University of Minnesota

A magazine for alumni and friends of the Institute of Technology | spring/summer 2009

INVENTING TOMORROW

INNOVATIVE PARTNERSHIP

Collaboration between the Institute of Technology and 3M has resulted in worldwide benefits >>

ALSO INSIDE:

IT faculty tackle global climate change issues >>

IT students' ideas save dollars for business >>

INVENTING TOMORROW

Spring/Summer 2009
Vol. 33, No. 2

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Inventing Tomorrow welcomes readers' comments and story ideas for future issues.

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spring/summer **2009**

INVENTING TOMORROW

DEPARTMENTS

ON THE COVER

Lester Krogh (Chem '52 Ph.D.), Art Fry (ChemE '55), and Pat McGuire (ME '81) are among the Institute of Technology alumni who have made innovative contributions to 3M's success • 14

PHOTO BY JAYME HALBRITTER

Introspection is key to college's success

We are confident that the outcome of examining our college will provide important feedback for decisions that will make us stronger than ever.

IN TODAY'S ECONOMIC CLIMATE, it is more important than ever that we continue to examine who we are as a college and the direction we are headed. We have clearly set our research priorities in the areas of energy and the environment, health care and medical devices, and a strong national infrastructure. We will achieve new breakthroughs by employing all the latest technology including nanotechnology and digital and electronic technologies. We also strive to provide top quality undergraduate and graduate educational opportunities for our students.

Beyond this important foundation, we are also looking at what other barriers we are facing in order to compete for research funds, students, and faculty. Earlier this academic year, my advisory board identified the name of our college (including its acronym IT) as increasingly problematic in terms of securing financial support and recognition for critical academic programs.

Today, IT has come to mean Information Technology to virtually everyone. The board also stressed that few people outside the University have an understanding of the difference between the Institute of Technology and other University of Minnesota research institutes.

In an effort to increase the visibility of engineering and science programs within the Institute of Technology, we have conducted wide-ranging discussions of a possible name change for the college. We commissioned the University's Carlson School of Management's Brand Enterprise program to assist with our research. Over the past few months, they have involved a wide variety of stakeholders in the discussions, including alumni, faculty, staff, students, business leaders, and other groups.

The results of the research will be examined over the next few months and discussed with the advisory board. Change is always difficult, but we are confident that the outcome of examining our college will provide important feedback for decisions that will make us stronger than ever.

In addition, we also recently conducted a statistically-valid survey about this magazine to assess its value. We were pleased to find that the reach of *Inventing Tomorrow* is high. About 88 percent of readers say they read at least one article and the typical reader spends about 25 minutes reading through the magazine. At least 70 percent report either skimming or reading each key section.

The survey also showed that *Inventing Tomorrow* is building awareness and providing information on the college's top priorities, especially in the areas of research and education in renewable energy and the environment.

This issue of the magazine is no exception. In the article "Winning the War on Global Climate Change," we highlight faculty researchers who are helping to tackle some of the most perplexing scientific questions about climate change, ultimately providing policymakers with a sound basis for critical decisions.

In the article "Innovative Partnership," we highlight the more than 100-year partnership between the Institute of Technology and 3M that has shaped innovative ideas and created products that we use every day. Many Institute of Technology alumni are among the most illustrious leaders of the company.

That spirit of innovation is continuing in our students today. In the story "Tapping Student Talent," we highlight two current Institute of Technology students and one recent graduate who are part of the Minnesota Technical Assistance Program. Last year, the program helped companies realize energy savings of more than $3 million.

It is stories like these that give me encouragement about the future. If we can ensure that our college remains strong, I am confident that we will play an important role in the economic turnaround of our state and nation. ■

RECOMMENDED Extras | on the Web

Each day, more Institute of Technology faculty, students, and alumni are being featured in videos on the Web. We've listed some of the more recent offerings you may want to view. Just visit our Web site at **www.it.umn.edu/inventing/videos** and click on each of the links.

Science of Watchmen

Authenticity rules in the movie "Watchmen" thanks to James Kakalios, professor of physics, who helped Hollywood get the science right. The video has been widely successful since it launched, with more than 1.5 million views.

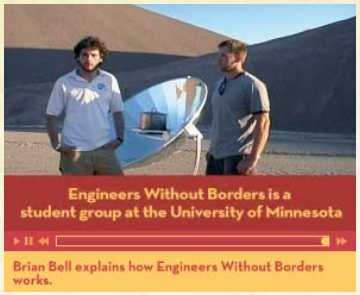
Study of Road Salt and Minnesota Water

A recent University News Service video features Heinz Stefan, civil engineering professor. Stefan and his research group have completed a study showing that road salt is increasing the salinity of lake and river water in Minnesota.

Beyond Fossil Fools

Joe Shuster (ChemE '55), author of "Beyond Fossil Fools: The Roadmap to Energy Independence" gives a relevant and revealing lecture on the most important issue of our time: energy.

Engineers Without Borders



Institute of Technology students Brian Bell and Nathan Knutson are working alongside other students in the Engineers Without Borders program at the University of Minnesota. Focused on Haiti's massive garbage problem, the students are developing a portable solar cooker that can melt plastic waste into a liquid that can be poured into molds to make usable items such as footwear, utensils, and sports equipment.

Left to Their Own Devices

The University of Minnesota Medical Devices Center (MDC) is at the intersection of medicine and technology. Art Erdman, professor of mechanical engineering and MDC director, explains how physicians and engineers work together to create tomorrow's medical miracles.

Medical Devices Fellows Program Director Marie Johnson talks about the program that is dedicated to developing new medical devices to improve health care worldwide.

GIVE US YOUR OPINION

Inventing Tomorrow has been published for more than 15 years, and we'd like to hear from you about what you like about the magazine and perhaps what you would like to change. So here's your opportunity to give us compliments, constructive criticism, even suggest story ideas. An online survey for Inventing Tomorrow has been set up for our readers that you may access from the Institute of Technology Web site at: **www.it.umn.edu/inventing/survey.** Simply click onto the site, answer the questions, and then click "send." The information will be used in planning for future issues. Thank you for your help and for reading *Inventing Tomorrow*.

TECHDIGEST>

Ancient stalagmite reveals information for U researchers about China's history

An ancient stalagmite taken from a cave in China has given two University researchers insight about how the region's precipitation has varied—and possibly influenced the rise and fall of various dynasties—for the past 1,800 years. Their findings were recently published in *Science.*

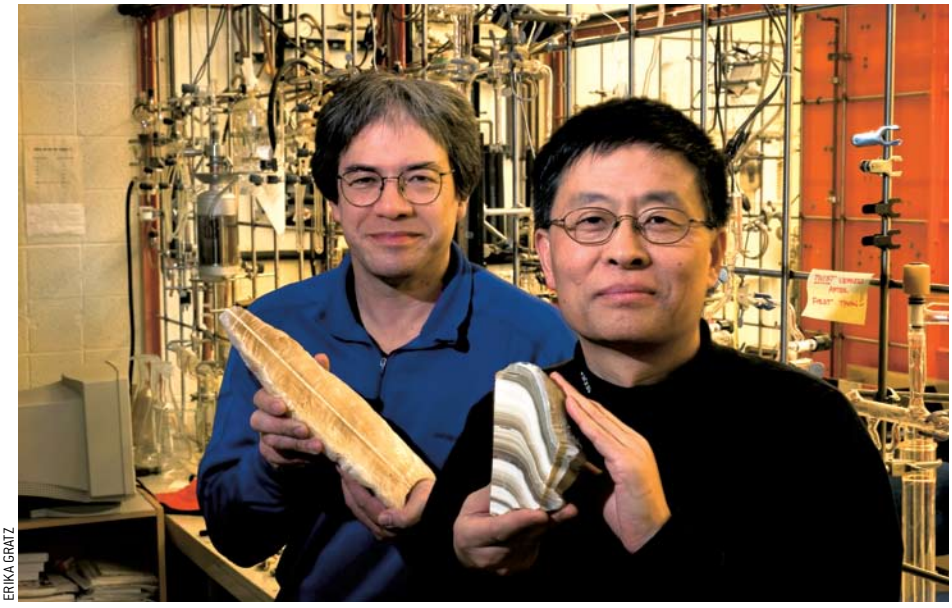
The work, conducted by Hai Cheng, University researcher in the Department of Geology and Geophysics, and Lawrence Edwards, professor of geology and geophysics, rests on climate records preserved in the layers of stone in a 118-millimeter-long stalagmite found in Wanxiang Cave in Gansu Province, China. The stalagmite started forming some 1,810 years ago, and also recorded information about the weather and the frequencies of monsoon events during the past almost two millennia.

When split in half length-wise, stalagmites expose wavy lines similar to growth rings in a tree. They can be considered nature's time capsule, showing the ebb and flow of climate on the earth. By measuring amounts of uranium and thorium throughout the stalagmite, the researchers determined the date each layer was formed. They also were able to determine which years were wet and which were dry, based on different types of oxygen found in the rock.

The researchers discovered that periods of weak summer monsoons coincided with the last years of the Tang, Yuan, and Ming dynasties, which are known to have been times of popular unrest. Conversely, the researchers found that a strong summer monsoon prevailed during one of China's "golden ages," the Northern Song Dynasty.

"The waxing and waning of summer monsoon rains are just one piece of the puzzle of changing climate and culture around the world," Edwards said.

