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### ON THE COVER
Mechanical engineering professor Art Erdman exemplifies the innovative spirit of the Institute of Technology. His research has resulted in more than 30 patents. • 10

**PHOTO BY JONATHAN CHAPMAN**
T HANKS TO POP CULTURE, most people have heard of the small-world effect, better known as “six degrees of separation.” Even if you’ve never heard the term, you’ve probably experienced the phenomenon—for example, discovering that a new acquaintance just happens to have a co-worker whose cousin works for your company’s branch office in Atlanta.

Making connections seems almost effortless in today’s world, where computers, cell phones, and the Internet link us to people and data instantaneously. Nevertheless, people often don’t recognize the connections between scientific research and their day-to-day lives.

A recent survey of Minnesotans revealed that many respondents support education and outreach but don’t necessarily recognize that University research—the essence of knowledge and discovery—has the power to improve lives and livelihoods. Yet the same survey found that there is overwhelming public support for research if people have enough information to “connect the dots.” At least 70 percent favored the University’s strategic positioning initiative to become a top research institution once they understood that keeping the state’s only research university strong bolsters Minnesota’s economy and quality of life.

This issue of Inventing Tomorrow helps people make the connections that are vital to our success. The stories show the impact the University is having on the world right now and reflect the direction of the college’s top priorities: nanotechnology, medical devices, renewable energy, and digital technology.

As our cover story, “Dedication to Innovation,” reports, a culture of discovery is alive and well within the Institute of Technology. In the last five years, 79 patents have been issued based on work done within the college—a third of the patents issued for the entire University during that time. Another 81 licensing agreements have been completed with companies that have paid the University more than $2.5 million for the rights to develop and market technological breakthroughs that emerged from the college. Ten start-up companies have been formed to translate pure research within the Institute of Technology into jobs and economic expansion for Minnesota.

Other stories in this issue show that interdisciplinary research is one of the Institute of Technology’s key strengths. The University of Minnesota led the successful effort to establish a new $21 million National Science Foundation research center based here that will explore more efficient uses of fluid power to save energy and spawn new technologies.

The University received high marks from Small Times, a leading nanotechnology trade publication, for its industrial outreach and research in nanotechnology and microtechnology, ranking second and ninth among U.S. universities in those areas.

Our students and faculty are sharing their knowledge and making connections around the world. In this issue you’ll meet some students and young alumni who gained work experience and met academic requirements through technical internships overseas. You’ll also read about alumni who forge invaluable partnerships with the college through their generous support.

This issue’s “Retrospect” profiles the Department of Chemical Engineering and Materials Science, which built its legacy of excellence by recruiting top faculty and students and by keeping its commitment to innovation.

Discovery is a way of life here at the University and within the Institute of Technology. Our constant dedication to do better and think creatively is the most direct route to a bright future for Minnesota and its people.
U ranks high in nanotech industrial outreach

THE INSTITUTE OF TECHNOLOGY’s Nanofabrication Center, Characterization Facility, and Particle Technology Laboratory as well as the chemical engineering and materials science programs were among the reasons why the nanotechnology trade publication Small Times recently ranked the University of Minnesota second among U.S. universities in industrial outreach in nanotechnology and microtechnology.

The University was also rated ninth in nanotech research, making it the highest-ranking Big 10 university in both categories.

Nanotechnology is the design, control, and manufacture of structures at the atomic or molecular level. [One nanometer is one-millionth of a millimeter. For comparison, a single human hair is about 80,000 nanometers wide.]

Small Times compiled a guide to the top universities in microtechnology and nanotechnology, based on responses to a survey sent to more than 100 research institutions in the U.S. Fifty universities responded to the survey in early 2006, answering questions about funding, facilities, research, courses, degrees, industrial partnerships, patenting, and other issues pertaining to nanotechnology and microtechnology. Respondents also were asked to rank their peer institutions in the areas of nanotech research and commercialization.

“The University of Minnesota is pleased to be recognized as a leading institution for nanotechnology,” said Steve Campbell, professor of electrical and computer engineering and director of the Nanofabrication Center. “Nanotechnology is the second most heavily funded area of federal research and is anticipated to be a $2 trillion market by 2015.”

He also explained that the University opens its labs to both faculty and companies for nano research. Users pay a fee to use the labs’ state-of-the-art equipment.

“By spreading the cost of these systems over a large user base, a wide range of capabilities can be made available,” Campbell said. “These capabilities will help keep Minnesota among the leaders in this emerging area.”


New NSF fluid power research center to be based at the U

DISCOVERING WAYS to reduce fuel consumption, developing devices for people with mobility impairments, and designing state-of-the-art rescue robots are just three of the goals of a new multimillion-dollar research center that will be based at the University of Minnesota.

The National Science Foundation (NSF) recently announced a $15 million, five-year grant that will support the new Engineering Research Center for Compact and Efficient Fluid Power. More than 50 industry partners will augment NSF funding with $3 million, and seven universities involved in the center will contribute an additional $3 million.

“Back in the 1950s and 1960s, the United States led the world in fluid-power research, but now Europe and Asia have passed us by,” said Kim Stelson, a mechanical engineering professor at the University of Minnesota and director of the new research center. “We hope that this...”

NEW NSF RESEARCH CENTER CONTINUES ON PAGE 4
new center will get us back on track in this growing field.”

Fluid-power technology is a $33 billion industry encompassing areas such as aerospace, agriculture, construction, health care, manufacturing, mining, and transportation.

With help from the National Fluid Power Association, more than 50 companies have agreed to provide support for the research center. Seven of those companies have annual sales of more than $500 million.

“This kind of industry support for an NSF-sponsored research center is unprecedented,” said Steven Crouch, dean of the Institute of Technology. “It clearly shows that we have the support to ensure the center’s success.”

Researchers at the center will study ways to use fluid power more efficiently in industry and will work to develop hydraulic-hybrid passenger cars that are less expensive and more efficient than current electric hybrids. A 10 percent improvement in efficiency in national passenger-car energy could potentially save about $10 billion a year.

Researchers also will work to use hydraulic technology to develop new or more efficient medical and rehabilitation devices and robots that could be used in rescue missions.

In addition to research, the center will be involved in developing youth education programs, improving efforts to increase student diversity in engineering, and offering short courses and labs for industry workers.

Other core universities involved in the center are the University of Illinois at Urbana-Champaign, Georgia Institute of Technology, Purdue University, and Vanderbilt University. Outreach universities include the Milwaukee School of Engineering and North Carolina A&T State University.

Outreach institutions include the National Fluid Power Association, Project Lead the Way, and the Science Museum of Minnesota.


CONTINUED FROM PAGE 3

U researchers uncover new details about evolution of zeolite crystals

THE POROUS, SIEVE-LIKE minerals known as zeolites are familiar to most people as the white crystals in aquarium filters or the ion-exchanging workhorses in advanced detergents that have been used for decades. Yet no one has been able to figure out exactly how the crystals form, even in the laboratory.

But now a team of University researchers using some of the most advanced microscopes in the research arsenal has uncovered new details of the step-by-step evolution from molecular soup to carefully engineered zeolite crystal.

The researchers recently reported their findings in Nature Materials, a cutting-edge materials science research journal. The study was supported by several National Science Foundation grants.

Ultimately, the researchers’ goal is to control the structure, size, and shape of the crystals well enough for zeolites to serve as sponges for hydrogen in fuel tanks or as separation membranes for chemical manufacturing.

“Controlling the growth of a certain crystal structure is difficult because it is done by trial and error, or what some critics may call a ‘mix, wait, and see’ approach,” said Michael Tsapatsis, a University chemical engineering and materials science professor.

Tsapatsis said researchers previously have lacked a clear understanding of nucleation and growth processes that control formation of zeolites and related organic-inorganic nanostructures.

To improve that understanding, Tsapatsis and his colleagues have spent more than a year monitoring the growth of zeolites in a laboratory setting, where they could watch the crystal growth process in exquisite detail.

