Eventually, the personal communicator, which works off of a worldwide satellite network, will enable us to reach and be reached by anyone, anywhere in the world.

Television is also creating a more homogenous global culture, with widespread sharing of economic, ethical, political, and cultural values.

Human rights and environmental protection are just two values on which the world seems to be moving toward greater agreement—in large part, due to the global reach of television. Another example is the faster, cheaper transportation we now enjoy due to recent technological advances.

Honeywell, for instance, developed a Global Positioning System that integrates navigation data on board an airliner with a constellation of satellites, allowing pilots to reduce the approach path to airports from 10-15 miles down to two-four miles. Once the system is installed, airports will be able to fit more flights into the same airspace with greater efficiency, safety, and speed.

The point is that technology is increasing our overall mobility, both informationally and physically, and greater mobility is accelerating the pace of globalization.

The reverse, however, is also true. Globalization is driving technological change. For example, globalization has created huge markets that clamor for technology to solve problems that transcend national borders. The former Soviet Union desperately needs energy-conservation technology. China needs pollution control systems. Developing countries in Africa, Latin America, and the Eastern Bloc need technology to build their infrastructures. All of these global demands are shaping tomorrow's technology.

Globalization is also driving the need for common international technical standards and open computer systems architecture.

Companies like Honeywell are being challenged to develop products that set a global standard and appeal to customers all over the world, yet remain responsive to local market conditions. What we've found is that, in a global economy, you're only a leader when you have a strong local identity on a worldwide basis.

Globalization also is driving the need for tighter technical coordination in companies that operate in different parts of the world. Since the 1960s, product lifecycles have shortened dramatically because of technological advancements, reducing the time it takes to get a product to market. At Honeywell, we've also had to use the technical skills of our employees interchangeably around the world and distribute resources and responsibilities cross-culturally for basic and applied research.

Finally, globalization and the ready availability of electronic components are driving companies to add value through knowledge and expertise, not just through lower cost. We can no longer compete on price alone. We need to contribute brain power and problem-solving expertise to our product offerings to differentiate ourselves in a global market and completely satisfy our customers' requirements.

Honeywell's customers rely on us to help them solve problems that transcend national borders—to conserve energy, increase productivity, protect the environment, improve total quality, increase safety and security, and enhance comfort.

Whether we're working with Dupont, Shell, Mazda, or Airbus Industries, our customers expect us to be where they are. They also demand a consistent level of attention and expertise, whether they're operating in Boston, Brussels, or Beijing.

The essence of our global strategy is to identify the broadest possible worldwide market for a product, locate manufacturing facilities where they operate most efficiently, and plan production for worldwide demand rather than on a country-by-country, piecemeal basis.

That's the way globalization is supposed to work—and needs to work—if we're going to ensure America's prosperity and technological leadership. What often happens, unfortunately, is we run headlong into barriers that keep our thinking short-term and essentially nationalistic in scope.

Barriers to Globalization

The first and most intractable barrier to globalization we face is our persistent lack of a global mindset. To change that, we need to overcome our complacency with what we've already achieved. As the saying goes, "When you're successful, you forget quickly and learn slowly." We need to move beyond our nostalgia for the glory days of the post-World War II era and get on with the business of regaining global technology leadership today.

We need to overcome our generic fear of change. It's natural to fear change; but what we need to fear far more at this point is *not* changing.

With change comes new cultural attitudes and standards. We must embrace these with confidence and poise. We must view diversity, for instance, as a competitive edge, not just a social good. That means freeing ourselves from stereotypes and prejudices that limit our potential to operate with authority and fairness in a global environment.

Another barrier to globalization is the conflict between global and "buy-American" or "us-versus-them" thinking. Globalization doesn't mean that companies like Honeywell will have, or should have, less loyalty to American markets or to American jobs. Honeywell is a U.S.-based company, after all, that abides by U.S. law and serves shareholders who are, by a vast majority, American citizens. Globalization means that we think differently—that we see the bigger picture in order to realize our full potential in the world economies of the future.

The fact is, U.S. businesses and consumers benefit from cross-cultural advances. As a nation, we must give up our "must-be-invented-here" bias and replace it with a determination to harmonize our employees, technology, manufacturing, and products cross-culturally. This will eliminate unnecessary duplication of effort and resources.

For instance, it makes sense, in the long run, to build factories where global competitiveness is maximized. If that means building factories overseas, so be it. In the end, the improvement in competitiveness will create more jobs here at home.

I'm not suggesting that we improve competitiveness at any cost. To protect America's social fabric, we need to orchestrate a smooth transition to a global mindset. I am suggesting, however, that we can no longer perpetuate inefficiency just to save jobs; our long-term competitiveness will suffer if we do and, in the end, the jobs we are attempting to save will be lost.

On another point, many opponents to globalization, specifically to the NAFTA proposal, predict a mass exodus of U.S. firms to foreign shores.

The realities of doing business, in Honeywell's opinion, will never permit such an exodus. No company will move its manufacturing farther from its home base than it needs. The reason is that cheap labor is not the only factor. Proximity to customers, worker skill levels, political stability, and potential cultural and communication problems are all part of this decision.

What we have found is that the farther away we go from our center of gravity, the more complicated it becomes to control and manage the business. Today, we're actually moving products back from Asia to the U.S. because we've learned that dangling a business at the end of a long string doesn't always work.

So what is it going to take for America to thrive and prosper in a global environment? What do we need to do to step into a leadership role on the global stage?

It is my firm belief that America's economic prosperity depends on—and demands—the rejuvenation of our technology and manufacturing leadership.

America's share of the global market for high-technology goods has been on the decline since 1980. We're never going to sustain, let alone improve our standard of living by doing each other's laundry and preparing each other's taxes—that is, by depending primarily on a service economy.

If we continue to walk down the service-only road, the European and Asian economies will eat our lunch. Our economic prosperity must be founded on what made America great in the first place—a strong engineering and manufacturing base with the economic might to compete successfully in the world's global markets.

We all have a responsibility—industry, universities, and government. American industry has a responsibility to orchestrate our resources, investments, and infrastructure to ensure we are contributing to a strong manufacturing base. And, because our universities are still the backbone of our technological expertise, they and industry must form stronger ties of cooperation. Universities have long looked to government. Now, they must look to industry as well. Partnerships--like the one between the University of Minnesota Institute of Technology and Honeywell—are a very positive step in the right direction.

A stronger manufacturing base depends, in my view, on an unwavering focus on quality. As a result, university curricula need to pay more attention to quality, with engineering and technology curricula leading the way.

Finally, just as academia and industry need to develop stronger ties, so also must government and industry. Currently, government and industry have little appreciation for each other's trials and tribulations and even less appreciation for how to work together toward a common goal.

Couple this lack of understanding with our cultural instinct that independence is natural and collectivism is not, and it's no surprise that we've had difficulty pooling the resources of American corporations and the U.S. government into a collective force that can compete successfully on the global stage.

As a nation, we need to decide in a technological context what we want to be famous for. We need to ask, what are the leading-edge technologies in which we want to achieve global leadership? What technologies will drive the world economy for the next two or three decades? Where do we need to focus our investments to make sure we come out in front? Where and to what extent are government subsidies of industry necessary and beneficial?

We need a technological vision and a set of industrial priorities that will support our country's economic goals—not an industrial *policy*. And, we need to support those goals with an investment strategy that replaces the "get-rich-quick" mentality of the 1980s with a long-term strategy for becoming competitive on a worldwide scale.

America has been effective in this area in the past. Boeing's fleet of "7" series aircraft, for instance, grew out of the U.S. government's heavy infusion of R&D into transport and tanker aircraft for the military. The formula for success was, and still is, very simple: Identify the goal, then work together as a nation to achieve it. We've done it before with the space program, and I'm confident we can do it again.

The early signs I see from the Clinton Administration indicate a willingness to learn about the realities of business. And some things are already changing. For instance, the Defense Advanced Research Projects Agency—or DARPA—is now just plain ARPA, with a focus on dual-use technology. That, in my opinion, is a small step in the right direction.

Thriving in a Global Environment

It's clear that American initiative and creativity are being tested by the forces of globalization. I am nonetheless confident that we have what it takes to succeed in a global environment.

Our strengths and resources as a nation surpass those of any of our individual competitors. America's unmatched physical and creative resources and our strong tradition of innovation top the list of our competitive advantages.

There are many who doubt America's ability to retain our leadership in the face of Japan's huge trade leverage and the vast economic potential of a unified Europe.

The facts remain, however, that we still are the most powerful and influential nation in the world—militarily, economically, politically, and culturally. Our open society and democratic system of government still produces more visionaries and technological geniuses than the highly disciplined bureaucracies with which we compete. Our diversity, both culturally and racially, still gives us a competitive edge in innovation and creativity over nations with more homogenous populations.

While Americans continue to consume more than they produce, we have seen a remarkable turnaround in the productivity of American manufacturing. Manufactured exports have been growing at an annual rate of 15 percent for five years—twice the growth of imports. What's more, from 1985 to 1990, we were the only nation to show a decline in labor costs per unit of output. In the global arena, that kind of turnabout is fair play and, I believe, a harbinger of more good news to come.

We have what it takes. Our strengths and resources are in place. All we need to do now is acknowledge that the world is going global and step up to the challenge of global leadership in a technological world. The decision is entirely up to us. ■

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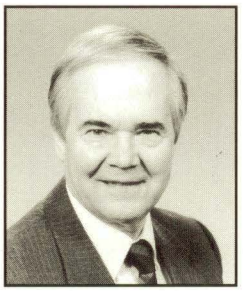

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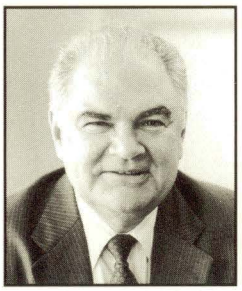

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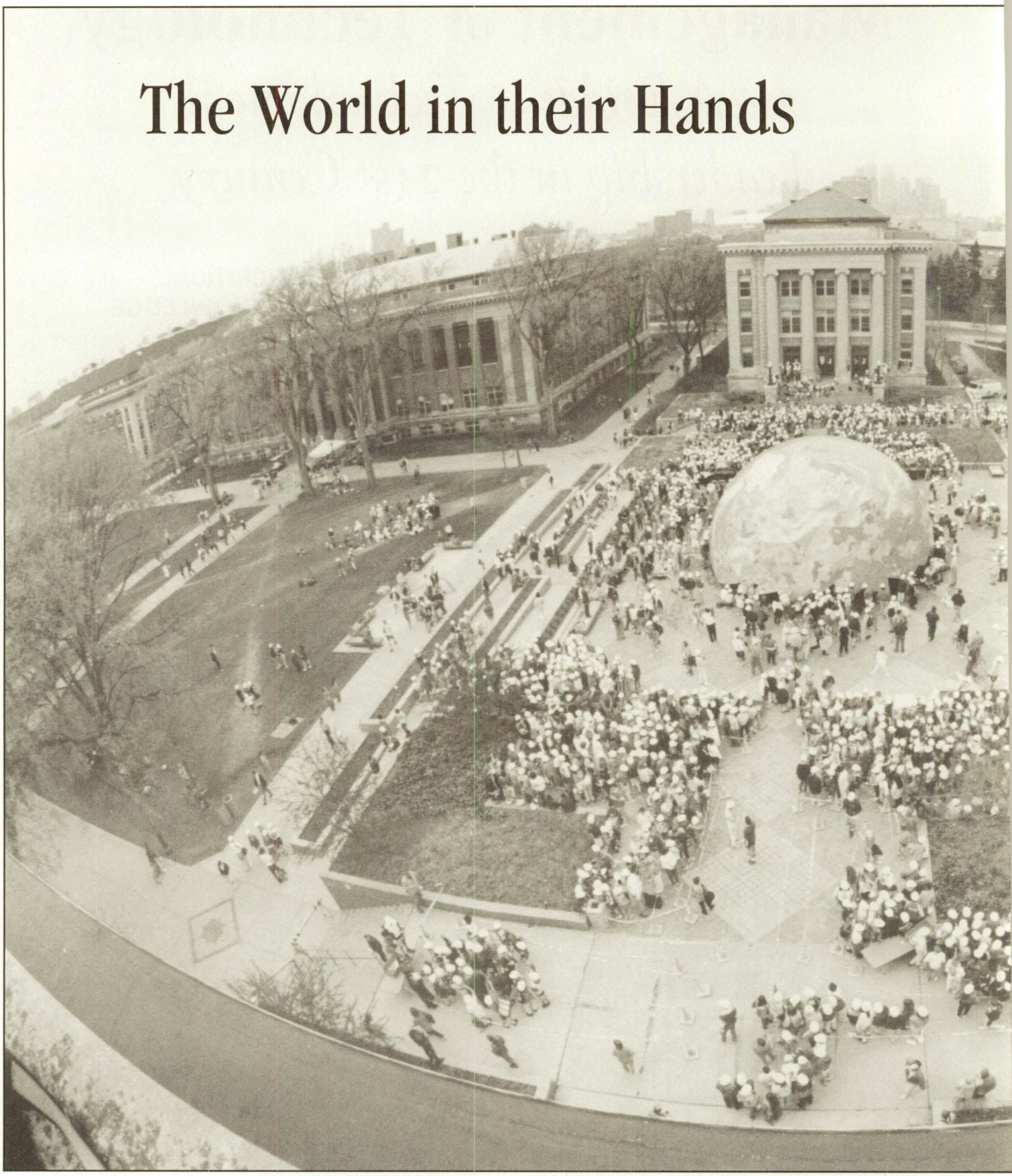
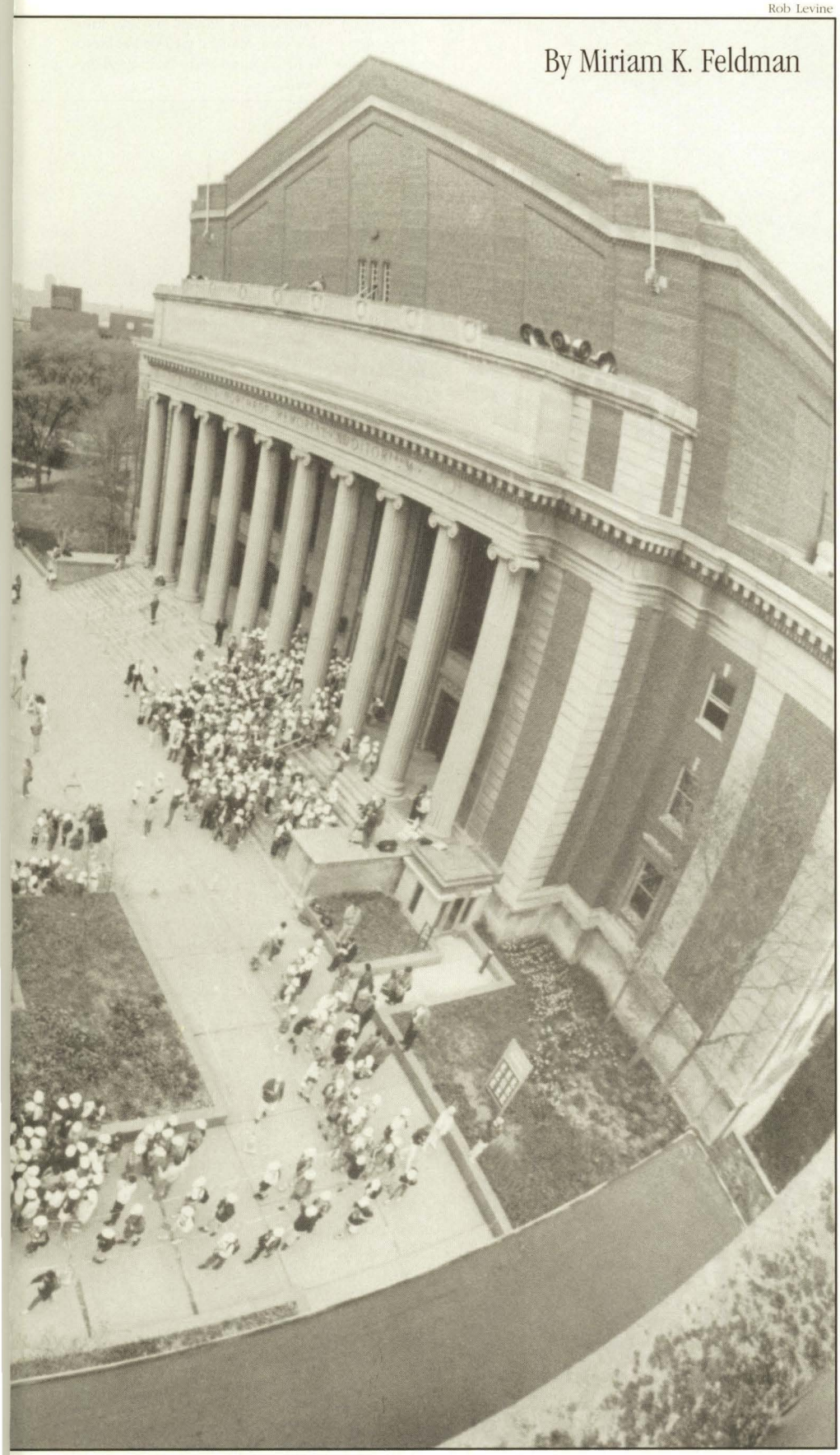
The World in their Hands



Ten thousand school children built a 42-foot scale model of Ea

Rob Levine



By Miriam K. Feldman

b—and a world's worth of goodwill for IT.

From the very early planning stages to the moment the first few panels were put into place, David Hoban, a pre-IT major in civil engineering, tried to imagine what a 42-foot, one-to-1,000,000 scale model of the planet Earth would look like. On May 4, when the last polycarbonate triangular panel was attached to the aluminum geodesic framework on Northrop Plaza, Hoban could stop wondering.