Currently, China is also facing a descending monsoon strength trend that started in the 1960s. Some say that global warming is to be blamed, others point at carbon emissions, while a third group claims that man-made soot is responsible.



ERIKA GRATZ

Lawrence Edwards, professor of geology and geophysics, and Hai Cheng, researcher in the Department of Geology and Geophysics, display stalagmites. Similar to growth rings in a tree, stalagmites are often composed of concentric layers that represent annual growth periods, and can help researchers tell which years were wet and which were dry, based on different types of oxygen found in the rock.

Hollywood consults physics professor on 'Watchmen'

HOLLYWOOD'S RECENT "WATCHMEN" FILM was a little more believable thanks to the expertise of University physics professor Jim Kakalios. He was hired by creators of the superhero movie to make sure its science didn't slip into a black hole of unbelievability.

Kakalios became involved in the production in 2007, when he received a call from the National Academy of Sciences. Movie producers were looking for someone to help them with science and wondered if Kakalios, author of "The Physics of Superheroes," had heard of the "Watchmen" comic books, published in the 1980s.

He had and after a couple of conference calls, he flew to the Vancouver set, where he talked with the filmmakers about how a physics lab might look in 1959—the year a physics-experiment accident gives superpowers to the character Dr. Manhattan—and 1985, the year the story takes place. He also showed them what might appear on a physics professor's blackboard.

Kakalios applied his physics expertise by making sense of Dr. Manhattan's superpowers, which include teleportation, controlling matter with his mind, and changing his size. He said the powers seem to be "more or less" quantum mechanical. In other words, they can be more or less explained by applying the physics of microscopic particles, or quantum mechanics, to humans and larger objects.

TO VIEW A VIDEO produced by the University where Kakalios discusses his involvement in "Watchmen," visit: www.youtube.com and enter the search term: Science of Watchmen.

Researchers find road salt affects Minnesota lakes and rivers

UNIVERSITY RESEARCHERS studied 39 lakes, three major rivers and their tributaries, and numerous wells around the Twin Cities and found about 70 percent of the road salt being applied in the metro area during the winter is retained in the watershed.

Heinz Stefan, a civil engineering professor at the University's St. Anthony Falls Laboratory who led the study for the Local Road Research Board, found salt concentrations in the water has increased over the last 24 years. While current salt levels aren't harmful, the research team says increases in sodium and chloride have been shown to decrease biodiversity in wetlands and reduce fish populations.

More efficient use of road salt could help lessen the impact on the environment and save money. The Minnesota Pollution Control Agency has mounted a training program to get road crews to apply salt more judiciously. Highway crews are using various techniques to cut down on the salt. They often lay down a thin layer of salt before a storm, so ice doesn't get a chance to form in the first place. They also mix salt and sand with water so it will stick better. The program is working at the University of Minnesota. Since training began two years ago, workers have reduced the amount of salt they use by 41 percent, saving more than $50,000 in one year.

MIKE WEISS

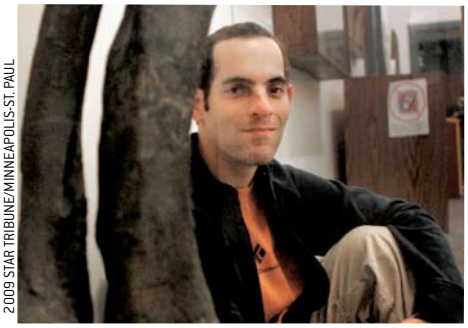
Civil engineering professor Heinz Stefan is leading a research team to study the effects of road salt on local water quality. Research showed 70 percent of the salt applied to de-ice roads during the winter in the metro area stays in the area.

"This is a wake-up call. If we keep on doing this for another 50 years, we may have a significant problem," Stefan said. "Certainly if groundwater becomes saline, when we use that water, we may have to treat it at significant cost.

U researcher identifies real Texas dinosaur

ACCORDING TO UNIVERSITY RESEARCHER, Peter Rose, a Ph.D. candidate in geology and geophysics, the current Texas state dinosaur, Pleurocoelus, has been misidentified. It turns out the dinosaur bones found near the Paluxy River in Glen Rose, Texas, and named the state dinosaur weren't Pleurocoelus bones at all, but a whole new dinosaur.

The discovery came while Rose was working on his master's degree in Texas. He began scrutinizing fossils from the Jones Ranch in central Texas. The fossils were from a sauropod, a huge plant-eater from millions of years ago. It was long-accepted that the large bones were Pleurocoelus, and by 1997 they gained the title of Texas State Dinosaur.



2009 STAR TRIBUNE/MINNEAPOLIS-ST. PAUL

Doctoral candidate Peter Rose discovered dinosaur bones found in Texas were misidentified.

Rose determined the fossils were not Pleurocoelus at all, and did not match any known genus and species. He named his new find Paluxysaurus jonesi, in a tribute to the Jones Ranch and its collection of fossils.

Rose's discovery is behind a resolution in the Texas Legislature to change its official state dinosaur from Pleurocoelus to Paluxysaurus, which he's excited about.

"But when you come down to it, whether it's a new species is not the big question. More important are some of the bigger picture ideas about how these organisms evolved and what they were doing when they were alive. I hope the future work I do has some broader implications," Rose said.

Video game offers new way to study human behavior

A RESEARCH STUDY by computer science and engineering professor Jaideep Srivastava and colleagues nationwide revealed findings showing that online game communities are large enough to resemble traditional communities in many ways now. The findings are being used in social science to study human behavior using games like EverQuest 2.

With data collected over the span of three years and weighing in at more than 60 terabytes, the study tracked the behavior of approximately 300,000 EverQuest 2 players who averaged 26 hours per week playing the game.

Because of the intense level of involvement and multi-player environment of the game, the researchers were able to model social and behavioral dynamics of individuals, groups, and networks within the EverQuest 2 community.

Their study presented evidence that the social sciences are at the threshold of a fundamental shift not only in our understanding of the social and behavioral sciences, but also the ways in which we study them.

The results were recently presented at the American Association for the Advancement of Science (AAAS) annual meeting during a 90-minute symposium titled "Analyzing Virtual Worlds: Next Step in the Evolution of Social Science Research."

FACULTY HONORS

Jon Anderson (physics and astronomy), an instructor in the University's PhysTEC program, won second prize from the 2008 Kavli Institute for Theoretical Physics Teachers Conference for his presentation on Particle Physics in the Age of the Large Hadron Collider.

Professor **Douglas Arnold** (mathematics) was elected as a foreign member in the Norwegian Academy of Sciences and Letters.

Five Institute of Technology faculty were named recipients of the 2009–11 McKnight Land-Grant Professorship, a program designed to advance the careers of the University's most promising junior faculty. They are associate professors **Arindam Banerjee** (computer science and engineering), **Ryan Elliott** (aerospace engineering and mechanics), **Tian He** (computer science and engineering), **Julian Marshall** (civil engineering), and **Martin Saar** (geology and geophysics).

Professor **Graham Candler** (aerospace engineering and mechanics) was named a Fellow of the National Security Science and Engineering Faculty Fellows (NSSEFF) Program, by the U.S. Department of Defense.

Professors **Paul Crowell** (physics), **Yong-Zhong Qian** (physics), and **Hans Othmer** (mathematics) have been elected fellows of the American Physical Society.

Professor **Jane Davidson** (mechanical engineering) and professor **Lanny Schmidt** (chemical engineering and materials science) were recently appointed to Gov. Pawlenty's Clean Energy Technology Collaborative. They are part of a 15-member team that will identify the most promising research and development related to clean energy technology that may be beneficial to Minnesota.

Professor **Jane Davidson** (mechanical engineering) was selected as the Ada Comstock Distinguished Women Scholar Lecturer for Spring 2009. Created to honor the scholarly leadership and achievements of distinguished women faculty at the University, her lecture, "Solar after Dark: Going Green at Night," reflects her work in using solar energy to create fuels.

Regents professor **H. Ted Davis** (chemical engineering and materials science) is among the first 10 people to be inducted into the Minnesota Science and Technology Hall of Fame, co-founded by the Minnesota High Tech Association (MHTA) and the Science Museum of Minnesota.

Professor **Will Durfee** (mechanical engineering) received the Volunteer of the Year Award at the Minnesota FIRST Regional Robotics Competition for his ongoing work to promote robotics within Minnesota high schools.

Professor **R. Lawrence Edwards** (geology and geophysics) has been awarded a prestigious 2009 Guggenheim Fellowship in the 85th annual U.S. and Canadian competition sponsored by the John Simon Guggenheim Memorial Foundation.

Associate professor **David Fox** (geology and geophysics) has been selected to be an Edward P. Bass Distinguished Visiting Environmental Scholar at Yale University. The Edward P. Bass Distinguished Visiting Environmental Scholars Program brings premier scholars in any field dealing with the study of the environment, past or present, to Yale for an extended period of time.

Four Institute of Technology professors have been named to three-year appointments as Taylor Distinguished Professors to work as a team of key advisors on matters related to improving undergraduate education within the college. The professors are **Lorraine Francis** (chemical engineering and materials science), **James Kakalios** (physics), **James Leger** (electrical and computer engineering), and **Kenneth Leopold** (chemistry).