The study showed that the zeolites form in a step-by-step, “hierarchical” fashion, with silicon-oxygen nanoparticles forming first. Those particles then aggregate into larger, more complex structures, incorporating other atoms and molecules while still leaving substantial pores and tunnels. Based on their findings, the researchers developed a set of mathematical equations that describe the nucleation and growth process.

Although laboratory zeolites tend to exist as microcrystal powders, the researchers hope the new insights may help yield larger structures—even layers and thin films—that are perfect for optoelectronics, sensors, and micro-reactors.

“There are essentially unlimited opportunities for these crystals if we can control their pore structure and crystal shape, tailoring designs to specific applications ranging from catalysts to bio-implants,” Tsapatsis added.

University of Minnesota graduate students and faculty researchers involved in the study include Tracy Davis, Timothy Drews, Harikrishnan Ramanan, Chuan He, Jingshan Dong, Efie Kokkoli, Alon McCormick, R. Lee Penn, and Tsapatsis.
Science of the small is a big deal at the U

BETH STADLER’S STUDY OF THE VERY SMALL holds promise for big discoveries. Her nanotechnology research could someday result in the creation of “artificial ears” or sensors for food protection and homeland security.

Stadler, an assistant professor of electrical and computer engineering, is using nanostructures to build sensors for sound and smell. The acoustic sensing nanowires that she constructs mimic the tiny hairs of varying length (called cilia) that line the curled-up cochlea in the ear. When a sound enters the ear, the cilia that can detect that pitch’s resonance frequency vibrate and generate an electrochemical signal to the auditory nerve. The nerve interprets this information and in turn sends a specific signal to the brain, which translates the signal into the appropriate sound.

“If you uncurl the cochlea, you would see something like what we are making, except that our cilia are much smaller,” says Stadler. “We are making a two-dimensional acoustic comb so small that it would take 600-2,000 nanowires [representing the comb’s teeth] to go across the diameter of a human hair.”

Although such an acoustic comb could hold promise for replacing cochlear implant technology, the immediate application of these “artificial ears” may be for sonar or medical ultrasound.

Stadler’s recent acoustic sensor studies include work on a new material called Galfenol, a gallium-iron alloy that exhibits high sensitivity and the mechanical properties of iron.

Her research on artificial olfactory sensors uses optical properties to detect the presence of a gas and “fingerprint” it. The gas sensors rely on tin oxide photonic crystals that control light, allowing or prohibiting certain colors of light [based on their wavelength] from penetrating the structure. The sensors would have applications in such areas as homeland security, food protection, and leak detection.

Nanotechnology appears to be critical to building the next generation of sensors. “These sensors wouldn’t work without nanostructures,” Stadler said.

Research results in better-tasting St. Paul water

THIS PAST SPRING AND SUMMER, the water for more than 400,000 St. Paul area residents tasted and smelled better, thanks to research at the University of Minnesota.

City water managers have tried for years to find a way of controlling geosmin, a chemical produced by algae, which contributes to the musty taste and odor of water during periods of warm weather. With the help of civil engineering graduate student Robert “Bo” Johnston and faculty advisers Raymond Hozalski and Michael Semmens, they’ve finally found a solution.

This year, water utility workers began installing a system of 24 granular activated carbon (GAC) filters that will effectively adsorb geosmin molecules. The small fissures in GAC create a larger surface area that can trap the smallest particulates and molecules, unlike regular carbon.

“Although it’s not a public health issue, it is an important aesthetic issue for the city,” Hozalski said.

When a previous feasibility study recommended that the city install GAC filters to remove the geosmin, Hozalski and Semmens suggested that Johnston undertake a pilot study as his master’s thesis.

Johnston’s findings confirmed that the GAC filters alone removed most of the geosmin, and when combined with ozone, they removed even more.

To keep costs down, water plant managers decided to install the GAC filters only and determine later if ozone injection is necessary. The project also includes redesigning the interior of the water reservoir.

Dean names department heads, center director

Professor Gary Balas is the new head of the Department of Aerospace Engineering and Mechanics. A leader in the field of experimental and theoretical control systems, Balas has been a faculty member at the University since 1990. He most recently served as co-director of the University’s Control Science and Dynamical Systems Center. Balas will succeed Professor William Garrard, who served as department head for 14 years.

Professor David Kohlstedt is the new head of the Newton Horace Winchell School of Earth Sciences and the Department of Geology and Geophysics. An internationally renowned researcher in rock deformation processes, Kohlstedt has been a faculty member at the University since 1989. Kohlstedt will succeed Professor William Seyfried, Jr., who held the concurrent posts for 13 years.

Dr. Samuel Moore is the new director of the Institute of Technology’s Academic Programs for Excellence in Engineering and Science (APEXES). Moore has more than 15 years’ experience in higher education as a teacher and administrator, most recently at Northwestern University. He previously served the University of Minnesota as APEXES director from 1996 to 1999 and as the Graduate School’s assistant dean for outreach from 1999 to 2002.
Professor **Massoud Amin** [electrical and computer engineering], director of the Center for the Development of Technological Leadership, has been appointed a member of the scientific advisory committee for the Computational Sciences and Engineering Division of the Oak Ridge National Laboratory for January 2006–May 2010.

Professor **Gary Balas** [aerospace engineering and mechanics] and Tamas Keviczky [ControlSci Ph.D. ’05] received the 2006 O. Hugo Schuck Award for Practice from the American Automatic Control Council for their paper “Flight Test of a Receding Horizon Controller.” Balas also received the Institute of Electrical and Electronics Engineers (IEEE) Control Systems Technology Award from the IEEE Control Systems Society.

Professor **Subir Banerjee** [geology and geophysics], director of the Institute for Rock Magnetism, has been elected a 2006 Fellow of the prestigious American Academy of Arts and Sciences.

Professors **John Bischof** [mechanical engineering], **Karin Musier-Forsyth** [chemistry], and J. Ilja Siepmann [chemistry] were three of the four University faculty to receive the 2006 Distinguished McKnight University Professorship, which recognizes and rewards outstanding mid-career faculty.

Professors **Stephen Campbell** [electrical and computer engineering] and **Catherine French** [civil engineering] have been named Institute of Technology Distinguished Professors. The honor recognizes outstanding faculty for their contributions to research, teaching, and service in their professions and in the college.

Assistant Professor **Daniel Cronin-Hennessy** [physics] has been named an Alfred P. Sloan Research Fellow for 2006. This highly competitive fellowship is awarded to exceptional young faculty in the sciences.

Associate Professor **Mark Distefano** [chemistry] and Professor **Jim Leger** [electrical and computer engineering] received the 2006 Horace T. Morse–University of Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education.

Assistant Professor **Kevin Dorfman** [chemical engineering and materials science] received a 2006 Career Development Award from the International Human Frontier Science Program Organization, based in Strasbourg, France. He is one of the first two Americans chosen to receive the competitive award, which supports young scientists during the critical period of setting up their independent laboratories.

Associate professor **Douglas Ernie** [electrical and computer engineering] received the 2006 George W. Taylor Award for Distinguished Service for his pioneering service to the continued development of the UNITE distributed learning program, his contributions to technology-enhanced learning, his services as interim director of the Center for the Development of Technological Leadership, and his involvement in undergraduate research programs.

Professor **Roger Fosdick** [aerospace engineering and mechanics] received a Laurea Specialistica Honoris Causa in Ingegneria Meccanica from the Politecnico di Bari, Italy. The award is the highest honorary degree granted in the engineering profession in Italy.

Professor **William Garrard** [aerospace engineering and mechanics] received the John Le- land Atwood Award from the American Society for Engineering Education Aerospace Division and the American Institute of Aeronautics and Astronautics. Garrard was also elected chair of the National Council of Space Grant Consortia funded by NASA.