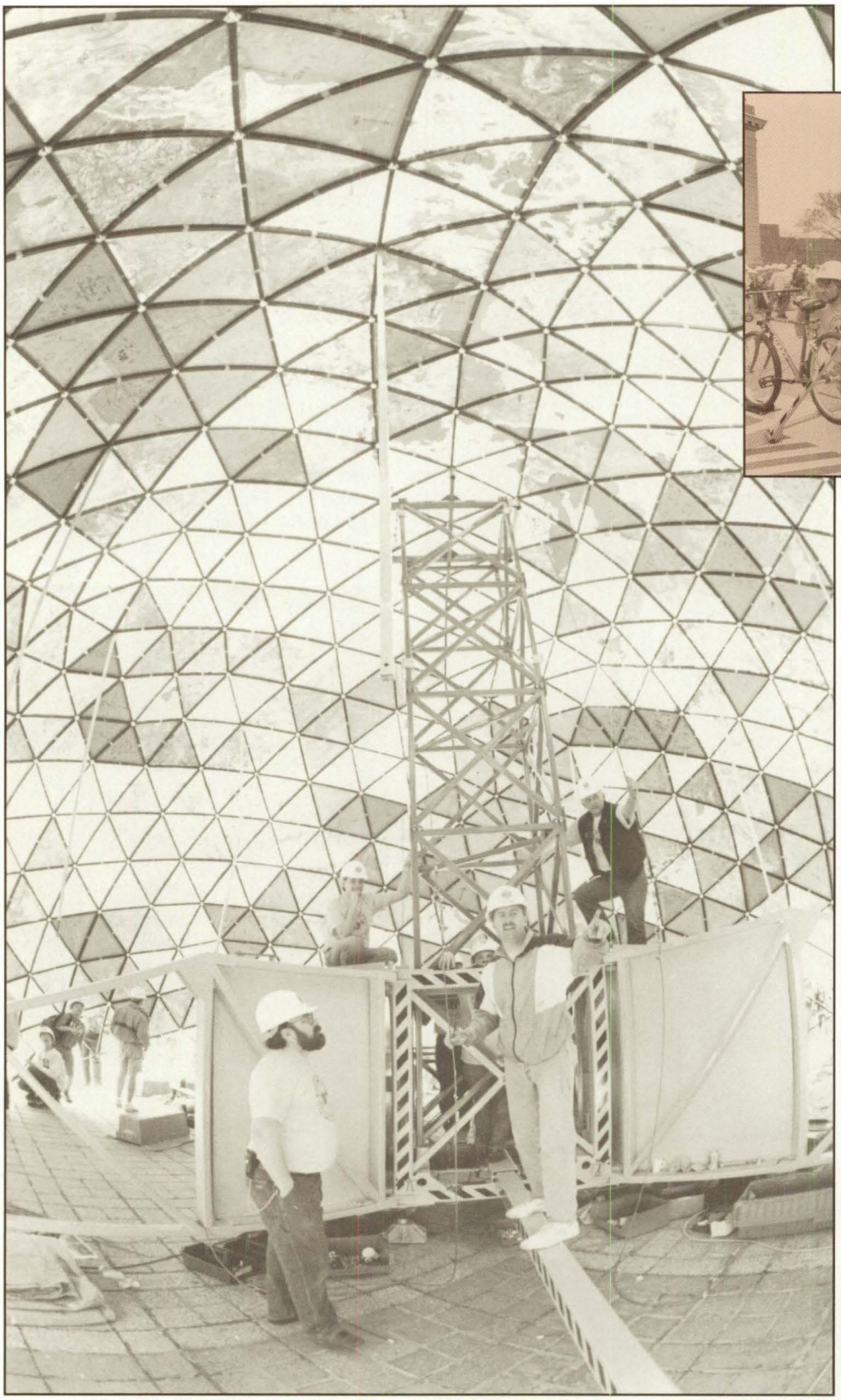
"When it was finally done and I backed up to Washington Avenue and looked at it, I thought, 'Wow, it looks a lot more like a globe than I thought it would,'" Hoban says.

"Wow," only begins to sum up the feelings of the thousands of participants who helped assemble the globe in a project known as Building a New World, which was the pièce de résistance of IT Week 1993. President Nils Hasselmo called it "the inspirational highlight of the academic year." Others described it in terms of awe, magic, and fun. "I think the size blew my students away," says Paula Verstegen, a fifth-grade teacher at Lake Elmo School.

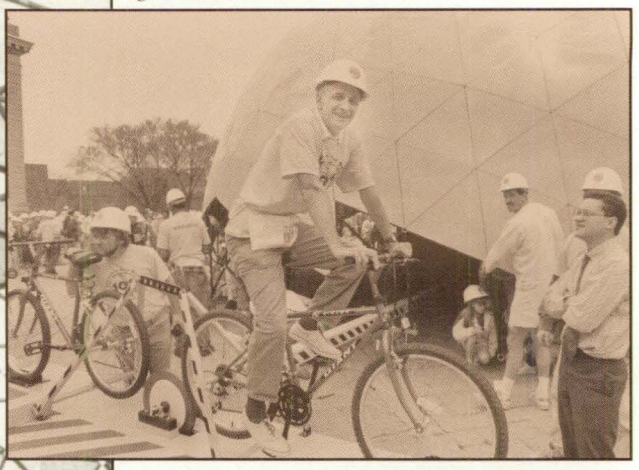
More than 200 IT student volunteers helped with the project, supervising the children as they waited in line or assembled a portion of the globe.

The size of the globe was only outweighed by the size of the crowd that converged on Northrop Mall to help build this monumental structure. In all, 10,000 students and 2,000 adults participated. While awaiting their turn to work on the globe, they created a line of builders that snaked around Northrop Auditorium, through the parking garage, down Church Street, past the Armory, and down University Avenue. They waited patiently for a turn to don hard hats, pedal a bike that lifted the globe up and down, assemble the frame, or put a panel in place.

"This project gave young students a chance to take a screwdriver in hand and build something that's really impressive,"



Project Leader Bryan Beaulieu (1972 Mechanical) kept busy inside the globe as successive rows of panels were added.



Acting Dean Gordon Beavers pitched in with a little pedal power of his own, taking a turn on the bicycle used to drive the lifting mechanism that raised the globe as it was built.

says Bryan Beaulieu (1972 Mechanical), founder and president of the Burnsville, Minn., company, Skyline Displays, and the mastermind behind the project.

Rousing the Sesame Street generation from its TV-induced lethargy to a hands-on experience was what Beaulieu had in mind when he conceived the project as chair of the IT Week Planning Committee. "If they can get a hands-on experience that shows them how much fun it can be to actually build something, hopefully it will inspire them to be something other than a passive observer in life," he says.

Beaulieu says today's children who, for the most part, are raised on television, "have no tactile feel of the world," and, consequently, they are coming to the University with little grasp of basic concepts. "It's a challenge to teach children engineering if they don't have a feel for force and motion and weight and scale," he says. "You don't get that kind of understanding from playing Nintendo."

Those involved in the project—grade school and junior high school students from roughly 200 schools throughout the state—began to grasp those concepts long before the first panel of the globe was put into place through numerous IT alumni, who visited the schools and served as mentors and as role models in the processs. Steve Levie (1964 Physics; 1966 Electrical M.S.), for example, was an IT mentor to his son's fourth grade class at Northview Elementary School in Eagan.

"I think some of the kids got a better idea of what engineers do and that math and science isn't strange and weird stuff," he says. Levie, a senior electrical engineer with DataCard in Minnetonka, Minn., made about six visits to his son's school to talk with students about everything from engineering as a career to the concepts of scaling up and down.

Much of the time, Levie helped the children prepare the triangular pieces of the globe they had been assigned to map and paint. Students located their portion of the globe (which had been divided into 1,620 triangular panels), traced that part of the world from the atlas onto transparencies, and then enlarged the tracing to full scale. Finally, the tracings were put on vellum and then transferred to the plastic triangles that the students then painted.

Scale is a difficult concept for fourth graders to grasp, says Levie. "This project did a really good job of helping these kids better understand it." Seeing the assembled globe really brought home the point. "You can tell them as many times as you want that the globe is going to be nearly 50 feet tall, but they don't comprehend how tall that is until they actually see it."

The project taught Paula Verstegen's fifth graders the importance of working together. Verstegen recalls the first day William Lundquist (1934 Chemical), a retired 3M engineer, visited her class. "He said, 'These kids don't know how to work together. They'd better learn, because that's what it's all about. At 3M, you don't work alone. You work in teams—always.'"

Jack Bartlett (1968 Civil), president of Bartlett and Associates, Inc. in International Falls, agrees that the project taught the importance of teamwork, something students rarely experience outside of sports. "This was a team activity that was cerebral," he says. "The students had a sense of being a small part of a whole. If you're an engineer, you may be involved in a big project and have to do some small part to make the whole thing work."

To make it work, the students learned another lesson—how to follow directions. "That's not something they learned playing with Legos, which are predefined," Beaulieu says. "You just stick them together, and whatever you make, you make. Building the globe is different. If you don't follow instructions, it won't work."

The project had the added benefit of introducing the University to many students. Bartlett took a group from International Falls High School on an overnight trip to the Twin Cities. "They got a chance to go to the University and see that it's just another place on the planet," he says. "When you go to a place where there are several times as many people working on a project on Northrop Mall at the same time as there are in their own school, there's a sense of awe."

Verstegen said she has never participated in a better organized project. "We

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The entire Building a New World project was funded through private and corporate donations of money, manpower, and materials. Our thanks go out to the following contributors.

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A few white clouds—the only detail on the surface of the globe not completed by the students—were spray-painted onto the surface for an added touch of realism.

didn't have to scrounge for anything," she says. "If you needed a pencil, they gave you a pencil. Everything came to us."

But it wasn't merely the the supplies, the atlas, and the teaching materials that impressed Verstegen. "I didn't just receive a packet of information about the project," she says. "We were able to interact with the experts and they were always readily available. As large as this project was, it still had a personal quality. I didn't have to play telephone tag for days. I'd get my questions answered then and there."

Although the classroom work on the globe is complete, Beaulieu has plans to take apart and reassemble this globe, or similar globes, up to 1,000 times in the next five years with a goal of involving up to 10 million students. Wherever it travels, the rule is that only children can put it up. "That way," he says, "they can share the experience of how satisfying it can be to build something with your own hands."

Thus far, the globe has been assembled at the Lion's Club's annual international convention at the Minneapolis Convention Center, and there are plans to assemble it at the State Fair, the Mall of America, a United Way event in Burnsville, and the Concordia language camp. Beaulieu also has hopes of seeing it assembled at the Winter Olympics in Norway and at the World's Fair in Budapest.

As this globe wends its way around the world, Beaulieu hopes to construct another globe, similar in size, but different in scope. The new globe will be divided into 88-acre plots of land—a plot for each of the world's 1.6 billion children. On the new globe, each triangular panel will be divided into smaller triangles (one thirty-second of an inch per side) with each corresponding to a real point on Earth.

The idea for the new project came to Beaulieu after he saw how strongly students identified with the globe panels they had been assigned to paint. Even students who had painted panels of water were eager to locate their contribution on the finished globe. "When they worked on a panel, they felt a bit of empowerment about it," he says.

The new project will build on that sense of ownership by encouraging students to learn as much as possible about their 88-acre part of the world. What's the weather like? The culture? Pollution? Population? The large amount of data collected will be funneled into one receiving center—hopefully, at the University of Minnesota.

Given how Building a New World came off without a hitch, the new globe project has a good chance of succeeding. Scott Bain, an electrical engineering major and co-president of Tau Beta Pi, recalls discussing all of the potential problems during early planning meetings for the first globe. But the problems never arose. "Given all the things that could have gone wrong, very few did," he says. "Even the weather cooperated."

Beaulieu also recalls some anxious moments, wondering whether 10,000 students converging on campus would be controllable and whether they would be able to do the work. But the results, he says, were great. "From the first sketch on a napkin, to the final few minutes of assembly, it worked out pretty perfectly." I

BEYOND ARTIFICIAL TRANSPLANTS

By Joe Moriarty

BIE researchers set the stage for growing replacement parts for the human body from living cells.

Finishing her routine on the uneven parallel bars, a gymnast over-rotates her dismount. The loud pop heard by everyone nearby as she lands is the shredding of the anterior cruciate ligament in her knee. Not to worry. Within six months, her knee is functioning almost normally, thanks to the implantation of a new ligament grown from "starter" cells from her own body.

A five-year-old child recently diagnosed with diabetes receives a transplant consisting of bovine pancreatic islet cells (the cells in the pancreas that produce insulin). These cells are encapsulated by a synthetic substance that allows the transplanted cells to interact with the child's body, produce insulin, and prevent rejection by the body's immune system. In effect, the child's diabetes is cured.

Science fiction scenarios? Yes, but perhaps not for long. Faculty, students, and industrial partners involved in IT's Biomedical Interfacial Engineering Program (BIE) are working hard to make these and other equally stunning treatments a reality. Together, they are developing strategies for transplanting living cells to replace lost or genetically missing

Matthew Tirrell, BIE program leader and professor of chemical engineering and materials science.

metabolic functions in such organs and glands as the liver, pancreas, and pituitary gland, as well as to repair or restructure damaged or malformed connective tissues, such as cartilage, ligaments, and skin.

The BIE tissue engineering program is in the forefront of efforts to fill the growing need for alternatives to artificial prosthetic devices used to replace bone, cartilage, and other connective tissue.

Why the need? "Permanent implants composed of synthetic materials have been mainstays as replacement parts for the human body for more than two decades," says Matthew Tirrell, BIE program leader and professor of chemical engineering and materials science. "The science and application of such materials as artificial joints has developed to a high level. It's a mature field, and progress in new applications and solutions to old problems has slowed considerably in recent years."

The explosion of knowledge in the ability to manipulate biological systems coupled with concerns over artificial prosthetic devices (underscored by the recent controversy over silicon breast implants) have also led to a growing interest in replacing damaged/diseased body parts with engineered biological tissues rather than conventional non-biological materials.

"Although many of these procedures have already been done, it's not been consistently enough or at an affordable cost," says Tirrell. "Product development and manufacturing are still at a primitive stage."

As part of the University's Center for Interfacial Engineering (CIE), BIE began in the spring of 1992 with a commitment from the University of $300,000 per year for three years. Led by Professors D. Fennell Evans, Jack Lewis, Matthew Tirrell, and Robert Tranquillo, as well as Associate Professors Joan Bechtold, Wei-Shou Hu, Perry Leo, and Daniel Mooradian, BIE staff are concentrating specifically on the role of surface and interface phenomena in biomedical problems. Their goal is to join in a collaborative effort to develop the next generation of cell-seeded tissue analogs of skin, tendon/ligament/cartilage, and blood vessel walls.

The Basic Research

According to Tirrell, BIE is bringing together established research groups in interfacial engineering, materials science, orthopedic bioengineering, biochemistry, cell-matrix (structure) biology, and collagen scaffold engineering, the latter of which builds cell support structures out of collagen (a common protein that imparts strength to such tissues as skin, ligaments, tendons, and cartilage).

"The underlying question we're exploring is how do you go about constructing a scaffold that will define the shape, size, and, to some extent, the mechanical integrity of an artificially-created tissue?" says Tirrell.

A difficult question at best. Unlike blood cells, which can be transplanted intravenously, most cells under consideration for these new therapies must be transplanted with some type of support device called a scaffolding. This scaffolding can serve as either a template to guide cell growth into a new tissue (to replace damaged cartilage, for example) or as a barrier that protects the transplanted cells from the host's immune system. Creating a coherent research and educational program in collagen scaffold design and application is, thus, one of BIE's primary—and perhaps most challenging—goals.

Projects already underway involve eight faculty members, six graduate students, three post-doctoral research associates, and four industrial collaborators. All of these projects focus on one of the following research topics: (1) interfaces in orthopedic applications, (2) topological effects on cell growth, or (3) engineered cell adhesion and growth.

With respect to interfaces in orthopedic applications, Department of Aerospace Engineering and Mechanics Assistant Professor Perry Leo and Department of Orthopedic Surgery Professor Jack Lewis are exploring the mechanical properties of cartilage, which is a collagen matrix (a readily available protein that imparts strength to tissues) with ingrown cells.

"We don't have a good understanding of what geometric arrangement gives cartilage its strength," says Tirrell. What's more, its strength changes as other body cells grow into the matrix, so there seems to be an interaction affected by the cells. Our research in this area is to try to relate structure and function."

Wei-Shou Hu, associate professor of chemical engineering and materials science, and Cheng-Cher Huang, professor of physics, have developed a way to pattern a material that will activate adhesion molecules (molecules located on cell surfaces that enable cells to bond with other cells in the body) along a laser-activated path. In this way, cells would grow only on that path.

"Perhaps one day we will be able to take a block of collagen and illuminate a holographic image of a tube, for instance, inside it," says Tirrell. "The cells would align along the image, and we'd have the scaffold for an arterial transplant."

At the same time, Professor of Chemical Engineering and Materials Science D. Fennell Evans, along with Dr. Patrick Parks and Dr. Donald Gibbons of 3M, are working to gain a better understanding of the relationship between cellular interactions, as well as how a scaffold's topology affects the way cells grow around and into it. How these scaffolds are put together—the diameter of the fibers, the spacing between them, and so on—dramatically affects the way cells interact with them.

With respect to engineered cell adhesion and growth, Department of Laboratory Medicine and Pathology Research Assistant Dan Mooradian is working on ways to treat scaffold surfaces with synthetic peptides in order to make cell adhesion possible.

"Let's say you know how to build a particular collagen scaffold, and you know the mechanical properties you want to have," says Tirrell. "While we know its geometry will encourage cells to grow in the desired pattern, this research will tell us how its surfaces should be treated to get the cells to adhere correctly."

Tirrell and Department of Chemical Engineering and Materials Science Associate Professor Robert Tranquillo, along with Department of Laboratory Medicine and Pathology Associate Professor James McCarthy, are also developing ways to measure adhesion strength.

"No one yet knows just how strong these individual cell adhesion interactions are—or should be," says Tranquillo. "We're trying to develop a means to directly measure the mechanical strength and the optimal strength of the bond. If it's too weak, the cell won't have any

The News is Out!

By Tony Carideo

Editor's Note: ***Early research by BIE investigators has caught the attention of the business world. This recent story by* Star Tribune *business columnist Tony Carideo featured Wei-Shou Hu's efforts toward liver tissue regeneration. (Reprinted with the permission of the* Star Tribune *Minneapolis-St. Paul.)***

Now *this* could be big.