Four Institute of Technology faculty have been named to three-year appointments as resident fellows within the University's Institute on the Environment. They include professor **Efi Foufoula-Georgiou** (civil engineering), assistant professor **I. Volkan Isler** (computer science and engineering), assistant professor **Julian Marshall** (civil engineering), and associate professor **Kristopher NcNeill** (chemistry).

Professors **Bin He** (biomedical engineering) and **Joe Konstan** (computer science and engineering) are recipients of the 2009 Distinguished McKnight University Professorship, which recognizes and rewards outstanding mid-career faculty.

Assistant professor **Tian He** (computer science and engineering), assistant professor **Efie Kokkoli** (chemical engineering and materials science), and assistant professor **Duane Nykamp** (mathematics) have been awarded National Science Foundation Faculty Early Career Development grants for their research. The CAREER program is one of the NSF's most prestigious awards for junior faculty.

Professor **David Kohlstedt** (geology and geophysics) has been awarded the Murchison Medal for 2009 from the Geological Society of London for his significant contribution to geological science.

Associate department head **Joe Konstan** (computer science and engineering) has been named a fellow of the Association for Computing Machinery (ACM) for his contributions to computing technology.

Associate professors **Doreen Leopold** (chemistry) and **James Stout** (geology and geophysics) received a Morse-Alumni Undergraduate Teaching Award for their outstanding contributions to undergraduate education.

Professor **Timothy Lodge** (chemistry) and professor **Shashi Shekhar** (computer science and engineering) have been awarded the distinction of Fellow from the American Association for the Advancement of Science (AAAS). Lodge is recognized for his contributions to polymer science, especially in polymer dynamics and in the phase behavior of block copolymers. Shekhar is recognized for his research, service, and teaching contributions in spatial databases, spatial data mining and geographic information science.

Assistant professor **Yoichiro Mori** (mathematics) has been awarded a Sloan Research Fellowship. He is one of 118 outstanding early career scientists who are conducting research at the frontiers of physics, chemistry, computational and evolutionary molecular biology, computer science, economics, mathematics, and neuroscience.

Associate professor **Paige Novak** (civil engineering) has been named a 2009 Leopold Leadership Fellow for her exceptional scientific qualifications, demonstrated leadership ability, and strong interest in communicating science beyond traditional academic audiences.

Professor **Hans Othmer** (mathematics) has been awarded the 2009 Akira Okubo Prize. He will deliver the Okubo lecture at the next Society

for Mathematical Biology annual meeting in Vancouver, Canada.

Associate professor **R. Lee Penn** (chemistry) has been named a University of Minnesota McKnight Presidential Fellow 2008–2011 for her research focusing on the chemical and physical behavior of nanocrystalline materials.

Associate professor **Stergios Roumeliotis** (computer science and engineering) has been awarded a prestigious Presidential Early Career Award for Scientists and Engineers (PECASE). The award is the nation's highest honor recognizing outstanding early career researchers.

Professor **Jaijeet Roychowdhury** and adjunct associate professor **Nikos Sidiropoulos** (electrical and computer engineering) were elected Fellows by the Institute of Electrical and Electronics Engineers (IEEE) Board of Directors. Roychowdhury was honored for his contributions to simulation and automated macromodeling of integrated circuits. Sidiropoulos was honored for his contributions to signal processing for communications.

Professor **Arnd Scheel** (mathematics) has received the 2009 J. D. Crawford Award by the SIAM Activity Group on Dynamical Systems for his work on planar defects, on structures generated by inhomogeneities in oscillatory media, on stability for almost planar fronts and viscous shocks, and for discovering new patterns in the process.

Professor **Fotis Sotiropoulos** (civil engineering) and postdoctoral candidate **Iman Borazjani**, researcher at the National Center for Earth-surface Dynamics, were recently among the winners of the prestigious Gallery of Fluid Motion competition at the 61st Annual American Physical Society (APS) Division of Fluid Dynamics meeting.

Regents professor **Donald Truhlar** (chemistry) has been named a fellow of the Royal Society of Chemistry for his outstanding contributions to the field of chemical sciences.

Professor **Ofer Zeitouni** (mathematics) will serve as editor-in-chief of the "Annuals of Probability" for 2009–11. The premier journal in probability theory is published by the Institute of Mathematical Statistics.

In memoriam

Naresh Jain

NARESH JAIN, A LONG-TIME PROFESSOR of mathematics and former head of the School of Mathematics, died Jan. 1, 2009. He was 71.

Born in India, Jain received a bachelor's degree in mathematics in 1956 from Meerut College, India, and a master of science in mathematics in 1958 from the University of Lucknow, India. He earned a Ph.D. in mathematics from Stanford University in 1965.

Prior to joining the University of Minnesota in 1965 as an assistant professor of mathematics, he served as a lecturer at Banaras Hindu University in India and as a teaching assistant at Stanford University.

Jain became associate head of the School of Mathematics in 1990, serving in that role until becoming head of the school in 1995. During his tenure, Jain fostered the research and teaching missions of the mathematics department by hiring outstanding faculty and supporting educational initiatives. Examples include the Institute of Technology calculus program and research experiences for undergraduates and helping to develop the University's Minnesota Center for Industrial Mathematics. He also worked closely with the Institute for Mathematics and its Applications (IMA). In 2003, he stepped down as head and returned to teaching and his research.

FILE PHOTO

Jain's area of expertise was probability theory, specifically Doeblin Markov processes, random walk asymptotics, Gaussian processes, and theory of large deviations. He authored numerous papers and was a frequent probability theory lecturer at conferences worldwide. He also was associate editor for the Institute of Mathematical Statistics' Annals of Probability publication.

U of M astronomers help exploded star come alive across time and space

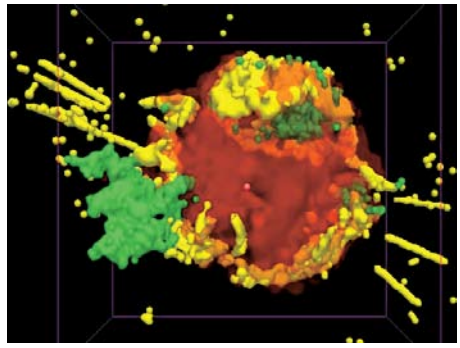
UNIVERSITY OF MINNESOTA astronomers led an international team of researchers who have developed a new three-dimensional visualization of the famous Cassiopeia A supernova remnant that gives astrophysicists new clues about how exploding stars form new stars and solar systems. The findings were presented at the American Astronomical Society meeting.

Astronomy professor Lawrence Rudnick led the NASA Spitzer Space Telescope observation program that yielded data for the 3-D visualization, which gives researchers a more complete understanding of how this famous supernova explosion and its remnant work.

The groundbreaking 3-D model was created by Tracey DeLaney, a 2004 University of Minnesota Ph.D. graduate in astrophysics who is conducting postdoctoral research at MIT. The model used data from NASA's Chandra X-ray Observatory, NASA's Spitzer Space Telescope and ground-based optical telescopes.

In addition to the 3-D simulation, a movie of data from NASA's Chandra X-ray Observatory was recently released. It shows changes in time never seen before in Cassiopeia A.

Together, these tools will help astrophysicists understand how supernovas seed interstellar gas with heavy elements, heat it with the energy of their radiation, and trigger blast waves that help new stars form.



A new three-dimensional model of Cassiopeia A will give astrophysicists new clues about how exploding stars form new stars and solar systems.

Winning THE WAR ON GLOBAL CLIMATE CHANGE

WRITTEN BY **RICHARD BRODERICK**

PHOTOS BY **JAYME HALBRITTER**

Vipin Kumar, head of the department of computer science and engineering, and graduate student Shyam Boriah, are developing algorithms and software that are being used by NASA to mine satellite images that create a history of changes in Earth's land-cover.

THE INSTITUTE OF TECHNOLOGY IS IN A STRONG POSITION TO HELP TACKLE MANY OF THE MOST VEXING SCIENTIFIC QUESTIONS ABOUT CLIMATE CHANGE

Scientific evidence increasingly shows that human enterprises—especially burning fossil fuels such as coal, oil, and natural gas—are altering the Earth's climate.

Scientists have voiced concerns for years about an alarming decline in the size of the Arctic ice cap, which functions as a giant air conditioner for the planet's climate system as it reflects sunlight into space. The U.S. Geological Survey recently released a detailed map of the Antarctic coastline and found dwindling and even disappearing ice shelves.

Though, among researchers, there is wide-ranging opinion over how quickly Earth's atmosphere is heating up, and a broad range of theories of exactly how that warming is going to affect the biosphere, there is almost no credible debate in the scientific community over one sobering fact: the hour is late.

"Climate change is not only a global problem. It is intertwined with land and water use, urbanization, deforestation, the emergence of new diseases, and more," said Jon Foley, director of the University of Minnesota's Institute on the Environment. "It's not just a question of overall average temperature rising, but a fundamental reorganization of the whole climate system."

The implications are almost incalculable. By comparison, Foley said, "Look at what is happening in the markets right now because people were messing around with some obscure financial instruments. The current situation pales in comparison to what might happen if, for example, several of the world's major breadbaskets were to experience a drought simultaneously."