Assistant professors **Demoz Gebre-Egziabher** (aerospace engineering and mechanics), **Yongdok Kim** (computer science and engineering), **Efie Kokkoli** (chemical engineering and materials science), and **Stergios Roumeliotis** (computer science and engineering) are among 10 recipients of the 2006–08 McKnight Land-Grant Professorship, a program designed to advance the careers of the University’s most promising junior faculty.

Assistant Professor **Christy Haynes** [chemistry] has been named a 2006 Searle Scholar. The award supports outstanding scientists who are in their first two years of their first appointment and who conduct research in medicine, chemistry, and the biological sciences.

Professor **Dennis Hejhal** [mathematics] received the prestigious Eva and Lars Gårdings Prize in Mathematics for 2005 from the Royal Physiographic Society in Lund, Sweden.

Professor **Ken Heller** [physics] has been elected president of the American Association of Physics Teachers.

Professor **Kenneth Keller** [chemical engineering and materials science, Humphrey Institute of Public Affairs] has been named director of Johns Hopkins University’s SAIS Bologna Center in Italy. He will be on a leave of absence from the University for this important assignment.

Professor **Vipin Kumar** [computer science and engineering] has been selected to receive the IEEE Computer Society’s 2005 Technical Achievement Award for his contributions to the design and analysis of parallel algorithms, graph partitioning, and data mining.

Professor **Tim Lodge** [chemistry] has been named the Reyerson Professor of Chemistry. The endowed professorship was created by the University in 2001 to recognize research excellence by chemistry department faculty. Recipients hold the professorship for five years.

Professor **Chris Macosko** [chemical engineering and materials science] has received the 2006 Fernley H. Banbury Award from the American Chemical Society for “research using fast-melt processing and chemical reactions to create new micro- and nano-structured polymeric materials.”

Professor **Kent Mann** has been named the Merck Professor of Chemistry. The endowed professorship was created by the University in 2001 to recognize research excellence by chemistry department faculty. Recipients hold the professorship for five years.

Professor **Alon McCormick** [chemical engineering and materials science] received the 2006 John Tate Award for Excellence in Undergraduate Advising.

Assistant Professor **Kristopher McNeill** [chemistry] received the 2006 George W. Taylor Career Development Award, which recognizes exceptional contributions to teaching.
In memoriam

Professor Wayland Noland (chemistry) is the 2006 recipient of the Charles E. Bowers Faculty Teaching Award, which recognizes an Institute of Technology professor who has demonstrated an exceptional commitment to teaching.

Professor Lou Pignolet (chemistry) received the 2006 President’s Award for Outstanding Service from the University of Minnesota. The award recognizes exceptional service and commitment beyond the normal duties of a faculty or staff member.

Professor Serge Rudaz (physics) has received the 2006 George W. Taylor/Institute of Technology Alumni Society Award for Distinguished Teaching.

Professor Guillermo Sapiro (electrical and computer engineering) received the 2006 George W. Taylor Award for Distinguished Teaching. He was honored for his contributions to the area of image processing and computer vision.

Professor Donald Truhlar (chemistry) has been elected to the prestigious International Academy of Quantum Molecular Science. The academy’s bylaws restrict the number of members younger than 65 years to only 34. Truhlar also received the 2006 Schroedinger Medal, which is given by the World Association of Theoretically Oriented Chemists to an outstanding senior theoretical/computational chemist. In addition, Truhlar was recently honored by the Journal of Physical Chemistry with a Festschrift (a special issue honoring an individual).

Associate Professor Renata Wentz covitch (chemical engineering and materials science) has been elected a Fellow of the American Physical Society. She was honored for “computational tools for and valuable predictions of structure and properties of earth minerals and exotic oxides, especially at high temperature and pressure.”

Professor Xiaoyang Zhu (chemistry) has received the Friedrich Wilhelm Bessel Award from the Alexander von Humboldt Foundation in Germany. The Humboldt Foundation grants only 20 Bessel Research Awards annually to young, top-flight scientists from outside of Germany who are recognized as outstanding researchers in their fields.

George Greenlees
GEORGE GREENLEES, professor emeritus of physics, died March 16, 2006, in Wayzata, Minn. He was 83.

An avid experimentalist, Greenlees contributed significantly to the understanding of the structure of atomic nuclei through his work on the optical model.

Born in Hartlepool, England, Greenlees entered the University of Cambridge but interrupted his studies during World War II to work on an assignment from the British government. His task was to improve the cavity magnetron, a high-power vacuum tube that made microwave radar feasible.

After the war he earned a Ph.D. from Cambridge and accepted a position at the University of Birmingham, where he became a leading researcher in nuclear physics. Dissatisfied with the classical accelerator at Birmingham, Greenlees designed a more sophisticated accelerator using new technology. But when the British government transferred the majority of nuclear research to National Laboratories, where the new accelerator was not implemented, he began looking for new opportunities.

In 1964 he joined the physics faculty at the University of Minnesota, where he had access to a new accelerator ideally suited to his field. His research flourished, and Greenlees established a world reputation for his work with theorists to develop the optical model of the atomic nucleus. Although his later efforts to find the hypothetical “fat atom” (an atom with an extra-large and very heavy nucleus) were not successful, the work contributed to the quark theory in use today.

He continued his experimental work until his retirement in 1993.
More Institute of Technology students are heading overseas to gain a competitive edge in the job market

WANTED: Resourceful, bright, and motivated new University grad who can adapt quickly to industry changes. Related international work experience highly desirable.

MARK KLEMA’S FONDNESS FOR CULTURE SHOCK clinched a job with his current employer.

After spending the summer after his junior year working on a research project in Montana, the civil engineering student discovered that he really liked being thrust into new situations. The following summer he decided to expand his horizons even further by going to Germany.

Klema (CivE ’05) obtained an internship through the International Association for the Exchange of Students for Technical Experience (IAESTE), a student-run organization that works with employers to identify paid internships suitable for international students. For each international student placed in the U.S., one American student can be placed abroad. Since its establishment in 2002, the University’s IAESTE chapter has grown to include 85 members,
making it the largest chapter in the country.

Klema spent the summer of 2004 in Frankfurt, Germany, where he worked at Hessisches Baumanagement (HBM), a government unit similar to the Minnesota Department of Transportation. Outside the cocoon of shared language and culture, Klema tested his resourcefulness on and off the job.

He rented an apartment, bought a bike, pedaled to work, and coped with humdrum chores that now presented some challenges. Although buying groceries and doing laundry were a bit of a hassle at first, learning how to function in another society was very rewarding—just as Klema hoped it would be.

“It’s amazing what you figure out when you’re on your own, when you get away from everything and everyone you know,” he said.

At HBM, he spent time in one division and then moved to another, going from mapmaking to cleaning up contaminated sites to inspecting construction on the Autobahn. “I didn’t really dive into the nitty-gritty details,” he said. “The goal was exposure.”

After returning to the University and serving as president of IAESTE for a year, Klema applied for a job with Bolton and Menk, an engineering consulting firm with offices in Minnesota and Iowa. He had the technical skills and background the company wanted, but what set him apart from the competition was the summer he spent in Frankfurt, Germany.

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“Even though my company is focused on doing business in a more local market, my employer was impressed with my international experience in Germany,” he said. “Learning how to adjust quickly to a new situation is a valuable skill.”

RECORD NUMBER OF STUDENTS STUDY ABROAD

Mindful that international experience looks better than ever on a resumé, a record number of Institute of Technology (IT) students are following Klema’s example by working and studying abroad.

“In 1998 there were six IT students who went abroad,” said Susan Kubitschek, assistant to the associate dean and coordinator for international programs in the college’s Office of Student Affairs. “This past year there were 158.”

Venturing abroad was not high on Andy Skoglund’s must-do list as a student. Skoglund (ME ’05), a mechanical engineer from Watertown, Minn., who calls his wide-ranging interests a “curiosity problem,” spent six years on campus taking classes in architecture and engineering while working as a freelance illustrator to help pay for tuition. He also raced motorcycles on the side.