A group of University of Minnesota scientists is in the final stage of animal testing of an artificial liver, a device that, if it works on humans, could be a major breakthrough in medical therapy.

The device appears to represent a significant improvement over an artificial liver that has been used on three patients by doctors at Cedars-Sinai Medical Center in Los Angeles, as well as some other technologies under development.

The University's team, headed by Physician and Surgeon Frank Cerra and Wei-Shou Hu, an associate professor of chemical engineering, has licensed rights to develop and market the device to Cellex Biosciences Inc., Coon Rapids.

Cellex plans to announce . . . that it is spinning off the venture as a privately held subsidiary called Regenerex, and that it has launched an effort to raise $3 million to $4 million in private financing.

Richard Sakowicz, Cellex's president and chief operating officer, said the financing would fund the first stage of a two-part animal study that will precede human testing. Cerra said he hoped to be ready for the first human trials in a year.

Cellex and the University aren't the only organizations in the race to produce an artificial liver. Advanced Tissue Sciences Inc., Genetic Therapy Inc., Somatix Therapy Corp., Alin Foundation Clinic, W. R. Grace & Co., and Systemix Inc. are working on research projects. Vanderbilt, Rutgers, Baylor, and Harvard also are pursuing projects.

Some of them are trying to regenerate the liver, while others are pursuing the route taken by Cedars-Sinai and Cellex and the University. That process involves marrying cell culturing techniques with hollow-fiber technologies.

"With the interdisciplinary approach we've taken at the University, we have been able to catch up with the other groups working on this and also to demonstrate higher level liver functions in animals," said Bruce Amiot, research and development director for Cellex's artificial liver project. "None of the groups so far has published similar data."

The prize is a big one. The human liver removes toxins from the blood, aids digestion, and creates clotting factors to stop bleeding. When the liver fails, toxins accumulate, causing brain swelling, coma, and death.

A safe and effective artificial liver could revolutionize the treatment of a condition that kills roughly 30,000 people a year in the United States. And it would represent a major new business for the company that brings it to market.

Sakowicz, who said Cellex will retain an equity stake in the new company, estimated that the U.S. market for the $50,000 machine that operates the artificial liver would be $300 million to $500 million a year.

"The quest for an artificial liver has lasted 30 years," said Cerra, who has specialized in conditions associated with liver failure. "Researchers have tried linking humans to baboons, humans to humans, using extraction resins, and running blood over charcoal. Nothing has worked."

Doctors at Cedars-Sinai announced last May that they had kept a woman alive for 14 hours using an artificial liver and have since used the device on two others.

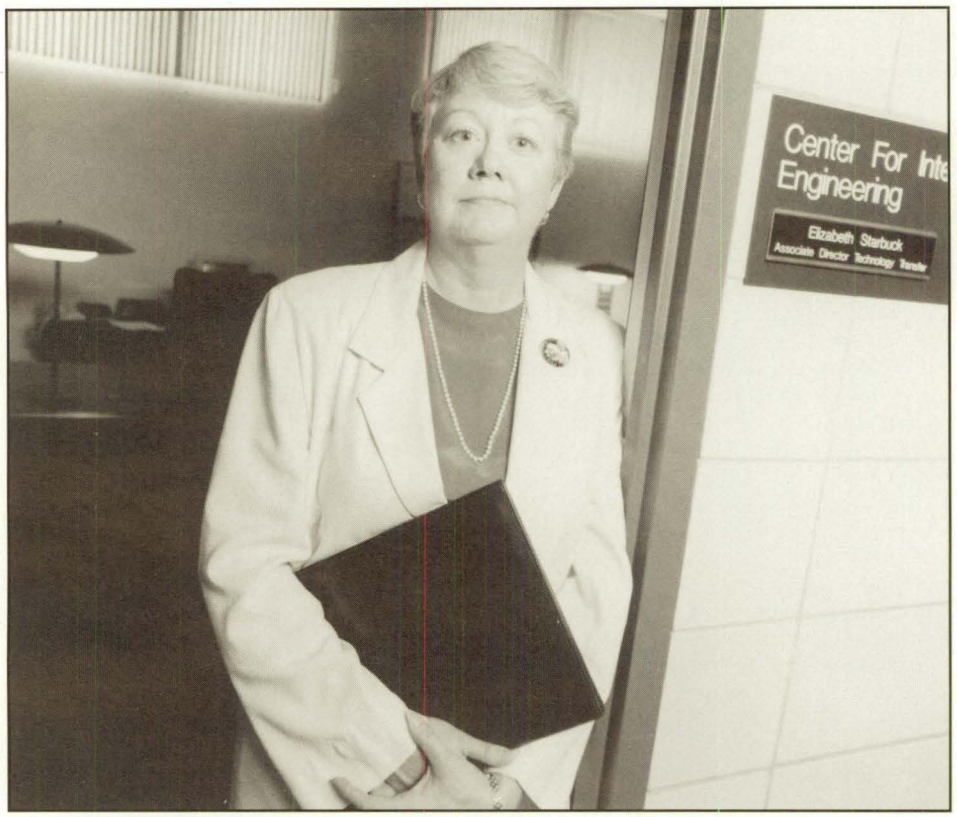
However, Amiot said that the Cedars machine is considerably more complex than the product under development at the University because it involves separating a person's blood.

Cerra said he envisions the device as a "bridge" technology, meant to help patients with a failing liver who simply need time to allow the organ to mend itself.

It would also help patients who are waiting for a liver transplant, Cerra said. "At any one time, there are 10,000 patients waiting for a liver transplant," he added.

Cerra and Hu began developing the technology about three years ago. The University's device uses a cylinder of hollow-fiber membranes filled with cultured liver cells from laboratory rats, which appear to perform the same functions as human liver cells. The artificial liver, used externally, is employed in much the same way as a kidney dialysis machine.

So far they have tested a prototype of the device on groups of rabbits and dogs, which have been kept alive without their own livers. ■



Elizabeth Starbuck, CIE associate director for technology transfer.

mobility, and it won't be able to get into the scaffold. If it's too strong, they'll all stick and jam up on the outside edges of the scaffold."

Regeneration Techniques

Researchers nationwide are primarily taking two approaches for creating and transplanting new tissues. Both use a human-engineered polymer scaffold in which donor cells from either the patient or a well matched individual are placed. In one technique, the donor cells are attached to the polymer scaffold outside of the body.

This cell-polymer device may then be implanted immediately or cultured for a few days. Ideally, once implanted, blood vessels from surrounding tissue will grow into the device and the transplanted cells will become part of the host tissue. It's by this method that replacement cartilage might be created. For example, an artificial cartilage-like scaffold would be made, injected with the patient's own cartilage cells, and then implanted. Eventually, the patient's own cells would fill in the artificial scaffold, thus replacing the damaged cartilage.

In the second regeneration technique, a polymer scaffold is transplanted into the host tissue several days before the donor cells are obtained so that blood vessels can grow into it, thus increasing the nutrient support capacity of the new host tissue. Transplant cells are then injected into the device, where their natural tendency to reform natural tissue structures can be used.

Selecting materials for such devices involves a delicate balance between bulk mechanical properties, surface chemistry, degradation properties (how the materials are broken down by the body's enzymes), and biocompatibility of degradation products.

"Because we want to mimic the natural environment of the cells," says Tirrell, "we've chosen to work with the proteins and carbohydrate polymers that are natural components of the body's extra-cellular matrix—the network of tissue, fibers, and fluid in which cells live."

The Biomedical Engineering Center in the Medical School has developed strong expertise in processing collagen—a polymer that, as previously stated, imparts strength to tissue. Staff members Fred Silver and Allison Hubble are collaborating with BIE researchers to study Type I collagen for use in scaffold devices.

Because collagen-based materials are not ideal for regeneration of all tissues, synthetic degradable polymers are also receiving increasing attention. Hu is looking at using such degradable polymers. Hu, together with researchers from the Biomedical Engineering Center, is working to better understand tissue regeneration in the liver (see "The News is Out!" p. 19). The liver's powerful regenerative capacity makes it an attractive candidate for cell transplantation because tissue could be obtained from living donors at relatively low risk, and a small amount of donor tissue could likely grow manyfold in the recipient.

Despite encouraging possibilities, regeneration of liver tissue also presents significant challenges. Liver cells are heavily vascularized (fed by many blood vessels) and need a large and constant nutrient supply. In early experiments, transplanted cells died from inadequate nutrition. Liver cells are also highly sensitive to the type of substrate to which they attach. When grown *in vitro*, they lose their liver-specific functions rapidly on most substrates, including those coated with Type I collagen.

The most promising approach to liver cell transplantation involves scaffolds made from degradable polymers. Most of the implanted cells now survive for at least a week if the polymer scaffold is implanted in the body first and blood vessels are allowed to grow into the device for several days. Long-term studies have yet to be carried out with this approach, and there are still many unresolved issues regarding interactions between the connective tissue that grows into the device and the transplanted cells.

Ultimately, however, the best materials for guiding tissue growth may be hybrids of synthetic polymers with specific adhesion receptors attached. "With such materials," says Tirrell, "we can exploit recent discoveries about how cells recognize extra-cellular matrix molecules."

Making these new tissue regeneration and transplantation techniques effective requires solving complex biological, engineering, and manufacturing problems. And that demands access to knowledge from many fields.

A Collaborative Effort

In the five years since its inception, CIE has successfully wedded basic research, graduate and post-doctorate education, and industry collaboration.

"The intent of such collaborations is to foster cross-disciplinary research in thematic areas that have been identified as having long-term, critical importance in economic development in the U.S., while, at the same time, bringing industries and University researchers closer together," says Elizabeth Starbuck, Ph.D. and CIE's associate director for technology transfer.

"University researchers are often unfamiliar with the activities of a specific com-

pany, and companies are likewise uninformed about faculty research," Starbuck continues. "At CIE, both sides talk about what they do and why. If they find mutual interests, they look for ways to complement and help one another in that area while protecting their respective interests."

The University's interests, according to Starbuck, are educating students and maintaining open publication. Companies want to develop products individually and maintain their proprietary interests in order to earn a profit. So how can the University and competing companies work together?

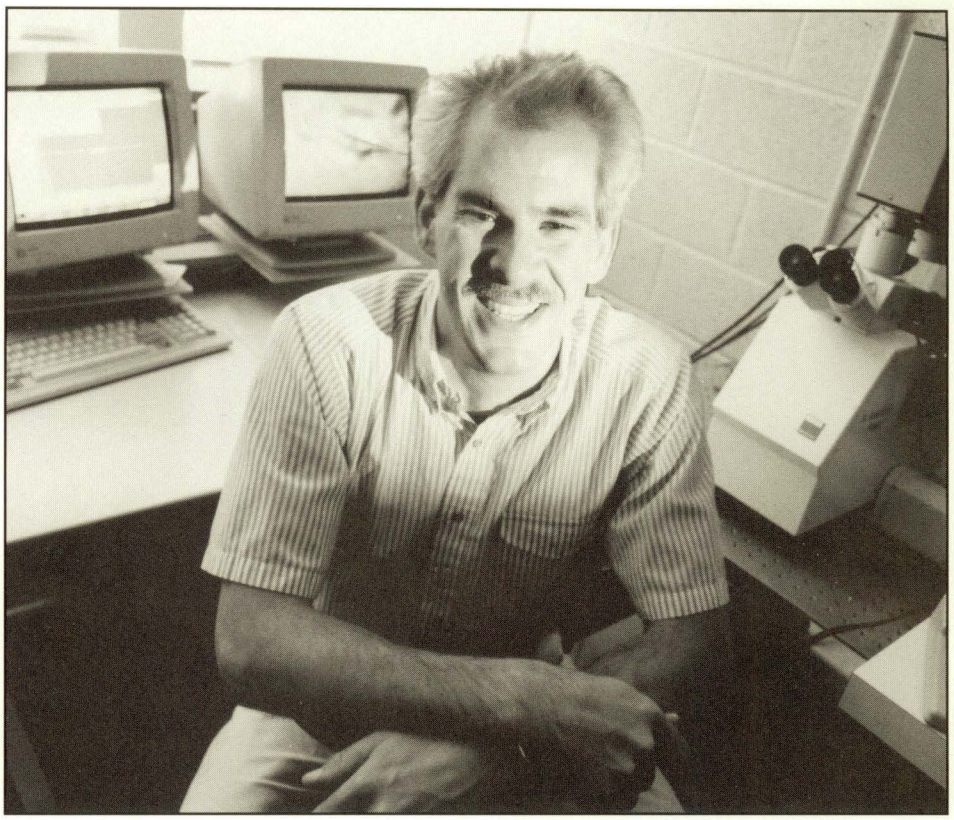
"We have negotiated agreements that allow both sides to accomplish their respective goals," says Starbuck, "which means we do research that is generic, precompetitive, and non-proprietary. This is research that a group of competing companies feel they can share because the discoveries will belong to everyone involved—basic information that may eventually develop into competitive products." In other words, Starbuck adds, the work done at BIE is at the early stage of innovation—*before* the need for secrecy or proprietary rights arises.

"This arrangement is very important because it's a way for companies to work together with the University without fearing that some information jointly developed would later find its way to a competitor," Starbuck says. "This is a big change for both companies and the University—one that opens a new realm of possibilities for all involved."

For the University, the biomedical industry's involvement in BIE as collaborators and partners provides access to expertise, materials, and clinical trials and equipment, as well as graduate student mentoring. Exposure to industrial researchers and their work, however, is not the only benefit to students.

"Each of BIE's collaborative projects is centered around the thesis research of a graduate student," says Tranquillo. "More money from both University and non-University sources is being targeted at biomedical research, and the vehicle for getting it to IT has been BIE. That money has all gone to creating these new seed projects. That allows us to fund more graduate students and post docs in their research efforts. No supply monies go to individual faculty members."

Because the seed projects are distinct, yet complementary, they have created much more interaction between University investigators—a result about which Tranquillo and others are excited. "We've all become much more familiar with one another's work, and our focus is broadening as a result," he says. "There's more dialog about ideas and more cooperation, and we're finding better ways to share information and equipment.



Robert Tranquillo, associate professor of chemical engineering and materials science.

"Perhaps most importantly, because we're in closer contact with one another through BIE," Tranquillo continues, "we're able to pursue new joint projects in biointerfacial phenomena that we hadn't thought of before. The program both motivated and allowed us to pursue them. It's very exciting."

"These seed projects also are helping us build more cooperation between BIE and the Biomedical Engineering Center," says Tirrell.

Likewise, industry is benefitting from the collaborative effort. "Our partnership allows us to explore problems we need to understand," says Patrick Parks, M.D., Ph.D., a former industrial fellow who works in the Biosciences Division at 3M. "It's very basic research that 3M wouldn't do itself, but the knowledge we are gaining will likely be applicable to areas in which 3M has interests."

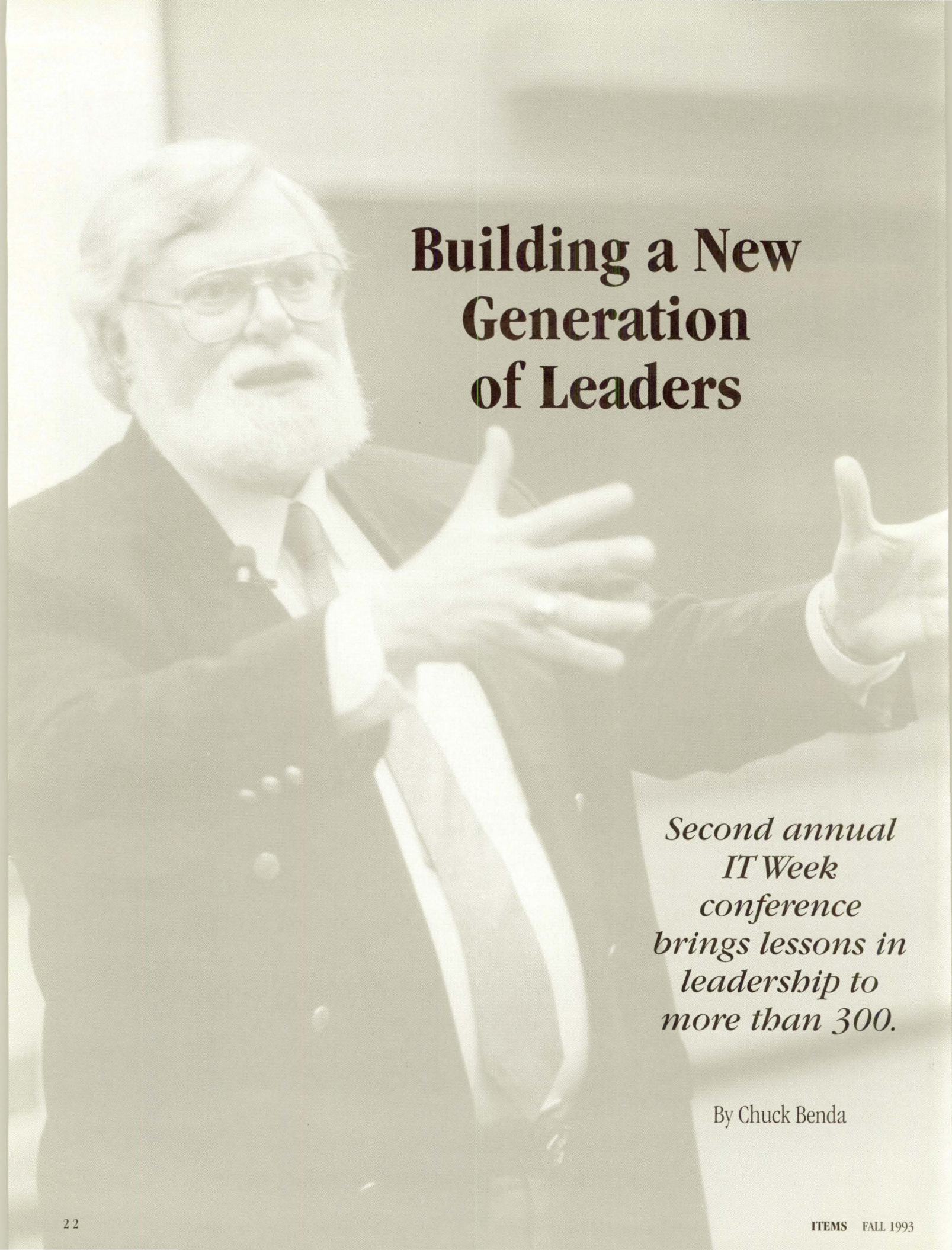
Other cooperating companies involved with BIE include Augustine Medical, Avecor Cardiovascular, Bio-Metric Systems, Flexmedics, Medtronic, St. Jude Medical, Orthomet, Possis Medical, and Spectrum Diagnostics.