The Institute on the Environment was formed two years ago to serve as a multidisciplinary bridge across the University—an "incubator" in Foley's words—designed to bring together "core physical science research" around environmental issues as well as thinking about the specific policy and legal implications of environmental impacts. In January, the Institute entered into a partnership with Climate Central, a new non-governmental organization (NGO) that already has partnerships with Princeton and Stanford. "Its goal is to take the best of the scientific and policy development worlds and bring their findings to policymakers using the lens of science itself," Foley said. "It's the first NGO I know of started by and for science."

One of the biggest challenges policymakers face is that there is still so much to be learned about the dauntingly complex causes of climate change and the equally daunting complexity of exactly how climate change will affect all of the Earth's myriad ecosystems.

The Institute of Technology is in a strong position to help tackle many of the most vexing scientific questions about climate change, ultimately providing policymakers with a sound basis for critical regulatory and resource decisions.

"The interface we have with IT brings tremendous depth in the physical sciences," Foley observes. "The University of Minnesota is especially strong in several disciplines directly related to critical environmental factors, including areas that involve the causes of climate change."

The following profiles of three Institute of Technology researchers provide a snapshot of the work being conducted on the Earth's changing global climate.

"Questions about how land use is changing are important for many reasons, but especially for policy planning."

—VIPIN KUMAR

Vipin Kumar

Modeling the impact

"We are computer scientists," declares Vipin Kumar, head of the Department of Computer Science and Engineering. "We develop algorithms and software that, among other things, can be used for data mining of complex information."

Mechanical engineering professor Peter McMurry is researching how and why clouds form, what role anthropogenic forcing plays in cloud formation, and the secrets of aerosol systems and their role in the formation of nanoparticles that go on to serve as cloud seeds.

Right now—and most critically when it comes to climate change—the data mining algorithms and software developed by Kumar and Shyam Boriah, a graduate student in computer science and engineering, are being used by NASA to mine satellite images to create a history of changes in Earth's land-cover. In particular, detecting changes in the forest ecosystem and its recovery period is critical for sustainable management of forest resources, monitoring the impacts of climate change on forests, documenting a nation's compliance with United Nations protocols, and carbon trading.

Kumar and his team have also developed algorithms to identify sudden changes in Earth's forest cover—a sure signal of rapid deforestation, which can contribute a double-whammy of CO_2 to the atmosphere. For example, fire releases carbon dioxide directly while fewer trees mean fewer leaves to absorb CO_2.

"There's a lot of satellite data now going back to the 1980s," Kumar explains. "It's a painstaking process to sort through that data in any meaningful way to determine what changes have taken place over time."

In a nutshell, that's what Kumar's spatio-temporal data mining techniques are designed to do. They also employ data collected by satellites to map out the interactions between ocean temperatures, weather patterns, and land cover in the larger pattern of fluctuation of atmospheric CO_2 levels.

"We have developed algorithms that take data from different parts of the globe and use them to identify changes to the Earth's surface," he said. "Questions about how land use is changing are important for many reasons, but especially for policy planning."

One of the first applications of Kumar's data mining system for detecting land cover change was done for the state of California. "When we applied it to the Bay Area vegetation data, we were able to detect changes like farmland being converted to housing subdivisions and golf courses," he said. "When we applied our software to the state as a whole, it identified numerous conversions of desert into farmlands and a large number of forest fires."

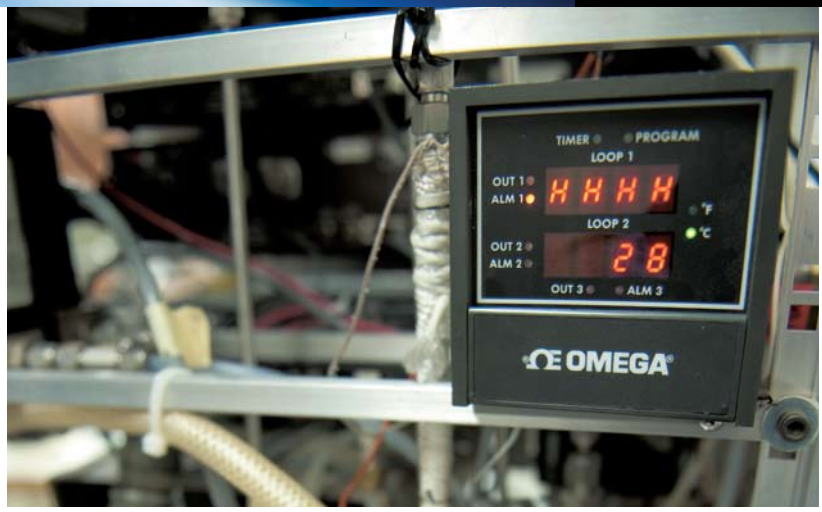
Once the systems Kumar is developing are completely fleshed out, he sees a number of potential uses beyond environmental policy.

"The biggest use, of course, will be for carbon modeling—the folks who want to know where vegetation is changing so they can use that information to help build models of how much carbon is going into the atmosphere and how quickly," he said. In this regard, it's vital to know the time frame over which change has occurred.

"It makes a big difference if trees are burned down or if they are used to make furniture," he said. "It's quick versus slow release of carbon. To do precise carbon cycle modeling, we need to know the answer to these kinds of questions."

But Kumar sees one additional role for his team's algorithms and software—public education.

"Our goal is to make this system available to the public so that even schoolchildren will be able to use it and see what is happening to our environment."



Mechanical engineering professor Peter McMurry and his colleagues built the apparatus shown above to measure the moisture absorption and volatility of atmospheric nanoparticles formed by nucleation.

Peter McMurry

Solving the aerosol puzzle

In his office, mechanical engineering professor Peter McMurry pulls up a satellite image on his computer screen.

Over the thin mid-section of Central America, a large cloud tails off to the west, obscuring a swath of land and ocean far out into the Pacific.

"See that?" he asks. "That's smoke from a forest fire. The fact that you can see it on this image means it's reflecting light back into space."

The net result of that reflection, he points out, is a cooling effect: the same as caused by the haze tapering upwind into clouds on another image he calls up off the East Coast of the United States. Cloud cover, in short, is a critical component of the globe's system of climate regulation. How and why clouds form, what role anthropogenic forcing (caused by humans) plays in cloud formation, and in particular the secrets of aerosol systems and their role in the formation of nanoparticles that go on to serve as cloud seeds are some of the primary research focuses carried on by McMurry and collaborators at the University, the National Center for Atmospheric Research (NCAR), and other institutions.

In turn, that research has led McMurry and his colleagues to develop a number of highly sophisticated instruments to measure the size and composition of aerosol particles. These instruments are being used to understand the chemical processes responsible for high rates of particle nucleation and growth that are observed in the atmosphere.

> "New particle formation occurs as a result of photochemical reactions in the atmosphere that lead to the production of condensable vapors."
>
> —PETER MCMURRY

Assistant professor of geology and geophysics, Katsumi Matsumoto, who considers himself a chemical oceanographer, is using numerical models called "global climate models" to simulate past climate changes to learn what happens to the carbon cycle when those changes occur.

"We probably have a limited window of opportunity to do something to prevent dramatic changes."

—KATSUMI MATSUMOTO

"New particle formation occurs as a result of photochemical reactions in the atmosphere that lead to the production of condensable vapors," he explains. "Those vapors can go on to nucleate and form molecular clusters that grow into sizes that are eventually big enough to serve as seeds for cloud formation. We are trying to understand the mechanism by which these particles are produced."

One of the earliest instruments McMurry created measures aerosol particles, individually counting nanoparticles as small as three nanometers while also evaluating the distribution of particles by size in any given sample.

Currently the team, which includes University of Minnesota chemistry professor Jeffrey Roberts and NCAR researchers Fred Eisele and James Smith, is working on other instruments designed to reveal why, under certain conditions, nucleation and growth rates are so high. For example, in places like Mexico City that are covered in dense smog, nanoparticles can grow to 100 nm—big enough to seed clouds—in less than a day.

"Typically, particles are produced at rates that are orders of magnitude greater than current models predict. Once formed, freshly nucleated particles typically grow about 10 times faster than can be explained. Clearly current models don't take into account all of the complex processes taking place in the atmosphere," he said. "Our goal is to identify and understand those processes so they can be included in global climate models."

KATSUMI MATSUMOTO

Understanding our oceans

"I am more of a chemical oceanographer," explains Katsumi Matsumoto, assistant professor of geology and geophysics and a contributor to the Intergovernmental Panel on Climate Change. "I use numerical models called 'global climate models', to simulate past climate changes to learn what happens to the carbon cycle when those changes occur."

For most of the past 10,000 years during this relatively warm interglacial period, there has been a fixed ratio between the amount of carbon contained in the oceans, the atmosphere, and terrestrial plant life and soils—about 60:4:1. It was a balance that, Matsumoto said, made the oceans and the atmosphere "happy."

Since the Industrial Revolution, and at an increasing pace over the past century, that long-time ratio

of carbon has changed as the amount of atmospheric carbon—one of the principal greenhouse gases—has climbed, from about 280 parts-per-million at the dawn of industrialization to about 380 ppm today. As the amount of gas in the atmosphere has risen, the oceans have absorbed an increasing quantity.

Today, though, the upper ocean has absorbed significant amounts of atmospheric CO_2, meaning that we are beginning to lose the buffer zone the earth's waters have provided for our excess greenhouse gases. In turn, climbing temperatures are heating up the oceans. The effect of this warming is something Matsumoto is trying to calculate.