Skoglund eventually thought about studying abroad, but by this time he was nearly finished with his degree program. Although he suspected he had missed his chance, he contacted the Office of Student Affairs and was delighted to find out that he could obtain a three-month internship overseas through the USA-Interns Program, a German-American

WANDERLUST LEADS STUDENTS OVERSEAS

Nick Bohl landed a paid internship at Kraftwerke Mainz-Wiesbaden, a power plant in Germany. He secured a scholarship that paid half of his airfare and many of his living expenses. He is pictured here in front of a 400-megawatt transformer at a substation in Germany.

THE INTERNATIONAL EDGE CONTINUES ON PAGE 19

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While Australia remains the most popular destination, Institute of Technology students are traveling all over the world, meeting academic requirements and gaining work experience in their field of study. Those who don’t want to be away for a full year or even a semester can choose from short-term programs offered during winter break, May Session, or Summer Session.

Grants from the U.S. Department of Education and the Bush Foundation have provided funding for the curriculum project at the University and for new scholarships. The Learning Abroad Center, with assistance from faculty, recently developed study abroad academic planning sheets for each of the college’s 19 majors. The planning sheets specify which courses in each major are offered at various universities approved by the University faculty.

Kubitschek encourages every IT student to consider spending some time overseas. To her, the benefits seem obvious.

“Local companies are looking for employees who have international experience,” she said. “A company’s headquarters may be based here, but its product line may be manufactured in Taiwan and shipped from China.”

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DEDICATION TO
INNOVATION
Discoveries by Institute of Technology faculty fuel University’s entrepreneurial spirit

WRITTEN BY JUDY WOODWARD
PHOTOS BY JONATHAN CHAPMAN

A GREAT UNIVERSITY embraces both the visionary and the pragmatic. The discoveries made in classrooms and laboratories can enrich the human spirit, but they can also lead to more tangible contributions to the economic life of the world beyond university halls.

Whether the issue is improving wireless Internet technology, providing high-speed pain relief, repairing the ravages of age-related blindness, or any of a host of other complex challenges, Institute of Technology (IT) researchers are at the forefront of cutting-edge discoveries. They are creating intellectual property that fuels some of the most vigorous entrepreneurial efforts in the nation.

In the last five years, 79 patents have been issued based on work done within the college. That’s more than a third of the patents issued for the entire University of Minnesota during that time period. Another 81 licensing agreements have also been completed with companies that have paid the University more than $2.5 million for the rights to develop and market the technological breakthroughs stemming from research within the college. Ten start-up companies have been formed to translate pure research into new jobs and economic expansion for Minnesota.

“Many IT departments and centers have a long history of strong collaborative relationships with private industries and corporations,” said Tim Mulcahy, the University’s vice president for research. “[But] entrepreneurship does not thrive in a vacuum. It needs to be fostered, valued, and rewarded. By doing just that, IT has created a climate that encourages the faculty to innovate, create, and translate discoveries into applications.”

Innovation is thriving at the University, and it begins in the classrooms and labs of IT. A look at just four Institute of Technology researchers clearly showcases the spirit of innovation within the college.

ART ERDMAN
Technology’s matchmaker

Mechanical engineering professor Art Erdman calls himself a Cupid, but his matches have nothing to do with romance. Rather, he’s a catalyst for fruitful liaisons between pure research and entrepreneurial know-how.

Holder of more than 30 patents, Erdman has applied his expertise to areas as disparate as the mechanics of high-performance sports, the design of dental crowns, and the development of remedies for macular degeneration, a leading cause of age-related blindness.

“I’ve worked on all the ‘ologies,”’ said Erdman. “There’s a great benefit in being at a world-class university with a medical school and a dental school. You have access to many experts, laboratories, equipment, and top-notch students.”

Over the years he’s pursued collaborations that have the potential to enhance both the University and made-in-Minnesota manufacturing. “It’s a service to the state,” he said of his efforts to create new products that generate start-up companies and strengthen Minnesota’s economy.

He’s also motivated by a wide-ranging intellectual curiosity and the challenge of solving complex mechanical engineering problems.

A runner who completes four or five marathons a year, Erdman has long been interested in applying standard engineering techniques to the analysis of athletic performance in winter sports. In 2001, he and a student were working on a way to optimize the biomechanics of the start used in the luge. News of that research prompted the U.S. women’s Olympic bobsled team to ask Erdman if he could develop an off-track start system.

“The bobsled practice track was very crowded, so they needed another way to practice,” he explained.

It was just the kind of challenge Erdman relishes—solving a recurrent problem that requires the combined efforts of multifaceted specialists.

“It was one of those Cupid things,” is the way he describes his ability to assemble “Team Minnesota,” a group of his former students, to attract corporate support from Aspen Research, a subsidiary of Andersen Corporation; EnduraTEC Systems Corporation (now a part of Bose Corporation); and Acceleration Minnesota, a manufacturer of high-end treadmills for the professional athlete.

The group devised a treadmill-based simulated start system, and the athlete who completed its first test run was amazed to discover that “she improved her performance by 20 percent on her first try,” Erdman said.

“IT has created a climate that encourages the faculty to innovate, create, and translate discoveries into applications.”

—TIM MULCAHY
Erdman also is involved in research- ing medical devices for urology. This tool, currently used by urologists to retrieve kidney stones, is one example of a device University researchers may redesign in the future.

With the new training system in place, the U.S. women’s bobsled team went on to win a gold medal at the 2002 Winter Olympics.

Throughout his career, Erdman has applied his ingenuity to many vexing mechanical engineering problems. His team developed the Linkage Interactive Computer Analysis and Graphically Enhanced Synthesis (LINCAGES) software package for mechanical design and analysis. LINCAGES has been licensed to more than 80 universities and companies and has produced more than a half million dollars in revenue for the University.

A few years ago, he worked on a system to digitize the standard technique for fitting a dental crown. As anyone with a bad tooth knows, fitting a crown can be a time-consuming ordeal involving several unpleasant appointments. Erdman and his colleagues worked out a way to truncate the whole process.

“We used a laser to digitize the 3-D coordinate system of the tooth [needing repair], and then the idea was to mill out the restoration,” he said.

More recently, Erdman and retinal surgeon Timothy W. Olsen have been working to improve retinal surgery procedures. Together with Ph.D. student Paul Loftness, they developed a scleral depressor, an automated device that will allow surgeons to see more of the retina during operations. The instrument will replace a century-old procedure in which a surgical assistant presses a crude, pen-like tool against the sclera (the outer membrane of the eye) to move the peripheral retina into the surgeon’s view.

The team’s work on macular degeneration is in an earlier stage and is still awaiting a patent, but a new start-up company named Macular Regeneration Inc. is set to market the researchers’ invention.

Although the potential for royalties always exists when an invention is brought to market, Erdman says that isn’t the driving force behind his creativity. “It would be nice [to make money from inventions], but that’s not the goal,” he said. “The idea of helping in a situation where somebody is losing their vision—well, you’d feel proud of your career.”

— ART ERDMAN

DAVID PUI
Big Ideas for a small technology

When David Pui was growing up in Hong Kong, he spent hours watching automated weaving machines in his father’s silk factory. The patterns were intricate and the colors sumptuous, but what really impressed the young boy were machine breakdowns.

Normally the machines transformed minute silken filaments into cloth, but mechanical disaster sometimes struck without warning. Periodically, the wooden cards regulating the pattern would slip out of alignment and send the shuttle ripping through thousands of delicate silken threads that made up the warp.

Only skilled human intervention could restore order. “Two workers would have to reconnect the threads by hand,” remembered Pui. “It took a lot of concentration, but they could do it so fast.”

Pui, Distinguished McKnight University Professor of Mechanical Engineering and director of the University’s Particle Technology Laboratory, traces his fascination with engineering to those deft rescue operations.