To further strengthen the University's collaborative efforts with industry and structure BIE's research program to complement University interests, BIE is proposing to expand its Industrial Fellows Program to tissue engineering technology. In this program, two to six fellows would spend a minimum of three months pursuing a research plan determined by University staff and industrial researchers. According to Tirrell, the program serves as a way to transfer research results to industry, as an educational vehicle for industrial practitioners, and as a catalyst in educating and assisting the biomedical industry on the technological information required to enter this new field.

"In addition, the Fellows Program broadens our students' educational experiences by exposing them to new ideas in tissue engineering and to industrial research techniques, motivations, and constraints," says Tirrell.

This University-government-industry consortium has created not only a cultural change at the University, but a well defined area of expertise among other universities, according to Starbuck.

"CIE is one of only 18 engineering research centers in the country, and each has a different area of focus," she says. "Ours is in this area of interfacial studies. The University of Minnesota is now the place to go in the country for this dynamic new field of study—one that has the potential to dramatically improve the lives of countless people." I



Building a New Generation of Leaders

Second annual IT Week conference brings lessons in leadership to more than 300.

By Chuck Benda

Patrick O'Leary

Fidelis N. Umeh (1965 Electrical), president of SEI Technology Information, answered questions after serving as one of the presenters for the session titled "The Vision Thing."

Left: **Robert W. Terry, president of the Terry Group, presenter for one of the 12 sessions, "The Upside Down Organization."**

By the time the 1993 IT Week Leadership in a Technological World Conference was half over on May 6, Larry Koenig (1967 Civil) decided he had already gotten his money's worth.

"The morning sessions fulfilled my expectations completely," says Koenig of Elk River Concrete Products, "and I'm looking forward to the afternoon sessions on team building."

IT's second annual conference—the second in an annual series of workshops designed to bring timely career topics to IT alumni—featured 22 state and national corporate leaders. Among them were opening speaker Michael Bonsignore, chair and CEO of Honeywell Inc. (see "Global Leadership in a Technological World," p. 6), and luncheon speaker Michelle Brekke (1975 Aerospace, M.S. 1977), assistant manager of space shuttle programs for NASA. These corporate leaders shared management techniques and personal experiences in the art and science of leadership through 12 one-hour-and-15-minute sessions. The 12 sessions were divided into three tracks: Leadership Skills, Lessons Learned, and Empowerment Strategies.

The Lessons Learned session, titled "The Role of Information Technology," was led by Donald F. Wright (1957 Mechanical), senior vice president for The Times Mirror Company, and Thomas G. Kamp (1949 Electrical), founder of Magnetic Peripherals, Inc., Disk Media, Inc., Peripheral Components, Inc., and Premier Computer. Wright focused on the rapidly changing field of information technologies and how leaders in the industry need to plan for and appropriately direct these changes.

"The essence of planning is recognizing the inevitable, which is not always very obvious," Wright says. According to Wright, industry leaders have a very poor track record at predicting change in information technologies, having predicted many things that never came to pass (such as video text systems replacing newsprint) and totally missing the big changes that did take place (such as cellular phones, personal computers, and VCRs).

Although these rapid technological changes offer numerous business opportunities according to Wright, sorting through all of the possibilities and determining which are practical to exploit requires both experience and leadership.

"Experience grows out of failure or, more precisely, out of learning from failure," Wright says. "That's why good leadership requires not only strong vision, but a tolerance of and room for failure."

Session three of the Empowerment Strategies track, titled "Ownership—Building It and Taking It," was presented by Edson Williams (1950 Mechanical), retired group vice president of Diversified Product Operations for Ford Motor Company (See "Still Motorin,'" p. 36). Williams detailed how Ford adopted a new approach to building cars in 1982, one that shifted the focus to continually improving quality. He explained Ford's definition of improving quality as reducing the number of "things gone wrong" (i.e., defects that require customers to return their cars to the dealers) and increasing the number of "things gone right" (i.e., the features that customers like about their cars).

"I really appreciated Williams' insights," says Thomas Suter of Network Systems, Inc. "Our company is going through a similar restructuring and is placing a greater emphasis on these types of things."

John McLaughlin who works at Honeywell, concurs. "Ford's experience is quite germane to Honeywell, which also had to 'reinvent' itself to stay competitive."

Occasionally, conference participants found themselves disagreeing with the presenters, which helped solidify the type of leadership style most appropriate in their own companies. Robert Fehr (1970 Mechanical) of Optics Technology Center at 3M, for example, contrasted the leadership styles of Kamp with that of Fidelis Umeh (1965 Electrical), president of SEI Information Technology. Umeh, who was a presenter in the Leadership Skills session, "The Vision Thing," seems to have a more personal, one-on-one style, according to Fehr, while Kamp's style is more formalized.

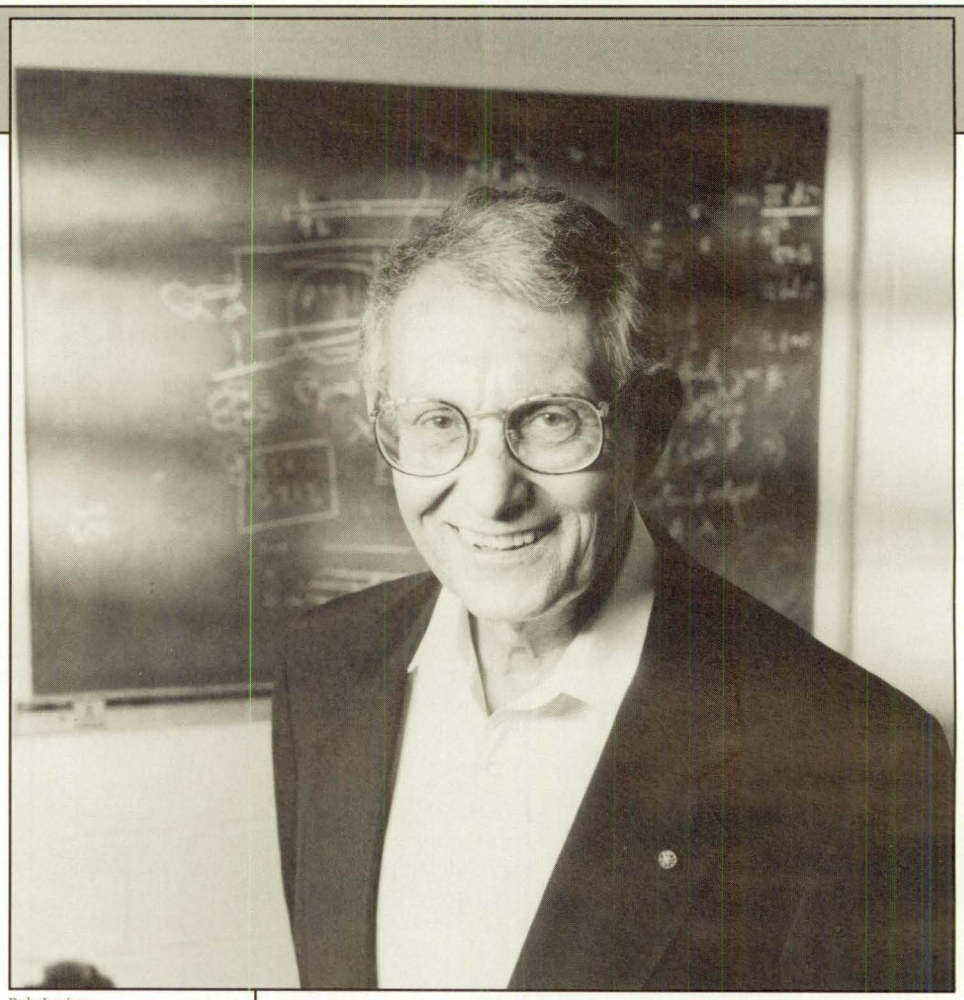
"Kamp's approach might work better for the firm as a whole, while Umeh's could be used at the departmental level," Fehr suggested.

Regardless of their perspectives, however, the participants agreed that the conference provided them with new ideas and techniques they could readily apply on the job.

"These conferences are excellent," said one person following the conference. "They deal with the real issues we're facing right now. This is the sort of thing that engineers need to know, but don't always get in the classroom." I

FACULTY

Joseph Achieves Rare Triple Crown



Rob Levine

Daniel D. Joseph, Russell J. Penrose Professor of Aerospace Engineering and Mechanics.

In April, Daniel D. Joseph—IT's Russell J. Penrose Professor of Aerospace Engineering and Mechanics—was elected to the prestigious American Academy of Arts and Sciences. Joseph, who had been previously elected to the National Academy of Engineering and the National Academy of Sciences, thus became the only University of Minnesota faculty member ever to be so honored by all three academies.

Although Joseph's research specialty can be succinctly summarized as "fluid mechanics," his long and productive research and teaching career transcends cursory summations. He first became well known for purely theoretical works grounded in mathematical analysis. In the middle of his career, however, he established a laboratory—an accomplishment that he regards as his crowning achievement.

The Academies agree. The Engineering Academy cited Joseph for "conducting novel and ingenious experiments in fluid mechanics," and the Science Academy citation reads, "Joseph has set the mathematical foundations of the fluid dynamics of viscoelastic fluids. His theoretical framework and elegant experiments have stimulated a generation of workers."

Joseph's research efforts have led to breakthroughs in the transport of heavy crude oils through pipelines and to the stabilization of the flight of liquid-filled spinning artillery shells. His current research activities, which include continued efforts to develop more efficient and effective means of piping heavy crude oil, demonstrate the ongoing breadth and depth of his interests.

Many of the Western Hemisphere's oil deposits are in the form of a very thick, viscous form of crude oil that cannot be readily transported through pipelines and, thus, oftentimes remain untapped for economic reasons.

Joseph and his colleagues have developed a method of mixing this crude with water in such a way that the water travels along the pipeline and the oil travels within a sheath of water, thus reducing the friction—in some cases, 10,000-fold. Joseph and his techniques were recently featured on CNN's "Science and Technology" news program.

Even when mixed with water, however, these heavy crude oils can eventually clog the pipelines as globs of oil break free and attach to the sides of the pipeline. To combat this problem, Joseph has developed test pipelines in which the inside is coated with various types of cement. The cement (when moistened) has a greater affinity for water than oil and in tests in a Venezuelan pipeline, the cement coating appears to eliminate the clogging problems.

Joseph is also using fluid mechanics to help extract more oil from existing reservoirs. One technique for doing this is to open up cracks in the reservoirs so that the oil can flow out. This is done by injecting solid particles suspended in liquid into the cracks so that they are well placed to keep the cracks open after the fracturing fluid is withdrawn.

In addition to research, Joseph has had an unusually productive career in terms of innovation and publication. He has written six books, holds three patents, and has two patents pending. He has published more than 200 articles in professional journals, frequently with both undergraduate and graduate students as co-authors. ("It's a good way to introduce students to the professional life," Joseph says, "and recognize the contributions they make.") He has edited four books and serves as an associate editor of six professional journals. He has served as a visiting professor at universities around the world and has won numerous awards for his research, including a Distinguished Service Award from the U.S. Army and the 1993 Bingham Medal from the Society for Rheology (to be awarded in October).

Ironically, Joseph wasn't attracted to engineering until he was in his late twenties. A native of Chicago, Ill., he began his academic career in sociology, earning a master's degree from the University of Chicago in 1950. During the next several years he worked as a semi-skilled machinist in different factories.

"In those days, I was a flaming radical motivated by some mix of idealism and stupidity," Joseph says. "I suppose the

gradual realization that there was more stupidity than idealism involved led me to conclude that sociology was not my strong suit. Besides, sociology, unlike engineering, is a subject about which ordinary people think they have expert opinions, leading to a certain lack of respect."

Joseph's work as a machinist, however, sharpened his interest in engineering. He returned to school at the Illinois Institute of Technology, earning his bachelor's degree in mechanical engineering in 1959, his master's degree in mechanics in 1960, and his Ph.D. degree in mechanical engineering in 1963. Joseph served one year as an assistant professor of mechanical engineering at the Illinois Institute of Technology before joining IT in 1963 as an assistant professor of aerospace engineering and mechanics.

> *I have had wonderful students through the years. They're comparable to the best at any institution. They're energetic and intelligent and, with the training we give them, they do their jobs in the laboratory as well as a professor could.*

Joseph's career flourished at IT. In 1965, he was named an associate professor and, in 1968, a full professor. In 1991, he was named to the Penrose Professorship.

Throughout his career, Joseph has strongly valued and readily acknowledged the contribution of both graduate and undergraduate students to his research efforts. "I have had wonderful students through the years," Joseph says. "They're comparable to the best at any institution. They're energetic and intelligent and, with the training we give them, they do their jobs in the laboratory as well as a professor could.

"The laboratory presents an exceptional opportunity for undergraduate students," Joseph continues. "They get to work on active, live research projects immediately without waiting to complete years of training. And, we get really valuable research work from an extremely dedicated and talented group of people who are working at apprentice wages hugely below what they will later get.

"These people make great contributions to our communal life. After they graduate, they work as engineers, professors, department chairmen, deans, and venture capitalists. One of my former students, Wendell Hung (1976 Aerospace, Ph.D.), is a founder and CEO of DELTAK of Plymouth, Minn. His company manufactures equipment to salvage waste heat and has gross revenues of $80 million per year. The *Minnesota Corporate Report* named Hung's company among the five fastest growing companies in Minnesota.

"Another student, C. C. Shir (1968 Aerospace, Ph.D.), is a founder and vice president of Komag, which manufactures thin film parts for high-performance disk drives. The company has gross revenues of more than $200 million a year and is listed on the NASDAQ Exchange. In 1988, Komag's product was named as one of the 100 best products made in America by *Fortune Magazine*. Shir says that he used the fluid dynamics theory in his master's thesis to solve a problem that made his company possible. Shir had a co-founder, Tu Chen (1967 Materials Science Ph.D.), who completed his doctoral studies with Dr. Sivertsen.

"These businessmen all came from Taiwan. They are modern-day examples of how the opportunities we give to talented and hard-working immigrants enrich our state and nation. And, the funding agencies that support this work are getting good value for their money, so everyone is a winner."

Similarly, the oil companies may not be the only "winners" when it comes to Joseph's current research on the transport of heavy crude oil. Recently, a candy manufacturer has become interested in Joseph's techniques for lubricating one fluid with the addition of another. After reading Joseph's papers on lubricated pipe lining, a representative came to him with the idea that you could extrude molten caramel or chocolate in a similar fashion and then freeze it to get a nice stick of hard candy in a continuous operation. And, the Gillette Company is hoping that Joseph can help them eliminate the messy blob that occurs all too frequently when writing with a ball-point pen.

Isn't this sort of superfluous research for a man who wears what might be called the academic triple crown? Not the way Joseph sees it.

"We all like to do research that helps us understand things without regard to whether or not it can be applied," he says. "In some cases, such 'Ivory Tower' research pays off; most often it doesn't. If such research was stopped altogether, we would be in deep trouble. But, we professors do have an obligation to think long and hard about what we are really contributing. Some of us—me included—are just more comfortable with research goals in which practical applications can be clearly perceived." I

By Chuck Benda

Agricultural

Mrinal Bhattacharya was promoted to associate professor with tenure, effective July 1. Associate Professor ***Chuck Clanton*** was recently appointed to the Minnesota Board of Architecture, Engineering, Land Surveying, Landscape Architecture and Interior Design by Minnesota Governor Arne Carlson. This board oversees the registration and licensure of architects and engineers in the State of Minnesota. ***Kevin A. Janni*** was promoted to professor and ***William Wilcke*** was promoted to associate professor with tenure, both effective July 1.

Chemical

Professor ***Frank Bates*** received the George Taylor Distinguished Research Award along with Professor **Tim Lodge** from the Chemistry Department. Professor **Edward Cussler** is vice president and president-elect of the American Institute of Chemical Engineers (AIChE). With 57,000 members, AIChE is the principal professional organization for chemical engineers. Assistant Professor ***Prodromos Daoutidis*** received a $20,000 grant from the Petroleum Research Fund of the American Chemical Society for a research project titled "Nonlinear Multivariable Control Methods for Chemical Processes." Assistant Professor ***Jeffrey Derby*** has been appointed director of the Fellows Program for the University of Minnesota Army High Performance Computing Research Center. Derby, who has presented several invited lectures in recent months, also received the American Association for Crystal Growth Young Author Award. Assistant Professor ***Lorraine Francis*** received a McKnight Professorship. This two-year, $33,000 award for selected junior faculty members will support

her research on ceramics processing. Professor ***William Gerberich*** has been elected vice chair of the board of directors for the Institute of Mechanics and Materials at the University of California at San Diego. Gerberich recently received a $70,000 grant renewal from the Department of Energy to study ductile-brittle transition in single and poly crystals and a $98,000 grant renewal from the Office of Naval Research to study fatigue initiation in aggressive environments. Assistant Professor ***Alon McCormick*** received the 1993 Union Carbide Innovation Award. This award comes with a $10,000 research grant. ***Lanny Schmidt*** has been appointed as an Institute of Technology Professor. These professorships were established to recognize distinguished faculty members within the Institute who are judge to be exceptional through (1) their unusual efforts in and contributions to teaching, (2) reputation in the scholarly field, and (3) a genuine commitment to the Institute of Technology and its activities. The professorship is accompanied by a one-time award of $15,000 to be used for professional development or research. Regents' Professor ***L. E. (Skip) Scriven*** recently presented the Pigford Memorial Lecture at the University of Delaware, as well as an invited lecture on the evolution of chemical engineering to the Department of Chemical Engineering and the Department of the History of Science at the University of Pennsylvania. Scriven also made invited presentations on coating process fundamentals at several locations around the world. Professors ***William H. Smyrl*** and ***Lanny Schmidt,*** Adjunct Professor ***Boone B. Owens***, and Research Associate ***Radoslav Atanasoski*** received a $250,000 award from the Department of Energy, Office of Energy Research, for studies of interrelation materials for high-energy electrochemical cells. Associate Professor ***Friedrich Srienc*** received a $140,000 award from the Midwest Plant Biotechnology Consortium to study biopolymer syntheses in yeast and plant cells. Srienc also received a $25,000 equipment grant from the National Science Foundation that enabled him to purchase an elutriation centrifuge. ***Robert Tranquillo*** was promoted to associate professor.