"If you heat water, it can hold less gas," he points out. "So as the oceans warm they will be able to hold less CO_2, which will return out into the atmosphere." Then this CO_2 will contribute to further warming in what Matsumoto describes as a "simple feedback system."

Rising temperatures will ultimately also hasten the melting of glaciers and the polar ice caps drastically reducing the albedo effect—the phenomenon by which sea ice, snow, and clouds reflect sunlight back into space, helping to cool the planet—but that's not the only untoward effect made possible by the complex interplay of changes set off by anthropogenic "forcing" of climate change.

There's also the impact on marine plant life—and its impact on CO_2—especially phytoplankton, the microscopic plant life that makes up the bulk of oceanic plant life. In performing photosynthesis, phytoplankton absorbs carbon dioxide. Warmer water promotes the growth of phytoplankton and hence CO_2 absorption.

That sounds like a good thing, right? Maybe not, because higher temperatures also speed up plant respiration, which produces mostly carbon dioxide. So, stimulate phytoplankton growth (and death), and ultimately you may end up with a net gain of CO_2.

"Climate change is very complex and there are lot of components to it," he explains. "But the only way we can run a numerical model that matches observations of postindustrial changes is to combine the effects of natural forces—like changes in solar temperature and reflective aerosols from volcanoes—with anthropogenic forcing like greenhouse gas emissions by humans.

Unfortunately, Matsumoto said, the climate system is slow to respond. Even if we stopped CO_2 emissions today, it wouldn't stop warming. It will take centuries before we reach equilibrium in Earth's energy budget (and thus temperature) similar to the "happy" pre-Industrial time.

"There is already warming coming because of the CO_2 we have emitted," Matsumoto said. "We probably have a limited window of opportunity to do something to prevent dramatic changes." ■

The graphic background (below) shows a map of conventional radiocarbon age (in years) in the deep ocean. The white in the continental region is land. The white in ocean basins are mid-ocean ridges rising above 3,000 meters water depth.

Innovative partnership

For more than 100 years, the partnership between the Institute of Technology and 3M has shaped innovative ideas and created products worldwide

Tim Hebrink (ChemE '84) spent time researching polymers at 3M during the summer of his junior year at the University of Minnesota. He now works at the company researching polymer mirror films used for concentrating or redirecting light in solar photovoltaic and solar thermal applications.

BRAD STAUFFER

WRITTEN BY **KERMIT PATTISON**

Tim Hebrink wants to capture more energy from the sun. Hebrink is a 3M scientist who researches how to make better solar films. It's been 25 years since he earned his degree in chemical engineering at the Institute of Technology, but Hebrink has never strayed far from his colleagues at the University of Minnesota.

Consider his recent collaborations with the University: serving on the energy and transportation strategic planning task force for the Department of Mechanical Engineering, initiating a project on wind turbines with the St. Anthony Falls Laboratory, discussing thin film photovoltaics with students in the mechanical and chemical engineering departments, and assisting teams of students building a solar house and a solar car.

"3M is more about applied science and the U is more about theory," Hebrink said. "Increased collaboration will mutually benefit both institutions." Indeed, for most of the last century, 3M and the University

3M Timeline

1900s

1884—University of Minnesota College of Engineering organized

1893—Institute of Technology's chemistry department established

R. P. Carlton

1902—3M founded in Two Harbors, Minn.

1919—Institute of Technology's chemical engineering department established

Harry Heltzer

1920s

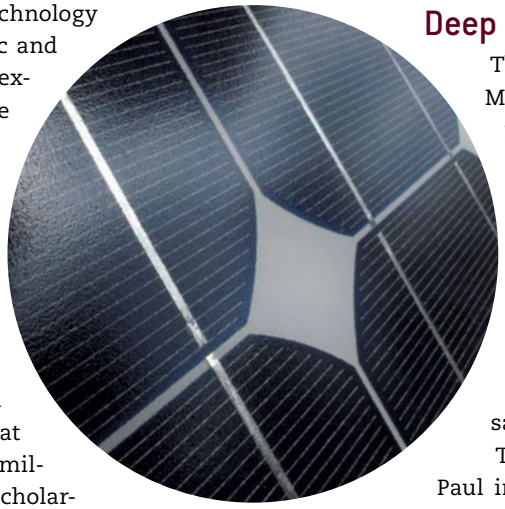
Innovation begins to thrive at 3M. The world's first water-resistant sandpaper is patented and introduced. 3M develops masking tape and the engineering department is established.

Richard P. Carlton *(EE '21)* established 3M's first Central Research Laboratory, which led to breakthrough technologies. He later served as 3M president.

Harvey Livermore *(ChemE '22)* was recognized for his work on water-based adhesives.

William Vievering *(Chem '25)* is the first University of Minnesota graduate hired by 3M. Vievering pioneered efforts in establishing 3M's laboratory and quality control operations.

of Minnesota's Institute of Technology enjoyed an unusually symbiotic and fruitful relationship. Scientists exchange expertise and ideas. The University has sent thousands of graduates to work at 3M—including many who dreamed up innovations for signature products like sandpaper, tape, and Post-it® notes—and to the very top of the company's leadership. Countless students have benefited from research and educational opportunities at 3M. The company has donated millions for research facilities, scholarships, and fellowships.



Alex Cirillo, vice president of 3M Community Affairs and the 3M Foundation, called the Institute of Technology one of the single most important factors in the history of 3M. "A lot of the core technologies that were used early in our business came from the Institute of Technology," he said. "It's huge."

3M is a worldwide corporation with offices in more than 60 countries and relationships with research institutions around the world, yet no other university is so closely tied to the company. Cirillo estimates that University of Minnesota alumni account for 10 to 20 percent of the workforce at 3M headquarters in the Twin Cities.

Many Institute of Technology alumni are among the most illustrious leaders of the company. Harry Heltzer (MetallurgyE '33) served as president, CEO, and chairman of the company. Richard P. Carlton (EE '21) served as president. The influence of the University of Minnesota remains strong: the 3M executive conference, which includes the top 100 executives in the company, includes eight alumni of the Institute of Technology.

Deep roots

The Minnesota Mining and Manufacturing Company was founded in 1902 by a group of businessmen in Two Harbors, Minn. who hoped to mine local minerals to make grinding wheels. That plan failed when local minerals proved unsuitable and the company reinvented itself as a manufacturer of sandpaper.

The company moved to St. Paul in 1910, setting the stage for a century of collaboration with the Institute of Technology. In the 1920s and 1930s, Institute of Technology alumni contributed key innovations that helped build the core businesses in abrasives and adhesives. (See timeline for listing of notable Institute of Technology alumni at 3M.) Institute of Technology graduates devised improvements such as synthetic resin technology and electrostatic coating for sandpaper, water-based adhesives, magnetic tape for electronic recording, roofing granules, and much more.

These graduates were among the early generations of scientists who helped turn 3M into a household name. One measure of the close relationship is the Carlton Society—a career science award at 3M and the company's highest technical award. Of the 12 charter members, eight are University of Minnesota graduates—six from the Institute of Technology. In all, 33 Institute of Technology graduates have been inducted into the Carlton Society, one-fifth of the total.

Says Cirillo, "It's clear that U of M graduates were the ones who built the company."

Former 3M leaders who are Institute of Technology alumni

John Benson (ChemE '66) served as Executive VP, Health Care Markets
Lee Berlin (ChemE '44) served as a VP
Krzysztof Burhardt (EE '71) served as VP, Research and Development
Richard P. Carlton (EE '21) served as President and the first Director of Engineering and Research
Paul Guehler (Chem '65) served as VP, Research and Development
George L. Hegg (ChemE '52) served as VP, Strategic Planning Services
Harry Heltzer (MetallurgyE '33) served as CEO and Chairman of the Board
Russ McNaughton (ChemE '57) served as Group VP, Electro Products Group
Lester Krogh (Chem '52 Ph.D.) served as Senior VP, Research and Development
Carl Kuhrmeyer (ME '49) served as Group VP, Graphic Systems
Joseph T. Ling (CivE '50 Ph.D. '52) served as VP, Environmental Engineering and Pollution Control
Cecil C. March (ChemE '32) served as a Group VP and Director
John Pitblado (ChemE '40) served as President, U.S. Operations
Paul Pankow (ME '56) served as VP, Medical Imaging
Charles Reich (Chem '64) served as Executive VP, Specialty Material Markets
Stanley W. Thiele (ChemE '51) served as Senior VP, Administrative Services
Frank Vikingstad (ChemE '62 M.S. '64) served as VP, Engineering
Robert N. Wolfe (ME '39) served as Senior VP of Engineering and Manufacturing

1930s

Joseph Kugler *(ChemE '26)* introduced synthetic resin technology and worked on electrostatic coating processes for abrasives.

G.P. Netherly *(ChemE '29)* developed gluebond sandpaper.

George Swenson *(ChemE '29)* invented colored ceramic-coated roofing granules.

By the end of the decade, 3M had five diverse businesses, including abrasives, masking tape, cellophane tape, roofing granules and adhesives.

Hubert Tierney *(Chem '30)* improved pressure sensitive tapes and contributed to the development of modern manufacturing.

Clifford Jewett *(ChemE '31)* developed the modern roofing granule.