Nowadays he deals with objects infinitely smaller than those pure silk filaments. Pui is a leading researcher in the burgeoning field of nanotechnology, where miniaturized applications are leading to outsize progress in fields from medicine to robotics. University president Robert Bruininks has emphasized

In 1999, mechanical engineering professor David Pui developed an electrospraying apparatus for continuous gene transfection. The “gene gun” shows great potential as a delivery method for gene therapy. More recently, Pui has begun exploring other applications for the new technique.
the role of nanotechnology in his strategic plan for making the University one of the top three public research institutions. Pui said that he is one of "three or four dozen" researchers at the University who are working in nanotechnology.

In 1999, Pui developed the continuous "gene gun," a method of inserting genetic material into living plant and animal cells. More recently, he has begun to explore other applications for the new technique.

And that's where Nanocopoeia, the company founded to market his ideas, comes in. The company's name is derived from "pharmacopoeia," the Greek word for a compendium of drugs.

"I mentioned [the name] to our former University president Nils Hasselmo, who is a linguist," Pui recalled. "He immediately thought of the mythological 'cornucopia,' the magnificent horn that filled itself with whatever meat or drink its owner requested. I like the interpretation that the horn is filled with fruits and flowers and [that it's] the symbol of plenty...of nanoparticle drugs."

Operating from a site near the St. Paul campus, Nanocopoeia has developed the ElectroNanoSpray™ formulation technique for coating surgical stents and other precision medical equipment. The company has received Small Business Innovation Research grants from the National Institutes of Health and the National Science Foundation for another extremely promising application, using the technique to deliver drugs in ultra-miniaturized particle format.

Reducing a drug to nano size greatly increases its surface area and rate of absorption, Pui explained. Using an extra-fine grind of coffee beans to produce a cup of super-strong espresso is based on the same principle.

"[This technique] will allow the drug to be absorbed in the body and make response time much quicker," he said.

That's good news for anyone who has ever waited anxiously for pain medication to kick in. The pharmaceutical industry is predicting that nanotechniques like Pui's could allow patients to achieve pain relief within three or four minutes after putting a capsule under the tongue.

Pui is the chief science advisor to Nanocopoeia, but he does not take an active role in its business management. "Very early on, I had the feeling that a good scientist is not necessarily a good business person or a good manager," he said.

However, Pui has exceptional networking skills that any entrepreneur would envy. The invention of the gene gun grew out of fruitful collaborations with scientists and physicians working in several other departments. Pui believes this type of intel-
Invent Ing tomorrow
summer 2006

Intellectual partnership is one of the advantages of doing research at the University.

“In a big University like ours, there’s a lot of opportunity for faculty of different disciplines to work together on interesting topics,” he said. “The University can create opportunities to get faculty from different disciplines talking to each other, and then the lightbulb [of invention] will go on.”

RAMESH HARJANI and JAE MOON
Wild ride on the dot-com roller coaster

Although their ideas are the critical currency that fuels start-up success, most entrepreneurial professors leave the details of founding a company to others. Typically, the professor continues to oversee research and development as an advisor, leaving the day-to-day business of running the company to management professionals.

Professors Ramesh Harjani and Jaekyun (Jae) Moon are an exception to all that. They decided to launch a company themselves and develop their ideas for wireless networks for multimedia and cable television.

In 2001, the two men took temporary leaves of absence from the Department of Electrical and Computer Engineering and set about founding Bermai Inc. They tapped all possible resources in starting the company, including Harjani’s wife, Savita, who provided free legal and administrative support to the fledgling firm.

They soon learned that entrepreneurship is not for the fainthearted. A month after 9/11, the nation was still in shock, and the dot-com commercial bubble had begun to deflate.

“Jae, Savita, and I were sitting in my office one evening in 2001,” Harjani said. “We had about $3,000 left—all our personal savings.”

Without outside funding, Harjani and Moon knew Bermai could not survive.

“Raising millions of dollars after the high-tech bubble burst in the aftermath of 9/11 was a challenge that looked insurmountable,” Moon said.

Despite the shell-shocked economic climate, however, they were able to secure funding. In less than four years, Bermai added more than 60 workers to its payroll, and the partners raised millions in start-up funds before turning over top management posts to outsiders with business backgrounds.

Then Bermai abruptly lost its financial footing in 2004, and at year’s end it was sold to DSP Group, “the biggest player in the field of making integrated chip-sets for cordless phones,” according to Harjani.

After absorbing Bermai, DSP Group established its presence in Minnesota, with its Bloomington design facility designated as its core research and development center. The Minnesota center now interacts with facilities and labs around the world. The team of Bermai engineers—many of them former students of Harjani and Moon—remains intact within DSP Group, as does the technology that the two University researchers invented.

“Our experience is an example of how start-up companies are obviously good for the local economy in the long term,” Moon said.

Harjani calls his days with Moon as high-tech entrepreneurs a “bare-knuckles wild ride.”

“I learned a lot about what it takes to raise money—how expensive it is in emotional terms. What you give up when you raise [outside] money is control,” he said.

But through it all, he credits the University for providing an environment where creativity flourishes.

“The U offers the freedom to develop the kind of ideas that made it all possible,” Harjani said.

He is happy to be back in academic life, but he doesn’t regret his wild entrepreneurial ride. “I would definitely do it again,” he said. “Whether I’d make the same mistakes...”

Harjani paused and then laughed, “I’d make different ones.”

FOR MORE INFORMATION see www.tcbd.umn.edu
Low-tech devices still rule the hearts of alumni three decades after the pocket calculator made them obsolete.

Let It Slide

Written by Steve Linders

Photos by Brant Sanderlin & Eugene Louie
Ah, the slide rule.

THERE WAS A TIME when no self-respecting University of Minnesota engineering or mathematics student would be caught on campus without one. Efficient by nature, sleek by design, these handsomely crafted tools of the trade could be seen hanging from their proud owners’ belts ready for calculating at a moment’s notice.

Although they came in a variety of shapes and sizes, most slide rules were 12 inches long and arrow-straight, crafted from a perfect blend of mahogany, enamel, glass, and just enough steel to guarantee sturdiness, accuracy, and longevity. Yes, engineering students could always count on their slide rules. If life were a mathematical equation, the slide rule was a constant—after all, they’d been around since the 1600s.

Up until the early 1970s, the device essentially ruled campus, allowing students to efficiently multiply and divide by sliding identical scales back and forth and making quick estimations.

Then along came the HP-35 electronic pocket calculator in 1972, and everything changed for engineering students.

In what seemed like a flash, slide rules—the tool of choice for engineers and mathematicians for centuries—became obsolete. Gone. Some were packed away in boxes, forgotten along with other memorabilia from the good old days. Most were thrown away, never to be seen again.

Or were they?

Today, 34 years after their supposed demise, a Google search for the term “slide rule” generates more than 20 million hits. And at any given time, a search on eBay brings up between 500 and 900 slide rules for sale. Even in today’s ever-changing technological world, where even last year’s calculators are antiquated, the slide rule seems to have engineered a special place in the hearts of their former owners.

The allure of the slide rule

Gary Flom (Math ’76) understands the slide rule’s powerful allure. Of all the educational mementos he kept from his college days—textbooks, diplomas, awards, photographs, and yearbooks—his slide rules are the most coveted and beloved.

“They are just the neatest things. They take me back to a different era,” said Flom, who has more than 200 slide rules in his personal collection.

Flom, an Atlanta-area ear, nose, and throat physician, has joined thousands of people around the world who collect, trade, and use the devices for fun. In fact, he’s such a slide rule fanatic that he started a club, The International Slide Rule Group, which has 1,100 members. He holds a leadership role in the Oughtred Society, perhaps the largest organization dedicated to the preservation of the slide rule, with thousands of members in more than 20 countries. He co-authored a book called The Oughtred Society Slide Rule Reference Manual. Flom also carries a three-and-a-half-inch slide rule with him everywhere he goes.

“I use it to calculate gas mileage and the price per unit in the grocery store, and to solve really challenging equations,” he explained. “When I’m using it, I get some pretty interesting looks from people.”