Civil and Mineral

Professor ***Roger E. A. Arndt***, St. Anthony Falls Hydraulic Laboratory, received the Fluids Engineering Award from the American Society of Mechanical Engineers. The award will be presented at the ASME Winter Annual Meeting in New Orleans, November 28-December 3, 1993. Associate Professor ***John Gulliver*** was selected as a member of the Organizing Committee for the Symposium on Leading Edge Technology in Hydropower. Gulliver is also chair of the American Society of Civil Engineers' Hydraulics Division Task Committee on Water Quality Enhancement Technology for Surface Waters and a member of the Steering Committee for the HydroVision '94 Conference. Professor ***Heinz Stefan***, St. Anthony Falls Hydraulic Laboratory, delivered a plenary lecture on climate change effects on lake and stream water quality at the International Conference on Hydro-Science and Engineering in Washington, D.C., June 7-11, 1993. Individuals from more than 30 countries attended the conference.

Earth Sciences

Subir K. Banerjee, professor and director of the Institute for Rock Magnetism, spent part of his sabbatical leave (1992-93) on a second tour of duty in Indian research institutes as a consultant to the United Nations' Development Program. Banerjee visited the National Geophysical Research Institute in Hyderabad and the National Institute of Oceanography in Goa. He also gave invited lectures in the Peoples' Republic of China on the magnetic proxy records of climatic changes. He completed successful negotiations for continued collaborative research efforts between Chinese institutions and the Institute for Rock Magnetism. ***Priscilla Grew***, professor and director of the Minnesota Geological Survey, left the Geological Survey in August for a position as vice chancellor for research at the University of Nebraska—Lincoln. ***David Southwick***, adjunct professor and assistant director of the Geological Survey will serve as interim director. ***Peter J. Hudleston***, professor and head of the N. H. Winchell School of Earth Sciences, was named the 1993 Joubin James Lecturer by the University of Toronto. Hudleston will present four lectures on Archean tectonics, folding, shear zones, and structures in ice at the St. George and Erindale campuses of that university. Hudleston is stepping down as head of Earth Sciences to refocus his efforts on teaching and research. Associate Professor of Geology and Geophysics ***Shun-ichiro Karato*** was invited to speak at the University of Bayreuth and the University of Potsdam in Germany and to discuss joint research projects on microstructural development during phase transformations. Karato was also invited to speak at the Ocean Research Institute at the University of Tokyo. ***G. B. Morey***, professor and associate director of the Minnesota Geological Survey, served as treasurer of the Organizing Committee for the 39th Annual Institute on Lake Superior Geology, held in Eveleth, Minn, in May. Morey helped members of the Mesabi Range Geological Society prepare a guide for a major field trip to the taconite operations of the Eveleth mines and the LTV Stell Mining Company at Hoyt Lakes and Dunka River. ***Mark Person*** joined the School of Earth Sciences in April as an assistant professor of hydrogeology and was appointed as the first holder of the George and Orpha Gibson Endowed Faculty Chair. ***Joseph Shapiro***, professor and associate director of the Limnological Research Center, delivered a series of invited lectures in Australia during August, including the plenary lecture at the Royal Australian Chemical Society in Perth, Australia. Regents' Professor Emeritus ***Herbert E. Wright, Jr.***, received the 1993 Fryxell Award from the Society for American Archaeology "in recognition of interdisciplinary excellence in the study of the relationship between the Earth's Quater-nary history and human be-havior." ***David Yuen***, supercomputer fellow and professor of geology and geophysics, was invited to a multi-disciplinary workshop in Hakata, Japan, in March 1993. He lectured at the Earthquake Research Institution, the University of Tokyo, and Hiroshima University. Yuen also reports that researchers/collaborators from the University of Minnesota swept the video contest held by the American Geophysical Union at its May meeting. The first three prizes all went to Minnesota entries.

Electrical

Associate Professor ***Stephen Y. Chou*** and his research group have invented and demonstrated a new semiconductor transistor that uses only a single electron to do switching. This single-electron transistor has much better performance than previous devices. The group has also demonstrated the fastest single crystal silicon photodetector reported to date. The detector has a band width of 110 GHz. Professor Emeritus ***Robert J.***

Collins retired in June after 30 years in the department. During that time, Collins served two terms as department head. Faculty members of the Signal Processing Group, ***M. Kaveh, K. Buckley, K. Parhi, A. Tewfik, G. Sobelman,*** and ***L. Lucke***, were the principal organizing committee members for the 1993 IEEE International Conference on Acoustics, Speech, and Signal Processing, held April 27-30, 1993, in Minneapolis. More than 2,500 delegates and exhibitors attended the conference. Professor ***E. B. Lee*** received an award from the National Science Foundation in June 1993 for control of distributed and hereditary systems. Professor ***Ned Mohan*** was selected as the first holder of the Oscar A. Schott Professorship in Electrical Engineering. Assistant Professor ***Jay Moon*** recently received two research awards: one for development of advance read channel from Seagate Technology Corp. and another for ultra-high density disk signal processing from NSIC/ARPA. Associate Professor ***Keshab K. Parhi*** received the Guillemin-Caver Award from the IEEE Circuits and Systems Society. Parhi received the award for the best paper published on circuits and systems during the last two years in *IEEE Transactions.* Parhi's paper was titled "Systematic Synthesis of DSP Data Format Converters Using Life-Time Analysis and Forward-Backward Register Allocation." Assistant Professor ***J. G. Zhu*** received four prestigious awards in 1993: the National Science Foundation Young Investigator Award, the McKnight Land Grant Professorship, the IBM Faculty Development Award, and the 3M Non-tenured Faculty Development Award.

Mechanical

Professor ***Avram Bar-Cohen*** recently received the Dedicated Service Award from the American Society of Mechanical Engineers. Assistant Professor ***Saifallah Benjaafar*** received the Research Initiation Award from the National Science Foundation (NSF) in August 1993. The award includes a $100,000 grant from NSF and a $10,000 matching grant from the University of Minnesota. The award will support Benjaafar's work on flexible manufacturing systems. Associate Professor ***Kevin J. Dooley*** received a $10,00 grant from 3M for his research on process knowledge gases. Regents' Professor Emeritus ***E. Eckert*** received the Centennial Medallion from the American Society of Engineering Education on June 22, 1993. ***Richard J. Goldstein***, regents' professor and department head, was elected chair of the Executive Committee of the International Center for Heat and Mass Transfer, 1993-94. He was also elected to the board of governors of the American Society of Mechanical Engineers for a three-year term, beginning in June 1993. Goldstein recently presented a series of lectures on heat transfer and flow studies related to cooling of high-temperature gas turbines at the Institute of Aeronautics and Astronautics, National Cheng Kung University, Tainan, Taiwan. Professor ***Warren E. Ibele*** was recently named an Institute of Technology Professor. The IT Professorships were established to "recognize distinguished faculty members within the Institute who are judged to be exceptional through (1) their unusual efforts in and contributions to teaching, (2) a reputation in the scholarly field, and (3) a genuine commitment to the Institute of Technology and its activities. Professor ***Benjamin Y. H. Liu*** was named a regents' professor in June 1993. The regents' professorship serves as the highest recognition for excellence given by the University of Minnesota through especially distinguished accomplishments in teaching and scholarship or creative work and contributions to the public good. Assistant Professor ***Susan C. Mantell*** was named Young Mechanical Engineer of the Year 1992 by the Minnesota Section of the American Society of Mechanical Engineers at the February 26, 1993, Annual Awards Banquet. The award is based on excellent credentials in four areas: technical achievements, community affairs, technical society contributions, and publications. Professor ***Ephraim M. Sparrow*** received the Horace T. Morse-Minnesota Alumni Association Award 1992-93. The award, which carries a stipend of $2,500 per year for three years, is for outstanding contributions to undergraduate education. Sparrow was also given the 1993 Best Instructor Award in Mechanical Engineering by the IT Student Board. In June, ***Paul J. Strykowski*** received the Taylor Career Development Award for 1993 from the IT Promotion and Tenure Advisory Committee. The award carries a one-time grant of $10,000 to enhance professional development in teaching and research and is meant to recognize exceptional contributions to teaching by a candidate for tenure during the candidate's probationary period. Strykowski has been promoted to associate professor with tenure, effective September 16, 1993. ***Kumar K. Tamma*** has been promoted to full professor effective September 16, 1993. ***Glenn Vinnicombe*** joined the department as an assistant professor on March 16, 1993, after receiving his Ph.D. degree from Cambridge University in the United Kingdom.

IT DONOR PROFILE

Bonestroo, Rosene, Anderlik & Associates

The Firm:
Located in St. Paul, Minn., Bonestroo, Rosene, Anderlik & Associates is a consulting engineering firm that specializes in a broad range of municipal engineering projects. Otto Bonestroo (1949 Civil; 1950 M.S.) founded the firm in 1956, and later brought in Robert Rosene (1945 Civil) and Joseph Anderlik as partners. The firm employs 166 people, generates $100 million in annual revenues, and has won several awards from the Consulting Engineers Council of Minnesota, including two Grand Awards in Engineering Excellence.

Recent Gift:
Each partner contributed $20,000 (even though Anderlik is not an IT graduate) to establish the Bonestroo, Rosene, Anderlik & Associates Undergraduate Scholarship and Faculty Award Endowment. Today, the endowment generates enough interest income each year to fund an undergraduate scholarship for an outstanding civil engineering student and an award to an outstanding faculty member.

Quote:
"The Institute of Technology does an excellent job of preparing people for their careers. The students they train contribute a great deal to the economy in this state."

Otto Bonestroo

Standing: Otto Bonestroo
Seated (left to right): Robert Rosene and Joseph Anderlik

Photo by Rob Levine

ALUMNI

1927

Harold T. Pearson (*Civil*) is retired from Paper Calmenson Co. He lives in Valencia, Calif.

1932

Arno R. Schwantes (*Agricultural*) retired from Minnesota & Ontario Paper (now Boise-Cascade), where he worked as an engineer. He lives in Stillwater, Minn.

1933

Leon J. Berman (*Aeronautical*) retired in 1976 from Hughes Aircraft, where he was a member of the technical staff. He lives in Culver City, Calif.

1934

Edwin C. Fremo *(Electrical)* retired from San Diego Gas & Electric Co., where he worked as a supervisor. He lives in La Mesa, Calif.

1935

Lester A. Malkerson (*Agricultural*) founded Malkerson Motors in Shakopee, Minn., where he still lives. He is now retired. **Neil A. Nelson (*Electrical*)** retired from the U.S. Air Force, where he worked as a supervisor in avionics engineering. He lives in Kettering, Ohio. **William W. Prichard (*Chemistry, 1939 Ph.D.*)** retired from E. I. Dupont, where he worked as a scientist. He lives in Hockessin, Del.

1936

Thomas E. Cooper (*Mechanical*) retired from Northwest Airlines, where he worked as an engineer and a supervisor. He lives in Edina, Minn. **Marvin W. Formo (*Chemistry*)** received his doctorate degree from Cornell University. He worked at Cargill, Inc. until he retired and now serves as a consultant. He lives in Edina, Minn. **Richard C. Poucher (*Mechanical*)** retired as a sales engineer. He lives in Santa Ana, Calif.

1937

Henry G. Lykken, Jr. (*Mechanical; Business*), retired as CEO of Roart Plastics. He formerly served as vice president of Apache Corporation and worked for 15 years at Honeywell. Lykken lives in Ponte Vedra Beach, Fla. **Harold R. Norton (*Civil*)** worked as an engineer for the U.S. Government until his retirement. He lives in Montgomery, Ala.

1938

Alfred A. Anderson (*Mechanical*) is retired and living in LaValle, Wis. **William M. Podas (*Chemical*)** retired from Ecolab, Inc., where he served as vice president. He lives in St. Paul, Minn.

1939

James L. Parsons (*Mechanical*) received his master's degree from West Virginia University. He retired from E. I. Dupont, where he worked as a manager. He lives in Wilmington, Del.

1940

Svend A. Bang (*Civil*) retired from 3M, where he worked as a manager. He lives in St. Paul, Minn. **Carl G. Beck (*Electrical*)** retired from Raytheon Co. as a software engineer. He lives in Grand Marais, Minn.

1941

Robert W. Lundy (*Aeronautical*) retired from Flight Simulation as an engineer. He now works as a consultant and lives in Los Altos, Calif. **John H. Schneider (*Aeronautical*)** is the chief executive officer for JSA Inc. He lives in Mequon, Wis. **Kenneth K. Susie (*Chemical*)** retired from National Rivet & Mfg. Co., where he served as vice-president. He lives in Waupun, Wis. **Gerald H. Syrovy (*Mechanical*)** retired in 1979 from Hughes Aircraft Co., where he worked as an engineer. He lives in Santa Monica, Calif. **Leonard C. Wilson (*Agricultural*)** was the owner of Wilson Implement Co. until his retirement. He lives in Rice Lake, Wis.

1942

Floyd H. Sandstrom (*Civil*) retired from Boise-Cascade Corp., where he worked as a regional sales manager. He lives in Ann Arbor, Mich. **A. T. Sutor (*Chemical*)** received his master's degree from the Case Institute of Technology. He retired from Rockwell Intl., where he worked as an engineer. He lives in Woodland Hills, Calif. **Bernard T. Svihel (*Electrical*)** received his master's degree from the Massachusetts Institute of Technology. He is a professor at Drexel University and lives in Philadelphia, Pa.

1943

Robert Abrohams (*Chemical*) has been an insurance agent since 1954 and now serves as an independent contractor. He lives in St. Louis Park, Minn. **Stanley Anonsen (*Chemical*)** worked as a chemist on the A-bomb project while at Mallinckrodt Chemical, Inc. He served as president and COO before leaving to become a director at another chemical company. He is now retired and lives in Sarasota, Fla. **Robert Berg (*Chemical*)** is founder and president of several particle data companies. He holds about 20 patents and lives in Elmhurst, Ill. **Lee Berlin (*Chemical*)** worked for 3M for 37 years in marketing, technical services, and as vice president of foreign ventures. He is currently founder and chair of Lectec Corp. and lives in Minnetonka, Minn. **H. James Boyd (*Electrical*)** retired from United Telephone, where he worked as a manager. He lives in Alexandria, Minn. **Bernard I. Bratter (*Chemical*)** managed a DDT production plant for 34 years. In the last 10 years, he has been a consultant in chemical manufacturing and hazardous waste. He lives in Encino, Calif. **Harry E. Connors (*Chemical*)** began his career with B. F. Goodrich and then went to Diamond-Shamrock Plastics, where he served as vice president, general manager, and president. He lives in Aurora, Ohio. **George W. Fernald (*Electrical*)** worked as chief of electrical design. He is now retired and lives in College Place, Wash. **C. Dudley Fitz (*Mechanical, 1946 M.S., 1954, Ph.D.*)** retired from the Fitz Co., where he served as vice president. He now lives in Mound, Minn. **Donald A. Franke (*Electrical*)** worked as a manager at General Electric Co. until his retirement. He lives in Schenectady, N.Y. **Milton Gorham (*Chemical*)** retired from petroleum research at UNOCAL. He facilitated the transition from leaded to unleaded fuel without losing quality or performance. He lives in Placentia, Calif. **Louis F. Jacobs (*Chemical*)** retired from 3M in 1980 after serving in manufacturing, engineering, and international divisions. He served as a plant manager for 3M in Venezuela for five years and now lives in New Brighton, Minn.

1944

Newman M. Bortnick *(Chemistry, Ph.D.)* retired and now serves as a consultant. He lives in Oreland, Pa. **Lynn N. Hokenson (*Mechanical*)** works as a realtor in commercial, investment, and industrial real estate. He

lives in Springfield, Ohio.

1945

Robert D. Turnacliff (*Mechanical, 1947 M.S., 1957 Ph.D.*) works for The Aerospace Corp. as an engineer. He lives in Palos Verdes Estates, Calif.

1946

Eugene J. Lenk (*Aeronautical*) was an engineer until his retirement. He lives in Shevlin, Minn.

1947

Raphael F. Aronson (*Physics*) received his doctorate degree from Harvard University. He is a professor emeritus and lives in West Orange, N.J. **Liang-run Gao (*Agricultural, M.S.*)** is a professor and advisor to presidents at the Jiangsu University of Technology in China. He lives in Zhenjiang, Jiangsu, China.

1948

Everett L. Burkholder (*Chemical*) served as a senior engineer until his retirement. He lives in St. Paul, Minn. **Edward S. Fisher (*Metallurgical*)** received his master's degree from the Illinois Institute of Technology. He retired from Argonne National Laboratories and now works as a consultant. He lives in Minnetonka, Minn. **Audun R. Fredriksen (*Chemical; Industrial Management, 1950, M.B.A*)** retired from 3M in 1981 after serving as group vice president for health care, vice president for European operations, vice president for Northern and Eastern Europe, and managing director of 3M Germany. He lives in Belvedere, Calif. **Laurence M. Thorsheim (*Electrical*)** received his master's degree from Denver University. He owned a business until he retired. He lives in Golden, Colo. **Stewart V. Wright (*Civil*)** works as an engineer at 3M. He lives in West St. Paul, Minn.