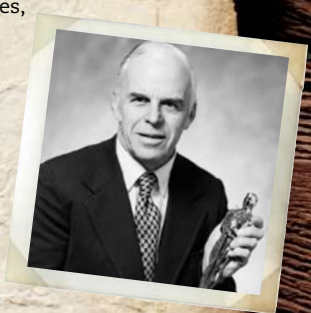
Wilfred Wetzel *(Physics '33)* studied elasticity in pressure-sensitive adhesives and established magnetic tape as the world's principal medium for electronic recording.

Harry Heltzer *(MetallurgyE '33)* served as 3M president and eventually became Chairman of the Board.

Carl Dahlquist *(ChemE '34)* was considered the company expert in adhesion, and invented low adhesion used in pressure-sensitive tapes.

Bill Lundquist *(ChemE '34)* applied organic chemistry to pressure-sensitive adhesives, tape backings and plastic film products.

Phil Palmquist *(ChemE '37)* received an Oscar in 1969 for developing a front projection screen using Scotchlite retroreflective technology.



Phil Palmquist

SOLAR DECATHLON TEAM ARTIST RENDERING

3M is a sponsor of the Solar Decathlon that will be held in Washington D.C. this fall. University of Minnesota's Solar Decathlon Team is designing, engineering, and constructing a fully functioning, highly energy-efficient, completely sun-powered house to compete among 20 international teams.

Innovators

Innovation is a founding principle at 3M. William McKnight, who served as 3M chairman of the board from 1949 to 1966, encouraged managers to "delegate responsibility and encourage men and women to exercise their initiative." The company was famous for allowing scientists to spend 15 percent of their time pursuing their own ideas.

This culture of innovation attracted people like Art Fry (ChemE '55). Fry joined the company in 1953 while a student at the Institute of Technology. He loved brainstorming new ideas and realized early that a broad education would be the best preparation.

His engineering major, then a five-year course, gave him a solid grounding in technologies plus other subjects like law and engineering. This laid the foundation for a career of mastering new technologies, integrating them, and synthesizing new ideas. Over the next four decades, his work spanned an array of areas: office products, tapes, breathing masks, gift wraps, and so on.

"Creativity involves finding a different pattern for doing something," Fry said. "You take knowledge you already have, put it together into a new pattern. A good education from the University involves learning a lot of the basics. When you are starting something new, there are no experts."

One such idea turned into one of 3M's most spectacular business successes. Fry sang in his church choir and placed slips of paper between the pages to mark the hymns. One Sunday, his homemade bookmarks slid onto the floor. "Everybody else was singing and I was trying to find what page we were on," he recalled.

Fry needed something sticky but not so much that it would rip the page, or, in his lingo, an adhesive with weaker adhesion to paper fibers than they have to each other. He used a pressure sensitive adhesive developed by a 3M colleague, applied it to the back of the bookmark, and passed around prototypes. Soon colleagues were using them to pass notes to each other. Thus was born the Post-it® note, which became the best selling branded product in 3M history.

The lesson? "A generalized, broad education is actually better preparation for innovators who seek to make things that are different, than a specialized education that prepares and inclines people to just make current things better," Fry said. "New-to-the-world products involve new skills and technologies where there are no experts. You have to be ready to start over with no one having much of an advantage, except those with broad and diverse skills."

Vern Rylander (ChemE '60) is another example of an innovator who had many careers within 3M. For Rylander, an education at the Institute of Technology represented a gateway to new opportunities. He grew up on a small dairy farm in northern Minnesota as the son of a Swedish immigrant and neither of his parents had gone to college. "I came to the University as a dumb farm kid because I had so little exposure to anything," he recalls. "I had to really start my science and technology at the U."

3M Timeline

1940s

During the 1940s, 3M found industrial uses to expand its adhesive business. 3M product innovations ranged from non-woven materials to vinyl electrical tape, and recording tape.

Francis Brown *(ChemE '44)* advanced acrylic adhesive technology, primarily in areas involving pressure-sensitive aerosol adhesives, plasticizer-resistant adhesives, as well as high solids and UV curing adhesives.

Robert Youngquist *(EE '48)* contributed to the first audio recording system, gigabyte data recording, and represents 3M in the recording industry.

3M stock was listed for the first time on the New York Stock Exchange.

1950s

During this era, 3M became more involved in health care. Product innovations included electrical connectors, Scotchgard® Fabric Protector, Scotch® videotape, and Scotch Brite® scouring pads.

Lester Krogh *(Chem '52)* became vice president of research and development, and sponsored the Genesis, Visiting Wizards, and Circle of Technical Excellence programs.

Joe Ling

Joe Ling *(CivE '52)* began developing the Pollution Prevention Pays program. He later became vice president of environmental, health and safety.

Robert Elm *(ME '54)* developed the first electrical flat cabling system using round conductors with insulation displacement connectors.

Soon after arriving at the University, Rylander asked which engineering major was the most difficult. When his advisor said chemical engineering, he picked that one. His education provided a broad exposure to technologies, and when he arrived at 3M he began to see how to take existing technologies and adapt them to capture market opportunities.

"That combination," he said, "is what gives you the innovative technique to see the possibility of technology—expanding technology a little bit, twisting it or turning it upside down to do something else."

Case in point: Rylander helped pioneer 3M's large print graphics business in the early 1990s. Up to that time, large graphics on billboards, trucks, planes or signs involved screen-printing, an expensive and laborious process. Rylander and his colleagues looked for a better method and honed in on technology that had been developed for something else—digital photography. At the time, digital photography hadn't caught on because the resolution wasn't good enough for photographs viewed up close, but Rylander and his colleagues realized it was perfectly adequate for large graphics viewed from a distance. They added a few technological tweaks and a new business was born—one now worth more than $20 billion per year.

"We took the scraps and made a business out of it—a huge business," said Rylander, who managed 3M's global graphics business from its inception until he retired in 1999.

Current collaborations

These ties have continued to expand as 3M has grown. Today, 3M is one of the most recognizable brands in the world with 76,000 employees worldwide and annual sales of $24 billion. The company has 45 technology platforms such as lighting, non-woven materials, microreplication, and nanotechnology. Now Institute of Technology graduates are pushing innovations far beyond glue, tape, and sandpaper.

A technologist may have several careers without ever leaving 3M. Dave Jungkunz (ME '78) has worked on many fronts in his 30 years at the company: data recording on half-inch tape, magnetic tape coders, chilled water systems, film packaging, dental products, high speed automated assembly, and pharmaceuticals inhalation systems. "Then I went to the dark side—I went into management," he said with a laugh. He now works as a design engineering manager and oversees a team that designs systems for putting products into mass production.

Jungkunz maintains several collaborations with the Institute of Technology. He assists the solar vehicle project team, and serves on a jury for a robotics competition. He also serves on 3M's recruiting team for the University of Minnesota and describes some of the young students he encounters as "pretty phenomenal," such as one who designed the front-end steering system for the solar car project.

"We're very fortunate because of our proximity to the University of Minnesota," Jungkunz said. "In the last 10-15 years there's been improvement and the University wants to reach out and collaborate with us more."

Similarly, Pat McGuire (ME '81) has seen much collaboration in his career at 3M. Last year, McGuire and his colleagues approached the Institute of Technology's Department of Mechanical Engineering and asked for help in developing solid-state lighting devices by combining optical technology with efficient LED lighting. Several students were assigned the challenge as part of their capstone project.

"They worked for a semester using some of 3M's novel optical materials, developed a good prototype, a novel luminaire, and did a very good job of distributing light and matching people's color expectations for an office building," McGuire said.

McGuire cannot comment on whether the company incorporated any of these designs. But he said the collaboration was a valuable exercise for all parties.

Current 3M Executives who are Institute of Technology alumni

John R. Houle (CivE '83, M.S. '84)
VP, Manufacturing and Supply Chain Services

Robert McDonald (ME '72, M.S. '74)
Senior VP, Marketing and Sales

William R. Myers (ChemE '80)
VP and GM, Energy and Advanced Materials Division

Michael F. Roman (EE '82)
VP and GM, Renewable Energy Division

Brad Sauer (ME '81) Executive VP, Health Care Business

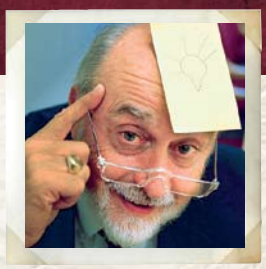
James E. Sax (ChemE '80)
VP, Research and Development, Electro & Communications Business

Paul D. Steece (ME '77) VP and GM, Electrical Markets Division

Greg Vandesteeg (Chem '77 Ph.D.)
VP, Research and Development, Health Care Business

In **3M's Technology Leadership Society,** there are 55 members who hold at least one degree from the Institute of Technology—23 chemical engineering and materials science, 11 mechanical engineering, eight chemistry, five electrical engineering, and several members hold degrees in math, physics, civil engineering, and computer science.

There are approximately 1,500 living alumni who currently work for or are retired from 3M. Combined with 150 deceased alumni, there are 1,650 Institute of Technology alumni who have worked or currently work for 3M.



Art Fry

1960s

Art Fry *(ChemE '55)* is the inventor of the Post-it® note.

Art Kotz *(Physics '55)* was credited with developing the 3M Mangi-Dry Copier and electronic reproduction systems.

The Carlton Society was established in the 1960s to honor outstanding technical employees, and named for former 3M President **Richard P. Carlton** *(EE '21)* who was hired as the first technical employee to hold a college degree.