Flom first learned to use the tool when he was a student at St. Louis Park High School in suburban Minneapolis.

“My first was a typical standard-issue slide rule,” he recalls. “It had about a 10-inch scale with a two-inch slider. I also had a slide rule holster that I used to wear on my belt. It had a sheath with a leather loop, and it hung like a sword.”
By the time he came to the University, Flom was quite adept at using the slide rule. He still wore it on his belt and, depending on which social circles he was in, it was either a status symbol or the epitome of nerdiness, he said. But by his second year of college, electronic calculators had begun to invade University classrooms.

"It happened between 1972 and 1974," Flom said of the switch from slide rules to calculators. "Of course, everyone wanted a calculator when they first came out, so the slide rule kind of fell by the wayside."

So, like many other students at the time, Flom tossed his slide rule into a box and didn’t think about it again. After all, who needed a slide rule when you had a calculator? Then one day about seven years ago, he came across that archive of college mementos. At the bottom of the box he discovered his old slide rule.

"I was sitting there looking at this thing, and I wondered if I could still use it," Flom said. "I started doing some simple calculations, and one thing just kind of led to another."

Energized by his rekindled interest in solving complex equations with the slide rule, Flom did an Internet search to see what he could learn about the peculiar little device that had stirred his memory and curiosity. What he found amazed him: He’s only one of thousands of devotees throughout the world who collect, trade, discuss, and love slide rules.

University alumnus Darrell Rinerson (Physics ’69, EE M.S. ’77) bought his first slide rule at the drugstore in Ada, Minn., the small town in the northwestern part of the state where he grew up. It was made of cheap plastic and cost no more than a couple of dollars. He taught himself how to use the gadget, which came in very handy throughout high school. Rinerson bought what he calls his first “real” slide rule a few years later in Minneapolis.

"It was a Post Model 1460 made of bamboo, and it was controversial," Rinerson said. "Back then, Japanese products weren’t known for being high quality, so people didn’t really know if it would hold up."

Rinerson still has that bamboo slide rule, along with about 800 others from all over the world. Rinerson, founder and current CEO of Unity Semiconductor in Silicon Valley, started collecting slide rules during the early 1980s.

"I guess I like the way they look, the way they work, and the precision they offer," —DARRELL RINERSON

"I guess I like the way they look, the way they work, and the precision they offer," he said. "I’d say my most prized slide rule is a Thatcher—it’s very complex and can calculate up to five decimal places. Most only go to three. Other people I’ve met would like to find one like it."

Both Rinerson and Flom say their interest in the calculating devices is more about the future than the past.

"Slide rules evolved over hundreds of years as the by-product of people’s natural curiosity about how to solve problems more effectively," Flom said. "I think it would be a shame if tomorrow’s generation of engineers and mathematicians forgot about the slide rule, because it represents the engineer’s natural curiosity."

"I would be surprised if people maintain this level of interest in slide rules; most of the people who collect them are older than I am," Rinerson said. "But when I’m done collecting I’ll probably donate my collection so that younger people can see them, and maybe they’ll appreciate the details and history as much as I do." ■

Darrell Rinerson, CEO of California-based Unity Semiconductor, started collecting slide rules in the early 1980s. He now has about 800 from all over the world. He said his most prized slide rule is a Thatcher that can calculate up to five decimal places.

EUGENE LOUIE
Invent Ing tomorrow

So he packed his bags soon after graduation and set off for Kassel, Germany, where he spent summer 2005 as an intern for EAM Energy (now E.ON Mitte), a company that supplies electricity, natural gas, water, and heat to approximately two million customers in central Germany.

The multifaceted internship was perfect for someone like Skoglund.

“Each week I had a different boss,” he said. “I got to see the whole company.” Sometimes he stayed in the office doing routine tasks, like pressure equations to determine how building a supermarket at a particular location would impact the local gas supply. On other days he accompanied technicians into the field to fix electrical and gas grid failures with equipment that looked to Skoglund as if it came straight off the set of a Star Wars movie.

The company paid for him to attend one-on-one German classes twice a week. It also provided him with free lodging and meals at a Jugenddorf, a dorm-like residence for the company’s trainees.

“Everyone was extremely friendly,” he said. “I was amazed at how much effort they put toward me.”

Nick Bohl (EE ’06) got his first taste of world travel in high school, when he spent three weeks in Germany as an exchange student. “I had the time of my life,” he said. “That’s what got me excited and motivated to go abroad.”

As a University student majoring in electrical engineering and German, he took advantage of opportunities to learn and work around the world, starting with a three-credit physics class in Europe during May Session 2003. The three-week class combined an hour or so of daily instruction with field trips to research facilities in Italy and Switzerland.

“Most people in the class didn’t speak Italian or French, but we learned that you can function in another country without knowing the language,” he said.

The following year, Bohl got involved with IAESTE and landed a paid summer internship at Kraftwerke Mainz-Wiesbaden, a power plant in Mainz, Germany. He also secured a von Falkenhausen Scholarship that paid half of his airfare and many of his living expenses. He stayed in a family-run pensione (European-style guest house), made his meals on a hot plate, and rode a light-rail train to work every day.

When the internship ended, Bohl remained overseas and completed some of his liberal arts requirements at Albert-Ludwig University of Freiburg, Germany, before returning to the University and graduating this past spring.

Bohl will put his international experience to work as a field engineer for Schlumberger, a company that supplies technology services to oil and gas companies around the world. He’ll be starting in Algeria, but he has no idea where he’ll go from there.

“I’ll be moving to a different country every 12 to 18 months,” he said.

Wanderlust also is a way of life for electrical engineering senior Nikola Kunovski, a native of Skopje, Macedonia. He had already been studying for six years in the United States when he decided he still hadn’t seen enough of the world. Armed with a von Falkenhausen Scholarship, he set off for Wiesbaden, Germany, where he interned during summer 2005 at PersonaTEc, an information management company.

“My project helped with a long-overdue system software development for the Chamber of Architects in the state of Hessen,” he said.

Not one to sit still, Kunovski spent his weekends on the road. “I explored 10 cities in 12 weeks I was there,” he said. “I think I got the maximum out of it.”

Employers also benefit when they provide internships for international students. “For every position IAESTE can provide locally, we can send a University student overseas,” Kubitschek said.

The University chapter of IAESTE is seeking locally based companies to provide technical internships for international students. IAESTE’s placement service has an annual applicant pool of 30,000 students from which to select a highly qualified intern.

“Having employees with international experience benefits everyone involved,” Kubitschek said. “For both company and student intern, it’s an edge—an absolute, positive edge.”

FOR MORE INFORMATION contact IAESTE@umn.edu

CAROLYN WAVRIN contributed to this story.
As someone who enjoys travel and exploration, I immediately felt right at home when I joined the Institute of Technology as director of external relations earlier this year. Discovery is a way of life here, making the college a very exciting place to be.

Since March, I have been meeting with department heads and Dean Crouch to gain a better understanding of research and education within the college. I've learned that our students are receiving a first-rate education, and that faculty and students are conducting research—often interdisciplinary—that will help solve some of the most pressing problems facing our world today, including the crises in energy and health care.

Now that the University has embarked on a journey to become one of the top three public research universities, the Institute of Technology’s role is more critical than ever, especially in today’s competitive, high-tech world. By strengthening the college, we’ll be in an even better position to help the University provide the outstanding education, public service, and research our citizens deserve.

Achieving our vision will require talented people, hard work, and resources. Institute of Technology department heads have told me consistently that they need more graduate student fellowships and undergraduate scholarships to recruit top students, more endowed chairs and professorships to attract and retain gifted faculty, and state-of-the-art research facilities that serve as “discovery incubators.”

The impact of such investments in our faculty, students, and facilities extends well beyond campus borders. During a recent visit to Arizona, I met some remarkable alumni who have used their education and research to make a positive difference in the world.