1949

William G. Chapin (*Electrical*) received his master's degree from Old Dominion University. He works as an engineer for the National Aeronautics and Space Administration (NASA) and lives in Hampton, Va. **Lee F. Hermsmeier (*Agricultural*)** received his master's degree from Iowa State University. He retired after working as an engineer and now lives in Brawley, Calif. **Rudolph W. Nelson (*Electrical*)** retired from Rockwell-Collins, where he worked as an engineer. He lives in Marion, Iowa. **Norman W. Nielsen (*Metallurgical*)** is retired from the Aluminum Company of America (ALCOA), where he served as general manager of metallurgy and quality assurance. He was also a two-time recipient of the Chairman's Award for Technical Merit. He lives in Santa Barbara, Calif. **Warren G. Selvig (*Aeronautical*)** retired from McDonnell Douglas, where he was an engineer. He lives in Cameron, Mo. **John M. Sheeks (*Civil*)** has worked for the U.S. Army Corps of Engineers, International Milling (now International Multifoods), and Krause Milling before becoming a minister. He has three children and five grandchildren and lives in Grand Junction, Colo. **Wilber T. Smith (*Electrical*)** retired as president of Smith-Owatonna Electric Inc. and now lives in Green Valley, Ariz. **Douglas G. Wolfangle (*Electrical*)** retired as a vice president. He lives in Roseville, Minn.

1950

James W. Bingham (*Geophysics*) retired from the U.S. Geological Survey, where he worked as a scientist. He lives in South Glastonbury, Conn. **Gerald G. Dongoske (*Mechanical*)** retired from TransAmerica Corp., where he worked as an engineer. He lives in Los Angeles, Calif. **Clarence H. Landgren (*Chemical, Ph.D.*)** is retired from Exxon Research & Engineering Co., where he worked as a long-

Amy Muller (1984 Chemistry, Ph.D.), distinguished member of technical staff, AT&T Bell Laboratories.

From the Lab to the Airwaves

Amy Muller received a lot of encouragement to become a scientist—from her dad, from a very inspiring high school chemistry teacher, and from IT chemistry Professor Peter Carr, her doctoral research adviser. Carr once asked Muller if he should go out and find a woman scientist to be a role model for her. To the contrary. Muller thought Carr, himself, fit the bill just fine.

"In science, women don't necessarily need other women as role models; they need good scientists," says Muller, who now serves in both capacities—as a role model and as a good scientist.

A native of Pennsylvania, Muller graduated magna cum laude in chemistry from Dartmouth College in 1978 and then worked for PPG Industries before launching into the doctoral program at IT. After completing her Ph.D. in analytical chemistry in 1984, she joined AT&T Bell Laboratories in Murray Hill, New Jersey, where she now bears the title "Distinguished Member of Technical Staff." One might add to that "teacher," "mentor," and sometimes "TV star."

In her lab, Muller develops new materials for microelectronics and telecommunication applications. Although she specializes in fiber optics and develops polymer coatings for optical

fibers, she is also known to take on more unusual research projects now and again. One such project included a study of air-born pollutants in Kuwait during the Gulf War and their effect on electronic materials and components.

For Muller, the world of research is a joy, and she spends much of her free time in the lab. "My favorite toys are here," she says. Her work, or perhaps play, doesn't stop at the laboratory door, however. Through her own efforts and company-sponsored projects, Muller constantly strives to promote a greater understanding of science and technology. "It's nice to work for a big company for that reason," she says.

> *In science, women don't necessarily need other women as role models; they need good scientists.*

Muller has organized the North Jersey Regional Science Fair for the past six years and speaks regularly at high schools, community organizations, and adult education classes on chemistry, research, and other technology-related topics. She also serves as technical advisor to the AT&T Teachers and Technology Institute and as an organizer of the AT&T Bell Labs New Jersey High School Science Teacher Workshop.

"I've also always have a teacher or two working in my lab so they can learn about industrial research and emerging technology," she says. "We hope they will return home with some new ideas for math and science curricula for their students and communities."

Muller also serves as an industrial mentor for the Semiconductor Research Corporation (SRC), which is a consortium of semiconductor manufacturers who fund university research with the goal of producing useful inventions for industry. Through SRC, academicians nationwide obtain industrial input on their research. "My role," she explains, "is to help researchers stay on track to meet the needs of the real world and industry."

Muller's projects aren't always so serious. In an April 1993 episode of "Live From Bell Labs," which aired on PBS, she proved she's willing to do whatever it takes to arouse young people's interest in science. She appeared with the comedy team of Penn & Teller, who, up to their usual tricks, set out to show what scientists "really" do in their laboratories when no one's around.

Penn & Teller put four eggs on top of four cardboard tubes. They set these on top of a tray, then put the tray on top of four glasses of water. They yanked the tray away, and the eggs landed miraculously in the four glasses of water. Muller may have nipped her comedy career in the bud, however, by quickly explaining the trick through principals of chemistry and physics. After Muller's explanation, the trick didn't seem quite so magical, and Penn & Teller vowed to avoid her assistance in the future. I

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range corporate planner. He lives in Swanville, Minn. **Jesse H. Pomroy (*Agricultural*)** is a professor emeritus at the University of Minnesota. He lives in St. Paul, Minn.

1951

Richard W. Anderson (*Mechanical*) retired from Weeres Industries Inc., where he served as chief executive officer. He lives in St. Cloud, Minn. **Wilfred A. Wahl (*Civil*)** worked as an engineer before retiring. He lives in Minneapolis, Minn.

1952

Richard Lindaman (*Physics*) retired from the Univac Division of Sperry Rand, where he worked as a scientist. He lives in Minneapolis, Minn. **Richard K. Nelson (*Mechanical, 1953 M.S.*)** received a master's degree from the California Institute of Technology. He is a vice-president at Cray Research and lives in Bloomington, Minn. **Harley M. Sutton (*Mechanical*)** is a vice president at Environ Laboratories. He lives in Lakeville, Minn.

1953

Roland E. Anderson (*Electrical*) retired from Unisys, where he was a manager. He lives in Merrifield, Minn. **John E. Moy (*Chemical, 1955 M.S.*)** retired from the U.S. Bureau of Mines, where he worked as an engineer. He lives in St. Paul, Minn. **Roger B. Swanson (*Electrical*)** is a self-employed manager living in Dunnell, Minn. **Thomas E. Vavra III (*Civil*)** is president of Vavra Architects-Engineers, Inc. He was recently elected president of the Elm Grove, Wis., board of trustees after having served both on the board of trustees and the board of appeals in that city for 16 years. He lives in Elm Grove, Wis.

1954

John L. Brandt (*Geological*) is retired from the State of Minnesota's Department of Natural Resources, where he worked as an engineer. He lives in Hibbing, Minn. **Oscar M. Hagen (*Mechanical*)** received his master's degree from the University of Wisconsin. He is retired from American Standard, where he worked as an engineer. He now lives in LaCrosse, Wis. **Norbert S. Mason (*Chemical, 1955 M.S.*)** received his doctorate from Case Western Reserve University and works as a professor at Washington University. He lives in Clayton, Mo. **Paul H. Richardson (*Mechanical*)** is a self-employed engineer living in Bloomington, Minn.

1955

Alan S. Goodyear (*Civil, M.S.*) retired from UNESCO, where he worked as a supervisor. He lives in New Zealand. **Robert Hanson (*Civil*)** is a self-employed engineer at Cardinal Engineering. He lives in St. Paul, Minn. **David G. Schulz (*Electrical*)** is a retired engineer living in Minneapolis, Minn.

1956

David E. Fogelson (*Geophysics, M.S.*) is a retired scientist living in Mendota Heights, Minn. **Joseph L. Ward (*Mining*)** has his professional license and is president of his own firm. He lives in Houston, Texas.

1957

Rodger D. Thuras (*Electrical, 1960 M.S.*) works as a consultant to Seagate Technology. He lives in Edina, Minn.

1958

Rolf F. Amundson (*Civil*) is an engineer living in Federal Way, Wash. **Richard C. Groen (*Metallurgical*)** is a supervisor at Elkem Metals Co. He lives in Mars, Pa. **Allan L. Nelson (*Electrical*)** received his master's degree from the University of Pennsylvania. He is an engineer at Martin Marietta Corp. and lives in Cherry Hill, N.J. **Elvis D. Simon (*Mechani-***

cal) retired from Martin Marietta Corp., where he worked as a manager. He lives in Denver, Colo.

1959

Redfield W. Allen (*Mechanical, Ph.D.*) is a professor emeritus living in Silver Spring, Md. **Lawrence H. Breimhurst (*Civil, 1963 M.S.*)** is a vice president at Professional Services Group, Inc. He lives in St. Paul, Minn. **Larry C. Oyen (*Mechanical*)** is a manager at Sargent & Rundy. He lives in Naperville, Ill. **Horace E. Staph (*Mechanical, Ph.D.*)** is retired from the Southwest Research Institute. He lives in San Antonio, Texas.

1960

Robert I. Iverson (*Electrical*) is retired from Sperry Corp., where he worked as a manager. He lives in Nelson, Wis. **Allen M. Olson (*Electrical*)** is an engineer with Westinghouse Electric Corp. He lives in Pasadena, Calif.

1961

Edwin A. Brown (*Mechanical, 1964 M.S.*) retired from Shell Oil Co., where he worked as an engineer. He lives in Spring, Texas. **Richard L. Hoppenrath (*Civil*)** is a resident engineer with the Minnesota Department of Transportation. He lives in Bloomington, Minn. **James B. Mehl (*Physics, 1964 M.S., 1966 Ph.D.*)** is a department chair and professor. He lives in Newark, Del. **G. Mishra (*Physics, M.S.*)** retired as president of the Government of U.P. India. He lives in Faizabad, India. **E. James Torok (*Physics, M.S.*)** is president and founder of Key Innovations Corp. He lives in Minneapolis, Minn. **Gordon O. Voss (*Mechanical, 1970 Ph.D.*)** is the chief executive officer of the Metropolitan Waste Control Commission. He lives in Blaine, Minn.

1962

D. M. Madden (*Mechanical*) is a director at Honeywell Inc. He lives in New Brighton, Minn.

1963

Robert B. Elo (*Metallurgical, 1966 M.S., 1970 Ph.D.*) is a manager at Intel Corp. He lives in San Jose, Calif. **Bernard D. Paul (*Electrical*)** is president of TDM Inc. and resides in San Diego, Calif.

1964

Daniel T. Hanson (*Chemical, 1968 Ph.D.*) is a professor at Texas A&M University. He lives in College Station, Texas. **P. K. Kuo (*Physics, Ph.D.*)** is a professor at Wayne State University. He lives in Detroit, Mich.

1965

Steven A. Bendson (*Electrical, 1967 M.S., 1972 Ph.D.*) is a manager at 3M. He lives in Minneapolis, Minn. **Kenneth M. Krall (*Mechanical, M.S., 1969 Ph.D.*)** is vice-president of Loral Vought Systems. He lives in Arlington, Texas. **Gilbert B. Overson (*Chemical*)** is a founder of TMC Industries Inc. He lives in Edina, Minn.

1966

Willis R. Almendinger (*Agricultural*) is the owner of PQT Co. He lives in Minneapolis, Minn. **Ralph E. Barr, Jr. (*Electrical*),** is a supervisor for the Commercial Flight Systems Group of Honeywell Inc. He lives in Phoenix, Ariz.

1967

Larry J. Blum (*Chemical*) works as a director at Rosco Mfg. Co. He lives in Madison, S.D. **Thomas J. Eggum (*Civil*)** received his master's degree from the University of Pittsburgh. He works as a director for the City of St. Paul, Minn., where he also lives. **Curtis W. Frank (*Chemical*)** received his doctorate degree from the University of Illinois. He is a professor at Stanford University and lives in Cupertino, Calif. **John A. Palyvos (*Chemical, M.S.*)**

Gene Waldorf (1964 Electrical), engineering specialist at 3M and former Minnesota legislator.

Engineering a Career in Politics

Engineering and politics make strange bedfellows. In the engineer's world of scientific truths, $E=MC^2$. In politics, E equals, well, whatever the majority wants. Gene Waldorf (1964 Electrical) has nonetheless balanced and blended these seemingly disparate interests. For the last sixteen years, he has worked both at 3M as an engineering specialist and in the Minnesota Legislature, first as a DFL representative and then as a senator for his Saint Paul district.

Waldorf spent three years in telecommunications in the Army which confirmed his interest in an engineering career. He initially attended Drexel Institute in Philadelphia and then transferred to the Intitute of Technology. Upon graduation, he worked for Bell Telephone for a short time before joining 3M.

His "other career" started simply. He got involved in a neighborhood project redesigning a park. Waldorf found he had a natural knack for consensus-building, getting the job done, and finding the answers. He decided to throw his hat into the ring in 1976 and run for the Minnesota House of Representatives. In 1980, he became a senator.

Waldorf left the Legislature this past January after 16 years in politics. "That's about sixteen years longer than I expected to be there," he says. He decided not to run for re-election last fall, opting instead to pursue his "real job" at 3M full time. "It was the right time to leave office," he says. "There was a lot of tension trying to do two jobs. Rather than short change either responsibility, I prefer to give my full attention to one."

Among his many legislative achievements, Waldorf is widely

recognized for his 10 years' work as chair of the Higher Education Finance Committee. There, he improved the state's student aid and student loan programs. In addition, the committee developed a new "depoliticized" selection process for University of Minnesota regents, one which he says attracts more folks to compete for the job.

Waldorf says his technical background proved to be as helpful in the political arena as in the business world. "In the legislature there's an attitude that `we support good ideas,'" he says. "They often fund one good idea and then move on to the next. Engineers are more result-oriented. They measure and evaluate the end result. It's part of our training to ask if the results justify the means. Also, in government finance work, it's helpful not to be afraid to analyze the figures. That came naturally with my engineering training."

Was it tough to leave the halls of government in favor of corporate corridors? "I haven't suffered tremendously," says Waldorf with a laugh.

Although he's down to only one job, Waldorf's extra-curricular plate is still extremely full. He again combines technical and political expertise as he campaigns for "Citizens for PRT" (personal rapid transit). PRT—the brainchild of former IT mechanical engineering Professor Ed Anderson (who was one of Waldorf's professors)—utilizes small vehicles in automated transit. According to Waldorf, it eliminates many of the problems of mass transit because construction and operating costs are lower. Most importantly, these small vehicles take individuals to their destinations with no stops and on demand, thus accommodating the user's schedule rather than the user adapting to the transportation schedule.

Waldorf adds a heavy dose of family life to his mix of business and civic activities. He and his wife, Bernie, have six children, ranging in age from 14 to 33, and five grandchildren. He's also an avid sailor.

All in all, Waldorf considers himself a pretty lucky fellow. "Who can say they've had two significant jobs that they've enjoyed so much in one lifetime?" ■

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received his doctorate degree from the National Technical University in Athens, Greece. He is now a lecturer at the National Technical University and lives in Athens. **Lowell H. Rosen (*Physics, 1969 M.S.*)** is a scientist. He lives in Arlington, Va.

1968

Michael R. Cameron (*Chemical*) received his doctorate from the University of Toledo, where he is a professor. He lives in Toledo, Ohio. **Frank J. Germann (*Civil*)** works for the Federal Aviation Administration as an engineer. He lives in St. Paul, Minn. **James K. Knudsen (*Chemistry; Physics, M.S. 1975*)** is a scientist with 3M. He lives in Woodbury, Minn. **John W. Koenst (*Chemical*)** received his master's degree from Carnegie-Mellon. He is a manager at Air Products and lives in Chesterfield, Mo.

1969

Ramesh K. Agarwal (*Aerospace, M.S.*) is a program director and a McDonnell Douglas Fellow at McDonnell Douglas. He lives in Chesterfield, Mo. **Sharadchandra N. Bhatt (*Industrial, M.S.*)** owns MEM Engineering. He lives in Excelsior, Minn. **Darrell F. Coleman (*Mechanical*)** is a director for Dieterich Standard. He lives in Longmont, Colo. **Roger W. Kwong (*Chemistry*)** is a physician with Gunderson Clinic. He lives in LaCrosse, Wis.

1970

Donald A. Andreasen (*Mechanical, 1972 M.S.*) received a master's degree from New York University. He works as a manager at M&M/Mars and lives in Chattanooga, Tenn. **Leonard H. Leuer (*Mechanical*)** is an engineer at Medtronic. He lives in Loretto, Minn. **Tycho T. Von Rosenvinge (*Physics, Ph.D.*)** is a scientist at the Goddard Space Flight Center (NASA). He lives in Bowie, Md.

1971

Bimleshwar P. Gupta (*Mechanical, M.S.*) is a manager at the National Renewable Energy Laboratory. He lives in Golden, Colo. **Peter R. Raatikka (*Civil*)** is a vice-president at Hakanson Anderson Assoc. He lives in Maple Grove, Minn. **Rolf N. Skogerboe (*Physics*)** is a physician at the Columbia Park Medical Group. He lives in Minneapolis, Minn.

1972

Alvaro F. Canizares (*Chemical*) received his master's degree from Princeton University. He is a manager at FMC Corp. and lives in Vorhees, N.J. **James E. Colten (*Chemical*)** is a programmer at the University of Minnesota. He lives in St. Paul, Minn. **Earl O. Knutson (*Mechanical, Ph.D.*)** is a scientist with the U.S. Department of Energy. He lives in Morristown, N.J. **Richard J. Loerch (*Mechanical, 1977 M.S.*)** is an engineer at Giddings & Lewis. He lives in Greenfield, Wis. **Dean R. Pedersen (*Mechanical, Ph.D.*)** is a manager at Argonne National Laboratories and lives in Naperville, Ill.