Dennis Enright *(ME '61)* developed electronic wiring connecting and handling systems.

1970s

The innovative products produced during the 1970s held automotive parts in place, fastened diapers, provided backup security for computers, gave dentists new filling materials, helped to keep buildings clean, helped to prevent theft of library books, and made insulated clothing less bulky and more comfortable.

3M inaugurated Pollution Prevention Pays, a program created by **Joe Ling** *(CivE '52)*, to encourage employees to prevent pollution at the source. It led to large reductions in pollution and waste in 3M's products, process, and daily operations.

BRAD STAUFFER

Marie Johnson, director of the University of Minnesota Medical Devices Fellows Program, worked with 3M to develop a next-generation electronic stethoscope.

"Students tend to look at things a little bit unconventionally, and that's a good thing," he said. "It's good for our research staff to maintain a close working relationship with professors who are interested in the same sorts of things that we are. It makes the University stronger and, frankly, that makes 3M stronger."

In fact, McGuire's teams have hired students identified through several projects sponsored with the University. McGuire, now a lab manager in the traffic safety systems division, remains engaged with the University on many fronts; now he is helping the Department of Mechanical Engineering draft a strategic plan for undergraduate education.

"It's very much a symbiotic relationship," he said. "3M gets a lot out of the close relationship and I think the University is very much strengthened by close collaboration. It makes certain that the work the professors and students are doing, especially at the graduate level, is meaningful to industry."

Smarter stethoscopes

One recent collaboration shows just how meaningful this partnership can be. Marie Johnson (BME M.S. '99, Ph.D. '04), director of the University of Minnesota Medical Devices Fellows Program, worked with 3M to create a next-generation electronic stethoscope. She applied voice recognition signal processing techniques for detecting cardiovascular abnormalities. The device uses mathematical algorithms to interpret the acoustics of a beating heart.

Johnson began the project while working on her doctorate in biomedical engineering at the University of Minnesota. She continued the work as a post-doctoral fellow, also with 3M Littmann Stethoscopes.

"3M funded my Ph.D. dissertation and they provided incredible training for me," Johnson said. "I interacted with their engineers, sales force, and the leaders associated with the Littman Stethoscope group. They were instrumental in my education."

At the same time, the University brought many benefits to 3M, such as research hospitals and experts in cardiology, engineering, and medical devices. Johnson's dissertation focused on her stethoscope research and her committee included a cardiologist, electrical engineer, chemical engineer, and businesspeople—an example of the sort of interdisciplinary approach that fosters innovation.

"At the University, we can bring cutting-edge, state-of-the-art knowledge from the basic science stage to a product if provided with the right informa-

3M Timeline

1980s

The 3P Program (Pollution Prevention Pays) was introduced in 1975.

A whole new product category emerged during the 1980s with the Post-it® note, which became a worldwide best seller.

Tom Wood *(Chem '81)* applied inorganic materials science to create new pavement marketing products. He is credited with creating novel 3M cubitron abrasives.

Terence Neavin *(ME '80)* was credited with advanced key manufacturing processes and equipment used to produce multilayer optical films, and was responsible for massive new-product growth related to his basic feedblock design.

The University of Minnesota used Tartan Turf surfacing material at Memorial Football Stadium into the 1980s, one of many stadiums around the nation.

tion and tools," Johnson said. "We can help translate faster—essentially we're taking it right out of the lab and into something that industry can use."

Philanthropy

3M remains a major benefactor to the University. According to the University of Minnesota Foundation, about $40 million has been given to the University by 3M or the 3M Foundation. These gifts have funded the renovation of Walter Library, an addition to the Mechanical Engineering building, scholarships, fellowships, programs to encourage diversity in the sciences, and much more.

One example is the 3M Science and Technology Fellowships, established with a $6.2 million endowment in 2001. The program provides four-year fellowships to 12 outstanding new doctoral students each year in science and technology.

After the fellowships are awarded by the University, 3M invites them to participate in a program where they are matched with a 3M technical employee. "By doing this, we connect the 3M technical employee to the students to serve as a mentor to them," said Kelly Anderson (ChemE '96, Chem Ph.D. '04) a 3M employee who serves on the company's graduate fellowship committee. "But it's also a way to connect the employee to the research advisor of the student who's working in a similar research area."

In this way, research and development scientists at 3M forge connections with both an academic researcher and a promising student. They also have a poster session at 3M where students can present their research to 3M employees.

New frontiers

3M continues to look at new innovations. One of those innovators is Tim Hebrink (ChemE '84), mentioned earlier, who can trace his scientific interests back to his undergraduate days. He became interested in polymers at the University and spent the summer after his junior year at 3M researching polymers. After graduation, he went to work at 3M full-time developing new polymers and new processes for making films from polymers.

Hebrink now leads a durable solar films team researching polymeric films used for concentrating and redirecting light in solar photovoltaic and solar thermal applications. Much of his research focuses on new optical designs, and how to make these films more scratch resistant and more stable under ultraviolet light to increase their useful product life outdoors.

Hebrink also lives his values. His house is powered by 2.4-kilowatts of solar photovoltaic modules on his roof and a 1-kilowatt wind turbine on an 80-foot tower, and he cooks with a solar oven. The house has never been connected to the utility grid.

When it comes to the power of ideas, however, he's definitely connected to the network. Hebrink is working with many University departments on renewable energy projects ranging from photovoltaics to wind turbines. He predicts that these sorts of exchanges will only expand with the growing interest in green energy. "This renewable energy opportunity is going to create an even stronger bond and more collaboration between 3M and the University in the future," he said. ■

DON MEREDITH

3M is a generous sponsor of the University of Minnesota Solar Vehicle Project team. The project provides undergraduate engineering students with an opportunity to research, design, construct, and race a solar-powered vehicle every two years.

1990s

3M continues to develop an array of innovations during the 1990s, including immune response modifier pharmaceuticals; brightness enhancement films for electronic displays; and flexible circuits used in inkjet printers, cell phones and other electronic devices.

In the 1990s, **Vern Rylander** *(ChemE '60)*, **Ed McCue** *(ChemE '63)*, and **Rich Rylander** *(Physics '75, EE '76, M.S. '77, Ph.D. '82)* created Scotchprint® large format digital imaging.

2000s

Sales topped $20 billion during this period, with innovative new products contributing significantly to growth. Products included Post-it® Super Sticky Notes, Scotch® Transparent Duct Tape, optical films for LCD televisions and a new family of Scotch-Brite® Cleaning Products that give consumers the right scrubbing power for a host of cleaning jobs.

Dick Minday *(Chem Ph.D. '70)* co-invented Novec 1230 for fire protection.

3M Post-it® notes remain a worldwide best seller today.

> "The project was so different from class work. When you intern, you know that no one has tackled this project before."
>
> —LAURA FLETCHER

Tapping Student Talent

Last year, the Minnesota Technical Assistance Program helped companies realize more than $3 million in energy savings

WRITTEN BY **JUDY WOODWARD**

PHOTOS BY **JAYME HALBRITTER AND KRYSTA LARSON**

If you had asked Laura Fletcher (ChemE '08) a few years back what she would be doing the summer after her senior year, chances are she wouldn't have said, "solving problems and saving thousands of dollars for a wastewater treatment plant." Yet, that's exactly what she did. Now, as an Institute of Technology chemical engineering graduate, Fletcher works full-time as an engineer for the Metropolitan Council Environmental Services where she considers her work vital to the community. "Without effective wastewater treatment, there would be major environmental health concerns," she said.

Fletcher's foray into the somewhat unglamorous subject of sewage was through a summer internship at St. Paul's Metro Wastewater Treatment Plant, the Twin Cities' main sewage treatment facility. She got her internship through the University's Minnesota Technical Assistance Program (MnTAP), where she was one of eight college juniors and seniors chosen to spend the summer of 2008 working with Minnesota companies on specific waste-reduction and energy savings projects.

Each year, MnTAP receives more than a thousand requests from Minnesota businesses looking to reduce waste and improve energy efficiency. Last year, the program helped companies realize energy savings of more than $3 million. MnTAP staff often visit participating companies to make on-site evaluation of their concerns, and when they do, said Krysta Larson, MnTAP Intern Program coordinator, they often identify projects where summer interns could be useful.

"We look for projects that will make a difference to the company and the State of Minnesota, but we also want companies that show a commitment to the project," Larson explains. "Without upper man-

agement support, no capital investment is likely to take place." Approximately 30 companies consider the intern program each year, and about 15 go through the full application process.

"We're not looking for projects featuring energy efficiency by itself," she said. "Rather than focusing on waste management, we look for pollution prevention opportunities."

Companies are carefully matched with student interns who have appropriate academic backgrounds. "Of the roughly 70 students who apply for positions each summer," Larson said, "the best candidates 'float to the top' through the interview process. They must have excelled in the technical coursework, but they also must have initiative and creativity. No one is going to hold their hand, and they must be comfortable in a manufacturing setting."

Each student is paid a $2,500 stipend and is assigned both a staff mentor at MnTAP and a supervisor at the company where they intern. Advisors and supervisors act as resources and backup support, however, interns have full control over the day-to-day details of their projects.

Internships offer practical benefits to both students and employers. On the business side, there are advantages to having the energy and fresh insights of young newcomers who haven't yet learned how to do things the "company way."