After outstanding contributions to the medical-device and health care industries, Robert K. Anderson (EE ’63) and Art Schwalm (EE ’62) are helping some of today’s students to obtain an education. Anderson, founder and CEO of Valleylab, Inc., has been a major benefactor of Institute of Technology scholarships. Schwalm, retired founder and head of Cardiac Pacemakers Inc., has set up a bequest to establish scholarships in the departments of electrical engineering and biomedical engineering.

Roger Haxby (ME ’58) had a long career with Ingersoll-Rand before founding Waukesh Alaska Corp., an energy-production company. He made a major gift to help fund the new mechanical engineering facilities.

Personal experience prompted Bob Sundahl to make a significant gift that will endow a named fellowship in materials science. Sundahl (MetE ’58, M.S. ’64, Ph.D. ’66), who as a young student struggled to make ends meet, is grateful for the education that launched his distinguished career with information technology giants Bell Labs, Allied Signal, and Intel. Sundahl is also helping to lead a $20 million campaign to raise support for endowed fellowships for chemical engineering and materials science graduate students.

The Institute of Technology is a wellspring of talent and creative ideas that enter the world and over the course of time make significant contributions to our quality of life. Today’s challenges demand the best from all of us, and the University has crafted a plan to address those problems through world-class education and pioneering research.

But we cannot achieve this vision without you. Contributions of time, talent, and financial support from the college’s 50,000 alumni are essential to our success. I ask each of you to join the Institute of Technology in this ambitious venture. Together we can accomplish great things.
Medtronic gives $500,000 to U of M for biomedical engineering fellowships

THE UNIVERSITY OF MINNESOTA has received a gift of $500,000 from Medtronic, Inc. and the Medtronic Foundation for the creation of the Medtronic Fellows in Biomedical Engineering Fund. The fund will help support new full-time biomedical engineering graduate students during their first semester.

The contribution from Medtronic, which will be spread over five years, is the second major gift in a campaign to support the entire class of first-year biomedical engineering graduate students each fall. About a third of the contribution will be used immediately for graduate fellowships, while the remainder will be placed in an endowment to earn interest and fund fellowships over time.

The goal over five years is to raise at least $2 million for biomedical engineering fellowships. The payout on the endowed funds will be matched by the University of Minnesota to generate an estimated $200,000 per year to support 20 graduate students during their first semester. Student support is currently the University’s top fund-raising priority. This gift is part of the University’s Promise of Tomorrow scholarship and fellowship drive.

“The University has a long-standing partnership with Medtronic, and we’re delighted with their continued support of our students and research,” said Bob Tranquillo, head of the biomedical engineering department. “Funding for fellowships is critical to attracting top graduate students to the University of Minnesota who can pursue research frontiers in biomedical engineering.”

“Medtronic is very pleased to offer support to biomedical engineering graduate students at the University of Minnesota,” said Becky Bergman, Medtronic’s vice president of corporate science and technology. “It is important to Medtronic and to Minnesota’s medical device and emerging biosciences industry that we attract and train world-class biomedical engineers to help continue the state’s legacy of medical technology innovation.”

Medtronic has ties to the University of Minnesota that date back to the 1950s. The company’s founder, Earl Bakken, a 1948 electrical engineering graduate, worked with University researchers to develop and test the first wearable, battery-operated cardiac pacemaker. Medtronic employs many of the University’s biomedical engineering graduates.

Dockter joins IT team as director of external relations

KIM DOCKTER WAS RECENTLY NAMED director of external relations for the Institute of Technology by Dean Steven L. Crouch. Dockter comes to the University with extensive leadership experience in fundraising and advancement for institutions of higher education and nonprofit organizations.

Most recently she served as director of principal giving at Macalester College, where she was responsible for managing top-level prospects and for cultivating and soliciting major gifts. She joined Macalester’s advancement staff as director of major and planned giving in 2001.

Before coming to Macalester, Dockter was director of capital gifts at William Mitchell College of Law, St. Paul, Minn., and director of development for the St. Paul Area Chapter of the American Red Cross.

GIVING TO IT

The Institute of Technology (IT) plays a central role in helping the University prepare for a time of unparalleled scientific and technological change. IT faculty and students are conducting cutting-edge research and forging alliances with business and industry to improve our quality of life.

The future requires a substantial investment of intellectual and financial resources. Only with private support can we meet the ongoing challenge of inventing tomorrow.

For more information on areas of specific need or instructions on how to give, visit the IT Web site at www.it.umn.edu and click on the “Make a Gift to IT” link in the Spotlight section.

DEVELOPMENT TEAM

The Institute of Technology’s experienced development team can help you determine your best options for supporting the college. They can give you information about college programs with funding needs that match your interests and that best fit your financial situation.
Alumni brainpower sparks stellar year

ANY ORGANIZATION IS ONLY AS GOOD as the people involved. The more than 6,000 members of the Institute of Technology Alumni Society (ITAS) can feel very proud of our organization. A look back at the 2005-06 academic year shows a long list of successes and an even more exciting future.

As your alumni society president for the past year, I am happy to report that we had a great year. We were honored as the University of Minnesota Alumni Association’s Outstanding Alumni Society of the Year because of the variety of our projects and the enthusiasm of our volunteers.

In the spring we had an outstanding Science & Technology Banquet, which featured a timely talk by Dr. Paul Horn, senior vice president and director of IBM Research. Dr. Horn has been a champion of translating technology-based research into marketplace opportunities. The event attracted more than 400 participants.

The success of our K-12 outreach programs continues to grow. More than 450 visitors—children and their families—attended Tech Fest at The Works, a hands-on museum that makes learning about science and technology interesting and fun. I have it on the best authority that the day was a huge success—my nine-year-old granddaughter and her friends loved it! We also sponsored teams in the FIRST LEGO League competition to encourage elementary-school students’ interest in science and technology.

Last fall a number of alumni braved inclement weather to return to campus for an ITAS-sponsored public lecture by Professor Max Donath about the achievements of James “Crash” Ryan. Professor Ryan was one of the early legends of the mechanical engineering department and a national advocate for transportation safety.

Our award-winning mentor program, which matches working professionals with Institute of Technology students, attracted more than 300 participants this year. Students toured such workplaces as Lockheed Martin, Seagate Technology, and Goodrich Corporation, learned networking basics, and enjoyed social events.

This summer we launched our new Young Professional Series, a networking and career development opportunity for alumni in the earlier stages of their careers. The inaugural event featured Michael Berman, veteran medical-device entrepreneur and venture catalyst. Berman, a former president of Boston Scientific’s cardiology business and a former member of the company’s executive committee, has co-founded six companies and served as chairman of four of them.

Even if you live far from the Twin Cities area, you’ll enjoy many benefits as an ITAS member. Dozens of alumni chapters help you stay connected to the University from locations around the world. Chapters support the University and plan spirit, social, and educational events that bring area alumni and friends together. Other benefits include online resources, including an alumni directory, access to national job and résumé postings, a career contact directory, alumni editions of two University Libraries databases, and discounted fees for a distance career counseling service.

As I hand over my duties as president of your alumni society to Dawn Spanhake, I want to thank everyone who helped make this past year such a memorable one for our alumni. The success of our programs depends on our hardworking volunteers, which is why I urge you to get involved with ITAS. I can’t think of a better way to grow professionally and personally while helping the Institute of Technology, our alumni, and the next generation of scientists and engineers.
UMAA offers new online library benefit

THE DESIRE TO LEARN doesn’t end after graduation, which is why the University of Minnesota Alumni Association (UMAA) is offering a new membership benefit in conjunction with University of Minnesota Libraries.


Both databases are designed for the research needs of the post-college professional. They include full-text magazines, trade publications, business and academic journals, market research, and peer-reviewed publications. Among the many general-interest magazines offered are Time, Newsweek, Fortune, Health, Popular Science, Money, and Child.