1973

Wayne P. Anderson (*Agricultural*) is a supervisor with the Minnesota Pollution Control Agency. He lives in St. Paul, Minn. **Ruby T. Fomunyam (*Chemistry, M.S.*)** received her doctorate from the University of Ife in Nigeria. She works for the Cameroon Government as a scientist and lives in N. W. Province, Cameroon. **Brian E. Golberg (*Civil*)** is a director with Target Stores and lives in Minneapolis, Minn. **Kenneth G. Haider (*Civil*)** is a director with the City of Maplewood, Minn., and lives in St. Paul, Minn. **Jay R. Knutson (*Physics, 1975 M.S., 1978 Ph.D.*)** is a scientist for the National Institutes of Health. He lives in Kensington, Md. **Kenneth M. Manke (*Electrical*)** owns Quality Technology Ltda. and MTS Sistemes de Brasil Ltda. He lives in Sao Paulo, Brazil. **Peter J. Molinaro (*Civil*)** is president of Pioneer Engineering. He lives in Northfield, Minn. **William C. Rothman (*Physical Chemistry, Ph.D.*)** is a self-employed consultant living in Scarsdale, N.Y.

1974

David E. Hoberg (*Mechanical*) serves as president of DBM Industries. He lives in Golden Valley, Minn. **James W. Luke (*Mechanical*)** received his master's degree from the University of St. Thomas. He works as a technician for the U.S. Government and lives in Bloomington, Minn. **Dennis R. Mathison (*Agricultural*)** works as an engineer for Loram Maintenance of Way, Inc. He lives in Hamel, Minn.

1975

Mark C. Hinrichs (*Electrical*) received his master's degree in electrical engineering from the Georgia Institute of Technology in 1991 and is pursuing advanced graduate studies at the University of New Mexico. He is employed by the University of California at the Los Alamos National Laboratory in Los Alamos, N.M. **William J. Hoban (*Computer Science*)** is a self-employed consultant. He lives in Plymouth, Minn. **Nancy C. Thurlow (*Computer Science*)** is a manager

Rebecca Schatz (1986 Computer Science, M.S.), founder and president of The Works.

It's In "The Works"

Rebecca Schatz journeyed to Japan with the mission of broadening her professional horizons. She returned with the mission of broadening our society's technical horizons.

No small job. Yet Schatz, with the help of a myriad of technical volunteers and dozens of scientific professional organizations, is doing just that. In 1990, she organized The Works, a nonprofit organization dedicated to increasing public understanding of technology. Based in Minneapolis, The Works' "hands-on, minds-on" exhibitions and activities for people of all ages will make their way into shopping malls, state fairs, and museums across the country starting next year.

The organization's first exhibition, The Interactive Image, will let participants explore the dynamic world of imaging and optical technology—from camcorders and fax machines to medical imaging and virtual reality. Want to learn about digital imaging? This exhibit lets you digitize and warp your own face. For those with a more musical bent, the Interactive Image offers an opportunity to play a harp with "strings" made of lasers and optical sensors. "We want to captivate, demystify and inspire," says Schatz.

Schatz' IT studies first sparked the idea for The Works. Before attending the University of Minnesota, Schatz received a bachelor's degree from the University of Texas at Austin in mathematics and managed the network engineering department at NCR Comten (now part of AT&T) in St. Paul for six years. She received a master's degree from IT in 1986 with a major in computer and information sciences and a minor in East Asian Studies.

Schatz was the first University of Minnesota student to become a Luce Scholar. Granted by the Henry Luce Foundation,

> *I came back from Japan very interested in public education and reaching the whole work force on the subject of technology.*

the fellowship enabled her to spend a year in Tsukuba Science City, a city located about two hours from Tokyo that was created specifically for science and technology development.

"I was interested in Japan because it's the preeminent East Asian society in technology development," says Schatz.

As she explored the societal background of Japanese technological development, Schatz became increasingly alarmed about America's ability to compete in the international marketplace of technological products.

"I wasn't focused on that issue beforehand," she says. "I had planned to go back to NCR and build widgets. Instead, I came back from Japan very interested in public education and reaching the whole work force on the subject of technology."

With that idea in mind, she set out to find the best way to implement her ideas. She toured science centers across the country and took special inspiration from the hands-on approach at the Exploratorium in San Francisco and the Ontario Science Center. She admired the effectiveness of learning by doing, tinkering, and discovering.

Rather than trying to create a whole new institution for technology education, Schatz decided to take the "touring exhibit approach" to reach broad audiences through existing institutions, such as science museums or shopping malls. The Interactive Image will reach more than one million people on a three-year tour starting in 1996. The Works has also created a high-profile technology exhibition that will occupy a 5,000 square-foot building at the 1994 Minnesota State Fair.

Schatz is currently looking for scientists to contribute to the development of these exhibits. "This is an incredible way for volunteers to use their technical skills on fun projects," she says.

(For information on volunteering at The Works, call Schatz at 612/377-3828.) I

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with Unisys Corp. She lives in Wayne, Pa.

1976

Andronic L. Castillo (*Math*) is a manager at Munich American Reassurance Co. He lives in Dunwoody, Ga. **Stuart W. Fall (*Electrical*)** is a manager with Honeywell Inc. He lives in Scottsdale, Ariz. **Richard A. Groshong (*Electrical*)** is an engineer with Rockwell International. He lives in Cedar Rapids, Iowa. **Mahesh K. Jeerage (*Electrical, Ph.D.*)** is a supervisor at Honeywell Inc. He lives in New Brighton, Minn. **Dale F. Johnson (*Physics*)** is a director for Norstan, Inc. He lives in St. Paul, Minn. **Mark J. Schreiner (*Civil*)** is a manager with Lockheed Ft. Worth Co. He lives in Fort Worth, Texas. **Jim Vashro (*Electrical*)** is a manufacturing manager for Hewlett Packard. He received his master's degree in the management of technology from the National Technological University in Fort Collins, Colorado. He lives in Garden Valley, Ind. **William J. Weckman (*Agricultural*)** is an engineer for Carver County, Minn. He lives in Shakopee, Minn. **Terry D. Welander (*Civil*)** received his master's degree from the University of Nevada. He now owns Industrial Applications and resides in San Ramon, Calif.

1977

Paul K. Axelson (*Civil*) is an engineer with Alliant Techsystems, Inc. He lives in Champlin, Minn. **Mark A. Johnson (*Civil*)** is an engineer at Dahl & Associates Inc. He lives in Minneapolis, Minn. **David E. Langseth (*Civil*)** is a vice president of Arthur D. Little, Inc. He lives in Lexington, Mass. **Richard J. McCluskey (*Chemical, Ph.D.*)** is a professor at Clarkson University. He lives in Potsdam, N.Y. **Thomas M. Steele (*Chemical*)** works as a manager at New Zealand Industrial Gases. He lives in Papakura, New Zealand.

David M. Strand (*Chemistry; Chemical*) received his master's degree from the California Institute of Technology. He lives in Sherborn, Mass., where he works as a vice president for Millipore Corp.

1978

Michael R. Fix (*Civil*) is an engineer at the Twin Cities Army Ammunition Plant. He lives in Circle Pines, Minn. **John T. Gilbert (*Mechanical*)** works as an engineer with John Deere & Co. He lives in Cedar Falls, Iowa. **John A. Nauman (*Math; Computer Science, 1978 B.S.*)** is president of Financial Information Management, Inc. He lives in Eden Prairie, Minn. **John L. Neslund (*Electrical*)** is an engineer with Unisys Corp. He lives in Atlanta, Ga. **Richard J. Remiarz (*Mechanical*)** is a manager with TSI Inc. He lives in Vadnais Heights, Minn. **Pui Tsui (*Chemistry, M.S.*)** is a scientist with the government of Hong Kong. He lives in Hong Kong. **Stephen M. Vajs (*Statistics, M.S.*)** is a manager for the U.S. Department of Treasury. He lives in Alexandria, Va.

1979

Martin A. Chelstrom (*Chemistry*) owns Chelstrom Assoc. and lives in Minneapolis, Minn. **John R. Fergus (*Civil*)** is self-employed and lives in Lone Rock, Wis. **John R. Gilkeson (*Mechanical*)** is an environmental policy analyst for the State of Minnesota. He lives in St. Paul, Minn. **Peter A. Kotlarek (*Mechanical*)** is an engineer for The Trane Co. He lives in Onalaska, Wis. **Daniel E. Messinger (*Computer Science*)** works as an engineer with Fisher-Rosemount Systems. He lives in Minneapolis, Minn.

1980

Steven J. Finnes (*Electrical*) is an engineer at IBM Corp. He lives in Pine Island, Minn. **Dale L. Finnila (*Aerospace*)** is a pilot in the U.S. Air Force. He resides in Marblehead, Mass.

1981

Scott L. Barnett (*Chemical*) is a supervisor at 3M. He lives in Minneapolis, Minn. **Bruce Brooks (*Mechanical, 1983 M.S.*)** is a technical development engineer for SDRC in Milford, Ohio. He recently served as a University of Minnesota delegate at the inauguration of the new president at Miami University in Oxford, Ohio. He lives in Cincinnati, Ohio. **Catherine A. Esberg (*Computer Science*)** is a programmer at IBM Corp. She lives in Rochester, Minn. **Richard A. Hale (*Geophysics*)** is a scientist at Chevron Production Technology Co. He lives in Slidell, La. **Glenn A. Hetchler (*Electrical*)** received his master's degree at Stanford University. He works as an engineer for Hewlett-Packard and lives in Santa Rosa, Calif. **John D. Mills (*Chemical*)** received his master's degree from Cleveland State University. He works as a programmer for Eveready Battery Co. and lives in Avon Lake, Ohio. **Marge Lind Mills (*Chemical*)** received her master's degree from Case Western Reserve University. She is a manager at Eveready Battery Co. She lives in Avon Lake, Ohio. **John J. Murnane (*Chemical*)** owns Joe Murnane Inc. and lives in Red Wing, Minn. **John F. Schwert (*Mechanical*)** is an engineer with Wheelabrator-Johnson Screens. He lives in Minneapolis, Minn. **Mark P. Stehly (*Civil*)** received his master's degree from the State University of New York at Syracuse. He is a director with the Santa Fe Railway Co. and lives in Shawnee Mission, Kan.

1982

David M. Chaves (*Mechanics, M.S.*) is an engineer at Moog Inc. He lives in Lancaster, N.Y. **Joseph V. Romano (*Geology, M.S.*)** works as a manager at AT&T. He lives in Mineola, N.Y.

1983

Dora B. Barlaz (*Geology, M.S.*) is a science teacher at The Horace Mann School. She lives in New York, N.Y. **Steven M. Bonser (*Chemistry, Ph.D.*)** is a senior research scientist at Eastman Kodak Co. He lives in Sudbury, Mass. **Laurel J. Canner (*Mechanical*)** works as an engineer at Minco Products, Inc. She lives in Minneapolis, Minn. **Reed L. Christiansen (*Chemical*)** received his Ph.D. from the University of Wisconsin at Madison. He is an engineer for Eastman Chemical Co. and lives in Kingsport, Tenn. **Todd A. Morgenstern (*Mechanical*)** works as an engineer with ADC Telecommunications. He lives in Bloomington, Minn. **Robert D. Rutkiewicz (*Physics*)** is an engineer at Rosemount Aerospace. He lives in Edina, Minn.

1984

Tamara K. Bratland (*Electrical*) is a manager at Honeywell Inc. She received her master's degree from the University of St. Thomas and now lives in Plymouth, Minn. **Choonkyung Kim (*Electrical, Ph.D.*)** is a director for Gold Star. He lives in Seoul, Korea. **Michael W. Lesley (*Chemical, Ph.D.*)** is a scientist for the Thiokol Corp. He lives in Ogden, Utah. **Kevin A. Schanilec (*Chemical*)** works as an engineer. He lives in Seattle, Wash.

1985

Peter J. Collins (*Electrical*) received his master's degree from the Air Force Institute of Technology in Dayton, Ohio. He works as an engineer for the U.S. Air Force and lives at Holloman AFB, N.M. **Nguyen-Thai Dang (*Mechanical*)** is a product design engineer for Courtaulds Aerospace and lives in Gardena, Calif. **Robert P. Fitzgerald (*Aerospace*)** re-

ceived his master's degree from the University of Texas. He works as a pilot in the U.S. Air Force and lives in Shalimar, Fla. **Thomas M. Foy (*Math*)** received his certificate in professional photography from the School of Communication Arts. He works as a computer operator for the Federal Reserve Bank of Minneapolis and lives in Maple Grove, Minn. **George F. Klemmick (*Geology*)** is a project manager for Addwest Minerals Inc. and is currently developing gold mines in Arizona and Alaska. He lives in Littleton, Colo. **Andrew R. Knauss (*Mechanical*)** is an engineer for the Lockheed Aeronautical Systems Co. He lives in Minneapolis, Minn. **Dennis W. Nygaard (*Geological*)** received his master's degree from Luther Northwestern Seminary. He works as a pastor at St. Mark's Lutheran Church and lives in Hastings, Minn. **Mehmet E. Ozcaliskan (*Civil, M.S.*)** is vice president of Birim Insaat A.S. He lives in Istanbul, Turkey. **Linda Mattson Ries (*Electrical*)** works as an engineer. She lives in Colorado Springs, Colo. **Philip G. Shriner (*Electrical*)** is a seismic navigator for GeoTeam Exploration Ltd. He lives in Minde, Norway. **Allan G. Von Ohlen (*Electrical*)** works for 3M as an engineer. He lives in Waverly, Minn. **Larry R. Zalesky (*Electrical*)** is an engineer at Pharmacia Deltec. He lives in Blaine, Minn.

1986

Connie J. Bekavac (*Electrical*) is an engineer for Intel Corp. She lives in San Jose, Calif. **Stewart D. Cran (*Mechanical*)** is a manager with The Jamar Co. He lives in Duluth, Minn. **Edmund Fleck (*Mechanical, Ph.D.*)** is an engineering department head at ABB. He lives in Wegberg, Germany. **Thomas D. Halverson (*Mechanical*)** works for Cray Research as an engineer. He lives in Austin, Minn.

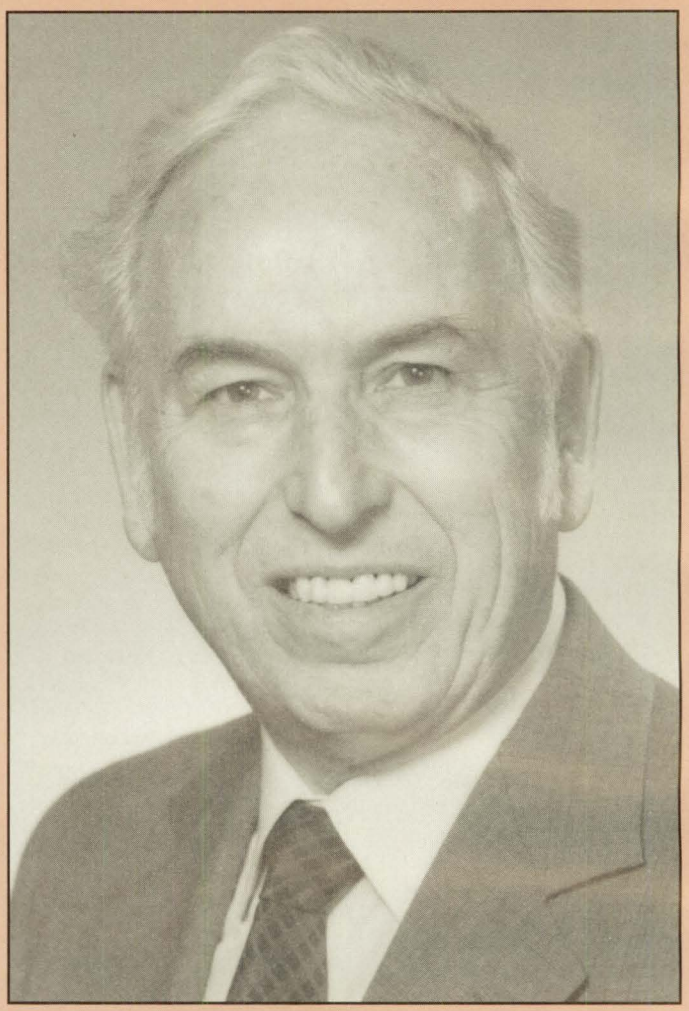
Maryanne Kelly Sonnek (*Civil*) is an engineer with the Minnesota Department of Transportation. She lives in Princeton, Minn. **Thomas S. Sundquist (*Math, 1992 Ph.D.*)** is a professor at Dartmouth College. He lives in Lyme, N.H. **Andrew N. Terwilliger (*Mechanical*)** is an engineer for DB Industries. He lives in Cannon Falls, Minn. **Anthony Varghese (*Electrical, M.S.; Biomedical, 1992 Ph.D.*)** is employed by the University of Minnesota as a scientist. He lives in Minneapolis, Minn. **Eric M. Westby (*Math*)** is a programmer for Integrated Foundation Services. He lives in Golden Valley, Minn.

1987

Arthur E. Borland (*Mechanical*) is an engineer at Mammoth. He lives in Maple Grove, Minn. **William M. Jones (*Electrical*)** is an engineer with Honeywell, Inc. He lives in River Falls, Wis. **John Lemke (*Mechanical*)** is a design engineer for Northrop Corp. He recently received his professional engineering license in the State of California. He lives in El Segundo, Calif. **Steven W. Lin (*Electrical*)** is an engineer with Central Engineering Co. He lives in New Brighton, Minn. **Gregory A. Peterson (*Aerospace*)** works for Alliant Techsystems Inc. as an engineer. He lives in Blaine, Minn. **Joe Sueyoshi (*Math, M.S.*)** is a professor at Maricopa County Community College. He lives in Phoenix, Ariz. **Tuyet-Anh T. Tran (*Computer Science*)** is a programmer at Cray Research. She lives in Hopkins, Minn.

1988

Alejandro Fernandez (*Civil, M.S.*) is a consultant with ICF Kaiser Engineers. He lives in Universal City, Calif. **Dale E. Hallstrom (*Electrical*)** is an engineer with DataCard Corp. He lives in Minneapolis, Minn. **James D. Hauge (*Mechanical*)** is an engineer at



Edson P. Williams (1950 Mechanical), retired group vice president, Diversified Products Operations, Ford Motor Company.

Still Motorin'

Edson Williams (1950 Mechanical) started his career building scooters and go-carts. As a kid, he had a passion for rebuilding motorcycles and puttering with all kinds of mechanical things—a passion he later transformed into an impressive 25-year career with Ford Motor Company. Before his retirement, Williams served as group vice president of Ford's Diversified Products Operations with responsibility for more than 10 Ford businesses that totaled roughly $15 billion in annual sales.