Academic Search Alumni Edition offers information in nearly every area of academic study, including biology, chemistry, engineering, physics, psychology, religion and theology, and more. Business Source Alumni Edition includes publications in nearly every area of business, including marketing, management, MIS, accounting, finance, econometrics, economics, and more.

Registration with a valid UMAA membership number is required to use this benefit, which is intended for personal research and educational use only. To learn more and to join the UMAA, visit http://www.alumni.umn.edu/U_of_M_Libraries1.

The Works + kids = chemistry

EXCITING REACTIONS that glowed, popped, foamed, and smoked wowed children and their parents at Tech Fest 2006, the second annual ITAS Day at The Works. The event, held earlier this year, was a whizbang success, with more than 450 visitors at the hands-on science and technology museum in Edina, Minn.

The Works celebrated its 11th anniversary and National Engineers Week with a fun-filled day of chemistry-themed activities for the whole family. Children made ice cream the old-fashioned way, learned about acids and bases, and concocted the “drink of doom.” Students from the University of Minnesota Department of Chemistry demonstrated the science behind dry ice, glow sticks, liquid nitrogen, and a special favorite—soda mixed with mints. Kids and their families also enjoyed the museum’s ongoing exhibits.

The Institute of Technology Alumni Society (ITAS) partnered with the Society of Women Engineers, The Works, and corporate sponsors to provide free admission to the celebration.

About 1,000 graduates officially joined the alumni ranks May 5 during the Institute of Technology undergraduate commencement ceremony. In addition to their diplomas, all new graduates received a one-year membership to the Institute of Technology Alumni Society (ITAS), compliments of the University of Minnesota Alumni Association.
History of excellence spurs new success

BY JUDY WOODWARD

Typical of a modest, homegrown Minnesotan, the legendary Neal Amundson has often said it was “just luck” that created the University of Minnesota’s world-class chemical engineering and materials science department. But in reality, it was smart recruiting, decades of innovation, and an arranged marriage between two somewhat reluctant partners that gave birth to an intellectual powerhouse.

Chemical engineering and materials science emerged as distinct fields long before Amundson took over as the University’s chemical engineering department head in 1949. During the 19th century, the Industrial Revolution spawned newfound technologies that required unprecedented amounts of chemicals as well as ever-increasing quantities of iron and steel. To meet these demands, science and industry came together in new and exciting areas of study, including what is known today as chemical engineering and materials science.

At the same time, the young University of Minnesota, which had been forced to close during the Civil War, reopened in 1869 with a new vigor and sense of purpose. By the turn of the century, the University was poised for greatness.

Although there had been tentative earlier efforts, chemical engineering at the University got its true start in 1919, when Charles A. Mann was hired to lead the newly created Division of Chemical Engineering in the School of Chemistry.

For the next 30 years, Mann presided over a field of study that he called the “controlled and disciplined magic of everyday life.” He often reminded audiences that it was the chemical engineer’s task to create “wealth out of waste,” developing valuable resources from what was assumed to be useless.

That same philosophy also undergirded the earliest beginnings of the materials science program. In 1892, the University founded the School of Mines and Metallurgy to provide the mining industry with technical training and scientific expertise. The longevity of Minnesota’s mining industry is due largely to the pioneering work of University faculty who in the 1940s developed the taconite process that extracted iron from the state’s deposits of low-grade ore.

As the second half of the 20th century began, the chemical engineering program was undergoing a remarkable transformation. Under the visionary leadership of Amundson (ChemE ’37, M.S. ’42, Math Ph.D. ’45), the department burst onto the international scene in the 1950s with its revolutionary applications of mathematical modeling. Today, the University’s chemical engineering program continues to be ranked among the nation’s best.

“We all consider Amundson our father figure. Under his leadership, Minnesota reinvented the field of chemical engineering.” —KEN KELLER

Neal Amundson, 90, is one of the hundreds of Department of Chemical Engineering and Materials Science alumni who recently celebrated the department’s distinguished legacy at a special weekend event on campus. The event launched CampaignFIRST, an important initiative aimed at maintaining the department’s excellence for decades to come. For more information, visit www.cems.umn.edu.

“At the same time he was blazing new intellectual trails, Amundson recruited some of the brightest minds from around the world. He was renowned for his ability to spot talent.
“Amundson is an almost infallible judge of people. It was his greatest strength,” said retired chemical engineering professor Arnie Fredrickson.

Amundson himself attributes his success to a very simple hiring practice. “I never hired anybody if I thought I was smarter than they were,” he said.

In addition to Keller and Fredrickson, Amundson hired H. Ted Davis, who eventually became dean of the Institute of Technology; L.E. Scriven, John Dahler, and the late Rutherford Aris, who laid the intellectual foundations of modern chemical engineering; and Lanny Schmidt, who invented a reactor that extracts hydrogen gas from ethanol.

The chemical engineering program also attracted top-notch students who produced outstanding work in their own right. Robert Gore (ChemE Ph.D. ’63), inventor of Gore-Tex, and recently retired ExxonMobil CEO Lee Raymond (ChemE Ph.D. ’63) are among the best-known alumni.

The program was very demanding, recalls Art Fry (ChemE ’55), inventor of the Post-it Note and retired longtime 3M employee. “Chemical engineering was always tough,” he said. “You had to take so many credits and work so hard, but if you could get through school, you could do just about anything.”

At the same time, Richard Swalin, Morris Nicholson, and their colleagues were shaping a new direction for the Department of Metallurgy, strengthening its focus on materials science. As the years progressed, the fields of materials science and chemical engineering began to intersect in significant ways, including the joint application of electron microscopy and a shared interest in polymer science.

In 1970, University reorganization plans called for a merger of chemical engineering and metallurgy. “Most of us objected very strongly to the merger,” says Keller. “We thought it would hurt our homogeneity of values and interests.”

But the University administration was adamant, and the merger went forward. The newly christened Department of Chemical Engineering and Materials Science quickly established a complementary mesh of research interests: the computationally oriented analysis of the processing of chemicals and studies of the properties of chemicals. This intersection resulted in groundbreaking research in such areas as polymers and cryomicroscopy.

“[The merger] was ultimately a wonderful success. When pushed to the wall, it was our imaginations that made it work,” Keller said.

Bill Gerberich, one of the first materials scientists hired after the merger, said that the combined efforts of the two disciplines brought the first atomic-force microscope to campus in the mid-1980s. Its availability changed his research concentration from metal fatigue and fractures to nanoindenters, a technology that has applications in the manufacture of silicon chips and transistors.

During the 1970s and 1980s, Aris, Keller, and Davis followed in Amundson’s footsteps as department head and continued to recruit stellar faculty.

Today, Professor Frank Bates is leading the department into the new century. Although there is no foolproof recipe for success, the department’s tradition of excellence is his trusted compass, he said.

“You hire smart faculty, work hard, demand excellence, and recruit great students,” Bates said. “And if you’re fortunate enough to inherit a department from Amundson, you’ve got a great starting point.”

FOR MORE INFORMATION see www.cems.umn.edu

TOM DE RANITZ AND CAROLYN WAVRIN contributed to this story.
Scholars Walk

Dedication Event
Friday, September 29, 2006

Join the University of Minnesota Alumni Association (UMAA) on Friday, September 29, to celebrate the completion of the Scholars Walk, a wide pathway across the East Bank campus honoring the research and academic accomplishments of the University’s award-winning students and faculty. Several Institute of Technology faculty and alumni are among those being honored.

Lined with trees, shrubs, and benches, the walk includes lighted glass-and-limestone monuments recognizing Nobel and Pulitzer Prize winners; Rhodes, Truman, and Marshall Scholars; members of top academic academies; and many others.

The Scholars Walk stretches 2,000 feet from McNamara Alumni Center west toward Northrop Mall, ending at the front door of Appleby Hall. The Scholars Walk and the nearby Alumni Wall of Honor are gifts to the University from the UMAA, the University of Minnesota Foundation, and the Minnesota Medical Foundation.

For more information, visit www.alumni.umn.edu.