Williams didn't go directly from building go-carts to building the Ford Motor Company. After a hitch in the Army Air Corps from 1942 through 1946, Williams received a degree in mechanical engineering at IT in 1950. (He also did extensive graduate work in the "school of hard knocks," he says.) Upon graduation, he worked for about 10 years in the boat business with Crestliner in Little Falls, Minn., and then shifted back to the world of wheels when he joined Ford.

"My first job was in recreational trucks," says Williams. "It was back in the pre-RV days, and there weren't any recreational trucks that were specifically designed to carry campers. We developed Ford's Camper Special with all the correct options." Rightfully stated. According to Williams, Ford still out paces the competition in the camper and recreational truck business.

Williams moved from that position to product development and marketing, determining what vehicles to build and where,

and, later, helped establish a new Ford Service Division. Over the years, Williams ran Ford's operations in Mexico, the Middle East, and Africa, working to establish new businesses anywhere Ford was not represented, particularly in the Arab world.

When Ford obtained an interest in Mazda and launched its business in Japan, Williams and his family moved to Melbourne, Australia, where Williams oversaw Ford's interests in Asia. Eventually, Williams landed the highest position of his career, becoming group vice president of diversified products, which included everything from managing defense and tractor operations to electronics, audio, glass, plastics, and steel.

Focusing on Ford's comeback after years of declining sales and productivity, Williams spoke this spring at the Institute of Technology's Leadership in a Technical World Conference during IT Week. (See "Building a New Generation of Leaders," p. 22.)

In the simplest terms, Ford's solution was a giant training program that took place in 43 countries with people of 24 nationalities.

"We realized 12 to 15 years ago that unless we changed our ways, we would no longer be here," he says. "In 1979, the company lost $2.5 billion. That delivers a pretty strong message."

Williams was part of management's effort to turn the company around. "It was fundamentally a matter of changing attitudes, both toward the company and toward the customer," he says. "In the simplest terms, Ford's solution was a giant training program that took place in 43 countries with people of 24 nationalities. That's a sizeable task."

In the process, Williams says he also saw leadership styles change from a profit-centered, autocratic, "orders-from-the-top" orientation to a customer-centered, teamwork-oriented framework in which ideas percolated up from the bottom.

The result: the company went from a 15 percent to a 24 percent market share. Now new vehicle designs go "from paper to market" in 37 months (instead of 53) and Ford is in a position of world leadership, according to Williams.

Now retired, Williams is once again back in the garage tinkering with machinery, albeit a bit more sophisticated than the scooters and go-carts of his youth. He restores antique cars, including several of Ford's "milestone" cars. He not only located a 1932 Ford (the first with a V-8 engine) in Argentina, which he restored and switched to left-hand drive, he also owns one of the company's first Lincolns, circa 1940. "This is where I use my engineering!" he says.

Williams and his wife, Irene, enjoy the company of their five children, their spouses, and eight grandchildren, which Williams calls "the gang of 20." The couple divides their time between their home in Michigan and another in Naples, Florida, and occasionally motors around the country with antique car clubs.

When Williams isn't on the road, he does a little boating and deep-sea fishing. "Unlike cars, I like my boats to be of a modern vintage," he says. "I want to get home." I

By Terri Peterson Smith

Honeywell Inc. He lives in Coon Rapids, Minn. **Debra A. Jensen (*Computer Science*)** works for Software Etc. She lives in Minneapolis, Minn. **Scott T. Knapp (*Electrical*)** is employed by Hedstrom Engineering as an engineer. He lives in Woodbury, Minn. **James M. Kroening (*Mechanical*)** is an engineer with Micro Component Technology. He lives in Woodbury, Minn. **Taiwai D. Leung (*Statistics, M.S.*)** is a manager with Time-Warner Asia. He lives in Vacouver, British Columbia. **William R. McKoskey (*Mechanical*)** is a manager at Horwitz, Inc. He lives in New Hope, Minn. **Hector L. Melendez (*Math*)** is a technician at Dorado Marine, Inc. He lives in Dorado, Puerto Rico. **Jeffrey E. Spethmann (Mechanical)** works as an engineer at the Donaldson Co. He lives in Inver Grove Heights, Minn. **Paul A. Tinucci (*Mechanical*)** works at TL Systems Corp. as an engineer. He lives in Inver Grove Heights, Minn.

1989

Guy A. Cordonier (*Chemical, Ph.D.*) works as an engineer at Shell Oil Co. He lives in Houston, Texas. **Jeffrey B. Hed (*Mechanical*)** works as an engineer at Minco Products Inc. He lives in Edina, Minn. **Chung-Mong Lee (*Computer Science, Ph.D.*)** is a professor at the Hong Kong University of Science & Technology. He lives in Singapore. **Daniel S. Rylicki (*Aerospace*)** is an engineer at the National Aeronautics and Space Administration (NASA). He lives in Lakewood, Ohio. **Tim Soderholm (*Aerospace*)** is a KC-135 air refueling tanker pilot for the U.S. Air Force. He is stationed at Malmstrom AFB in Great Falls, Mont. **Joan Treder Stiller (*Electrical*)** is an engineer at IBM Corp. She lives in Rochester, Minn. **Charles V. Voigt (Electrical)** is a navigator for the U.S. Air Force. He lives in Rapid City, S.D. **Elizabeth T. Wendland (*Computer Science*)** is a programmer at the MECC. She lives in St. Paul, Minn.

1990

Abdullah M. S. Alamri (*Geophysics, Ph.D.*) is an assistant professor at King Saud University. He lives in Riyadh, Saudi Arabia. **Daniel D. Baker (*Mechanical*)** is an engineer at 3M. He lives in St. Paul, Minn. **Duane G. Binder (*Computer Science*)** is a programmer at Motorola. He lives in Palatine, Ill. **Sean Jiam (*Computer Science, M.S.*)** works at Sun Microsystems, Inc. as an engineer. He lives in Fremont, Calif. **Michael P. McDonald (*Physics*)** is an environmental application engineer with Osmonics, Inc. He received his bachelor's degree in Russian language and area studies from the University of Minnesota in 1991 and currently lives in St. Paul, Minn. **Mark D. Salzwedel (*Electrical*)** is an engineer with Motorola. He lives in Blaine, Minn.

1991

Aaron W. Buesing (*Civil*) works as an engineer at the U.S. Army Corps of Engineers. He lives in Inver Grove Heights, Minn. **Joseph P. Clayton (*Mechanical*)** is an engineer at Shiely Masonry Products. He lives in Monticello, Minn. **Denise D. Hafermann (*Mechanical*)** is an engineer at Rosemount, Inc. She lives in Minneapolis, Minn. **John P. Hamre (*Math*)** is a graduate student at the Carlson School of Management at the University of Minnesota. He lives in Roseville, Minn. **Woo-Young Hong (*Electrical, Ph.D.*)** is a professor at the Korean Naval Academy. He lives in Kyoungnam, Korea. **Jay H. Ismande (*Mechanical*)** works as an engineer at 3M. He lives in Brainerd, Minn. **Susan L. Ishaug (*Chemical*)** is a graduate student in chemical engineering at Rice University. She lives in Houston,

Texas. **Gregory J. Kampa (*Chemistry*)** is an engineer at Medtronic Inc. He lives in Blaine, Minn. **Kuang-Han Ke (*Aerospace*)** received his master's degree from Stanford University. He works as a graduate trainee at Applied Materials and lives in Portola Valley, Calif. **Paul M. Lindner (*Computer Science*)** is a programmer at the University of Minnesota. He lives in Minneapolis, Minn. **Brian C. Schmidt (*Mechanical*)** is an engineer at Johnson Controls. He lives in Woodbury, Minn.

1992

Robert A. Burmeister (*Physics*) is a technical aide in 3M's fiber optics lab. He lives in St. Paul, Minn. **Jack R. Copeland (*Statistics*)** is an industrial engineer assistant for EcoWater Systems. He lives in Oakdale, Minn. **Corey J. Hymes (*Mechanical*)** is an engineer at Uno-Ven. He lives in Justice, Ill. **Timothy J. Johnson (*Electrical*)** is an engineer with the U.S. Department of Commerce. He lives in Ham Lake, Minn. **Timothy P. Jones (*Mechanical*)** is an engineer at Rosemount, Inc. He lives in Bloomington, Minn. **Michael B. Jost (*Materials Science, Ph.D.*)** is an engineer with Rosemount, Inc. He lives in Savage, Minn. **Thomas J. Rossini (*Electrical*)** is pursuing additional studies at the University of Minnesota. He lives in Eagan, Minn. **Kevin A. Schwartzbauer (*Mechanical*)** is an engineer at KAS Industries. He lives in Roseville, Minn. **Barbara J. Stallman (*Chemistry, Ph.D.*)** is a professor at Lourdes College. She lives in Sylvania, Ohio. **Jonette Wellhouse-Herman (*Electrical*)** is an engineer in the Standards Department at the Underwriters Laboratories. She lives in Raleigh, N.C. **Daryanto Winoto (*Materials Science*)** is a first-year graduate student at Northwestern University. He lives in Evanston, Ill.

DEATHS

Harry Carlson *(Civil 1934)*, 85, on February 18, 1993, in Waconia, Minn. Carlson, who lived in Minnetonka, Minn., worked for the U.S. Army Corps of Engineers for 32 years after graduating from IT. He was also a home builder and land developer. Carlson was born in Minneapolis and graduated from North High School. For 20 years he worked on flood control projects on the Mississippi and Minnesota Rivers for the St. Paul District of the corps. When his supervisors asked him to transfer to Boston in 1953, Carlson left the corps and began building houses and developing real estate parcels. He built houses in Carver County west of Excelsior, Minn., for about four years and then developed the Virginia Heights Subdivision on Lake Virginia near Excelsior. In 1960, Carlson returned to work for the corps. He retired in 1972, but remained active doing carpentry work and serving as a tax adviser for senior citizens. He was a member of the American Society of Civil Engineers.

Clayton Ray "Buzz" Dalrymple *(Mechanical 1950)*, 65, of cancer on January 31, 1993, in Seattle, Wash. Dalrymple worked for The Boeing Company for 36 years.

Harold V. Flinsch *(Civil 1936)* of Alzheimer's disease on March 3, 1993, in Columbia, S.C.

Andrew O. Jensen *(Electrical 1950, M.S. 1953, Ph.D. 1956)*, 65, in October 1992, in Pasadena, Calif. Jensen was born in Delavan, Minn., and graduated from John Marshall High School in Minneapolis. He started his professional career as a research assistant to electrical engineering Professor Henry E. Hartig in 1950, and, in 1953, became an instructor in electrical engineering at IT. Jensen completed his doctoral research in electro-acoustics under electrical engineering Professor Robert F. Lambert. Upon completing his doctoral studies, Jensen joined the General Electric Company and worked as a project engineer on gas discharge phenomena. In 1961, he went to work for Electro-Optical System (EOS) in Pasadena, Calif., and, in 1968, became vice president and general manager responsible for research and development of light sources, plasmas, infrared sensors, laser technology, EM counter-measures, and reconnaissance systems. When EOS was absorbed by Xerox and become XEOS, Jensen joined Xerox as vice president and chief scientist with primary responsibility for all activities conducted by the EOS Division, including the Xerox Laser Scanning Technology Center. He was largely responsible for the spectacular growth of most electro-optical components and scanning systems at Xerox during 1972-1983. In 1983, Jensen left Xerox and became vice president and technical director of the Pasadena Project, a new company formed to develop a high-volume solar photovoltaic manufacturing plant. In 1984, Jensen became vice president of engineering for Zwan Magnetics, a new company formed to manufacture thin film magnetic media for the disc drive recording business. Jensen remained with Zwan until poor health forced him to take early retirement. During his technical management career, Jensen was a prolific inventor and published numerous technical articles. In the 1960s, while at EOS, he also served as head of the Presidential Commission on Energy Resources for the Kennedy-Johnson Administration.

Izaak M. Kolthoff, 99, on March 4, 1993. Kolthoff was one of IT's most renown professors and was considered by many to be the father of modern chemistry. He received numerous honors and awards throughout his career, including election to the National Academy of Sciences, a half-dozen honorary doctoral degrees from universities around the world, and an award from the American Chemical Society for excellence in teaching—an award that Kolthoff greatly treasured. He was also knighted by the government of his homeland, The Netherlands, and it was widely rumored that he was nominated for the Nobel Prize on several different occasions. During World War II, Kolthoff invented synthetic rubber while working for the government. Later, his research led to methods for the analysis of metal ions used in coping with water pollution. By the time he retired in 1962, Kolthoff had published nearly 1,000 papers. One of the textbooks he wrote is still the standard in most countries, and his encyclopedic *Treatise on Analytical Chemistry* is perhaps the most extensive and comprehensive work ever written on analytical chemistry. Kolthoff was also a very dedicated teacher, having guided the research of hundreds of Ph.D. students. Kolthoff began his formal training in The Netherlands at the University of Utrecht, where he initially studied pharmacy. He soon switched to chemistry, and his first scientific paper was published in 1914. Although he earned his Ph.D. degree in 1918, he stayed on at the University of Utrecht for several years. In 1927, Kolthoff was invited to teach at IT after a lecture tour in the U.S. Somewhat outspoken and a political activist, Kolthoff helped German scientists persecuted by Hitler find jobs at IT, and he fought against McCarthyism

in the 1950s. He teamed up with former Minnesota Governor Elmer Benson to seek a pardon for Morton Sobell, who had been convicted as an associate of Julius and Ethel Rosenberg, both of whom were executed for espionage. Kolthoff apparently aroused the ire of Senator Joseph McCarthy. Although he was accused of belonging to dozens of subversive groups, he was never brought before McCarthy's committee.

Kolthoff's stature as one of the world's preeminent analytical chemists brought him a steady stream of visitors, many of whom were elite scientists from corporations and universities from around the world. He often entertained his guests in a quiet corner of the Campus Club library.

Arthur H. Lund *(Geology 1938)*, 78, on April 11, 1993, in Bloomington, Minn. Lund was an advertising executive who spent most of his career with the Campbell-Mithun agency (now CME-KHBB Advertising.) He helped create the popular Hamm's beer commercials, featuring an animated bear roaming through the woods, and encouraged Hamm's to sponsor the Minnesota Twins on radio and television when the team moved to Minnesota in 1961. Lund also recruited athletes to feature on the front of Wheaties cereal boxes. A native of the Twin Cities, Lund began his advertising career working in the Promotions Department for WCCO-Radio. He joined Campbell-Mithun in 1944.

William D. Munro *(Mathematics 1947, Ph.D.)*, 76, of pneumonia on January, 20, 1993, in Minneapolis, Minn. Munro was a professor emeritus of mathematics and computer science at IT and one of the founders of the Department of Computer Science. A native of Cedaridge, Colo., Munro earned his bachelor's and master's degrees from the University of Colorado at Boulder before joining the IT faculty in 1938. In the early 1970s, Munro worked closely with Professor Marvin Stein to establish the Department of Computer Science, thus making IT one of the first institutions in the country to offer an undergraduate major in computer science. He was also a founding director of the graduate studies program in computer science and served as that program's director until he retired in 1985. Munro also co-authored three textbooks with Stein and served as an adviser for dozens of computer science graduate students.

Donald A. Nelson *(Mechanical 1942, M.S. 1948)*, 72, of progressive cerebellum degeneration on January 26, 1993, in Edina, Minn. Nelson was a research scientist who spent the bulk of his career working for Honeywell Inc. A native of Minneapolis, Nelson taught mechanical engineering and mathematics at IT for several years following the completion of his education. He was a Navy officer during World War II and also worked for the National Advisory Committee for Aeronautics (the predecessor to NASA) before becoming a research engineer for A. O. Smith Corp. in Milwaukee, Wis. In the 1950s, Nelson began working for Honeywell and stayed with that firm until he retired in 1985. He held several management positions for Honeywell, including chief engineer of electronics for defense systems.

Theodore H. Rauen *(Chemical 1926)*, on December 24, 1992, in Fort Washington, Md. Rauen retired as general superintendent of the St. Paul plant of Koppers Coke in 1962. He was born in St. Paul, Minn., grew up in White Bear Lake, Minn., and attended St. Thomas College prior to enrolling at IT. Rauen was a registered licensed engineer in the State of Minnesota and past president of the St. Paul Engineers Society.

Harold W. Rehfeld *(Chemical 1929)*, 87, of complications from Parkinson's disease on April 2, 1993, in Lilydale, Minn. Rehfeld was a chemical engineer with B. F. Goodrich in Akron, Ohio, for 17 years and an executive with 3M for 21 years. A native of Aberdeen, S.D., Rehfeld grew up on his family's dairy farm near Rush City, Minn. He was valedictorian of his high school graduating class and graduated from IT with honors. During World War II, Rehfeld was commissioned to rebuild Michelin tire plants in France and Belgium which supplied tires to the U.S. Army. He was awarded the Distinguished Service Medal for completing the assignment ahead of schedule. He joined 3M in 1950 and played an integral role in the development of manufacturing operations for rubber adhesives.

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Graduation Year/Degree/Department _____

Job _____

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Erick O. Schonstedt *(Mechanical 1941)*, 75, on March 20, 1993, in Reston, Va. Schonstedt was founder and president of Schonstedt Instruments Co., a leading manufacturer of magnetometers and other precision instruments. He was also a noted philanthropist, having generously supported IT, the Greater Reston Arts Center, numerous charities, and other organizations. A native of Minneapolis, Schonstedt grew up during the depression and financed his education at IT with a partial scholarship and hard work. He founded Schonstedt Instruments in 1953. Schonstedt magnetometers have been part of the instrument package on more than 400 satellites and space probes, including those of the Apollo Program. Schonstedt was awarded 20 patents for his inventions and was recognized internationally for his contributions to the field of magnetics. He received many honors and awards during his life, including a doctorate in humane letters from Augustana College in Rock Island, Ill., and the University of Minnesota Outstanding Achievement Award.

Charles D. Swift *(Electrical 1924)* on March 20, 1993.

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