"We're getting, very inexpensively, someone who is dedicated full-time to just one project," said Mike Costello, who has supervised interns at a medical device firm, Aritech, Inc., and at a previous employer. "The students get an idea of how their education will apply in the real world. That connection fuels their enthusiasm."

For the students, the payoff can be immediate. Like Fletcher, many are offered permanent employment once their internship ends.

Laura Fletcher

Efficient waste

Both her MnTAP mentor, Karl DeWahl, and her supervisor at Wastewater Board Services, Brad Gehring, agree that Laura Fletcher was academically prepared for the tricky job of calculating the optimal air flow for the giant blowers that provide oxygen for the decomposition process at St. Paul's Metro Wastewater Treatment Plant.

The plant treats 185 million gallons of wastewater daily and the aeration process accounts for more than half of the plant's daily electricity usage—a cost of approximately $450,000 per month. If Fletcher were able to calculate the most efficient way to utilize the giant blowers, the cost savings could be substantial.

As a summer intern through the MnTAP program, Laura Fletcher (ChemE '08) worked on optimizing the energy use of this blower for St. Paul's Metro Wastewater Treatment Plant. The blowers provide oxygen for the decomposition process.

DeWahl, who describes his support role as steering a middle course "between letting interns learn, yet keeping them from falling into the abyss," characterized Fletcher as "fairly advanced," even considering her status as a recent Institute of Technology graduate. As such, she neatly fit the bill in terms of what he looks for in intern applicants. "We look at school record, ability to perform independently and some evidence—even a hobby—that shows an interest in how things work, as well as an ability to go beyond theory," DeWahl said.

Fletcher was adept at bringing a theoretical understanding to her project, but she may have been even more pleased by some of the practical knowledge she acquired during the course of the summer.

"The project was so different from class work," she said, explaining that lab exercises—however well-designed—invariably have a predetermined, 'right' answer. "When you intern, you know that no one has tackled this project before."

Not that she denies the value of her academic coursework in tackling her particular project. "I had taken a chemical engineering senior lab that helped me look at data and figure things out without always knowing what I was doing at the start," she said. By luck, one of her laboratory problems gave her precisely the right preparation for her project. "I had a lab on blowers and air flow meters," Fletcher said. "It was a small scale version of what I did as an intern."

Fletcher also gives credit to DeWahl. "He's another resource. He's had years of experience; he had ideas when I wasn't able to see what to do next," she said.

Thanks to her mastery of the relevant calculations, Fletcher was ultimately able to suggest reconfigurations of the blowers that would save the plant upwards of $60,000 in annual electricity costs.

"Laura is very bright and fresh out of school, so she was comfortable with the theoretical framework of the project. The blower efficiency equation is very complex, and some of our own staff had steered clear of it, but she dug right in," Gehring said.

"We look for projects that will make a difference to the company and the State of Minnesota, but we also want companies that show a commitment to the project."

—KRYSTA LARSON

> "I realized that I have chosen a good major, and one where I can make a real impact in someone's life."
>
> —MAUREEN HOLLER

(Right) Biomedical engineering student Maureen Holler, who interned at Aritech, Inc., in Plymouth, Minn., last summer, examines the paperboard card and Tyvec pouch that houses the Watchman Access System, which will go through a sterilization process before it is used.

Maureen Holler

Packing it in

When Maureen Holler, a senior majoring in biomedical engineering, learned she would be interning with Aritech, Inc., in Plymouth, Minn., she couldn't have been more pleased. Her assignment was to reduce waste in the packaging and preparation of the delivery system for an implantable device called the Watchman, which helps prevent potentially life-threatening blood clots from forming in the heart's left atrial appendage and entering the bloodstream. Holler's mission was to improve the packaging of the catheter that is threaded through veins in a patient's leg in order to introduce the Watchman into the heart. "I was going to work on something that was keeping people from having strokes," she realized. "How cool is that?"

From Holler's perspective, one advantage of her internship was the opportunity to take ownership of the project. "Before this, I've worked on other people's projects, but this one was mine," she explains. "I came in not knowing anything about plastics, and I had to work with outside vendors, do research. I learned how to ask the right questions. It was trial by fire, but I loved being thrown in."

Holler said her biggest surprise of the project was learning about the documentation requirements of sophisticated biomedical engineering. "There's so much paperwork involved," she said. "You can't just write things down in a notebook…I had to get all these official approvals, because so much oversight is required."

According to Holler, problem-solving skills were vital to getting started on the project. "I hadn't had a whole lot of engineering coursework in packaging but my classes had prepared me to ask, 'What angle can I attack the problem from?'" she said.

Holler quickly zeroed in on three areas that could improve the catheter's bulky packaging. By replacing the all-plastic tray with a paperboard tray that contained a small plastic component to hold the catheter in place, Holler demonstrated that the company could save almost $6 in production costs for each device produced, and reduce packaging waste by nearly one-half pound. She also advised Aritech to substitute less environmentally damaging plastics for the polyvinyl chloride used in packaging. Finally, she recommended replacing the sterilization system currently in place with a method using less toxic chemicals.

Her supervisor Mike Costello, director of operations for Aritech, quickly recognized her efforts. "There was a real alignment of the planets on this

one," he joked. Although some of her ideas were tabled for a later date, Holler's suggestions for packaging modifications were "instantly implemented," he said. "She had the support of the entire company on this one."

Holler looks forward to the future with confidence. "This was my first experience working in a biomedical company," she said. "It made me realize that I have chosen a good major, and one where I can make a real impact in someone's life."

Mat Waddell

Casting out costs

For Mat Waddell, a junior majoring in mechanical engineering, one of the most valuable parts of his experience as a summer intern at Twin City Die Castings was what he learned about himself. After his internship, the Minneapolis company, a producer of metal parts for a broad variety of industrial, medical, military and recreational purposes, offered him a permanent job after graduation. Although he is only an undergraduate, Waddell knew he had made a significant impact on the company's bottom line. Yet, he decided he will aim for graduate studies in mechanical engineering instead.

"I loved the experience at Twin City," he said. "But knowing I have this experience in my background, I can use the skills I've gained in a different way."

Waddell's project was to identify ways to save energy at the manufacturing facility. Energy efficiency engineer Dao Yang was his supervisor. Yang found Waddell to be a quick study on the job.

"He's a self-starter. Very determined and focused," Yang said. "I'm very busy at work, so I gave him a quick overview, and Mat was able to pick up from where I left off."

Waddell turned out to have natural ability as a project manager. He started out by conducting a thorough energy audit of Twin City's facility and an assessment of which areas could realize the biggest energy savings. Some of his proposed solutions were as simple as replacing an ill-fitting door on the main furnace and posting signs reminding workers to replace covers on dip wells. In another case, Waddell recommended specially designed covers for hand-fed furnaces where access to the interiors had to be balanced against the energy savings produced by covers.

Other improvements Waddell suggested were designed to reduce high temperature and increase airflow in the compressor room, where the large machines that power the manufacturing processes are kept.

> "I got hands-on experience with material that I've actually learned about in class."
>
> —MAT WADDELL

Waddell said the best part of the project was having an opportunity to apply his academic learning to real-world problems. "I got hands-on experience with material that I've actually learned about in class," he said.

He was also surprised by the degree of autonomy expected. "As my own project manager, I did pretty much everything myself," he said. Waddell adds that he set all the elements of his work process—what problems to address, whom to talk to, where to go, what to do.

In his final project presentation, Waddell estimated Twin City could save more than $100,000 on its furnace and compressor operations if his suggestions were fully implemented.

"Mat found at least 15 projects that would give us possibly hundreds of thousands of dollars in energy savings," Yang said. "His ideas and work paid for his time here." ■

(Below) Mat Waddell, a mechanical engineering student who spent last summer interning at Twin City Die Castings in St. Paul, opens the main door of the liquid bath furnace to take a temperature reading of molten aluminum.

ALUMNI REPORT
JIM PICHLER
ITAS PRESIDENT

Enhanced volunteer program on horizon

With a campus as vast as the University of Minnesota, sometimes it is hard to grasp all the volunteer opportunities available.

THE INSTITUTE OF TECHNOLOGY has long relied on the efforts and passion of volunteers. They are the ones who can make the difference when it comes to improving student recruitment, creating student experiences, and developing career opportunity networks for graduates.

Volunteering has a dual effect—folks feel good about lending a hand to help and they also feel good about the impact they leave.

It is not difficult to look around and see activities that have relied on help from many volunteers. The Code Freeze event hosted by the University of Minnesota Software Engineering Center (UMSEC) is a good example. Conceived and executed by volunteers and friends of the UMSEC, this one-day event draws several hundred software engineering industry members and researchers to share in a great networking and learning opportunity. Without volunteer drive and initiative, it would not be the success it is today.

Another example is the annual Science & Technology Banquet hosted by the Institute of Technology's Alumni Society and office of the Dean. Each year, Institute of Technology Alumni Society members participate in this premier event, which raises funds for student scholarships.

With a campus as vast as the University of Minnesota, sometimes it is hard to grasp all the volunteer opportunities available. From supporting fundraising and outreach events, to supporting students, many folks are eager to help out and give their time, but aren't sure how to find out about what's right for them.

For the past few months, the Institute of Technology Dean's Office and the Institute of Technology Alumni Society have been laying the groundwork to renew and expand its ongoing volunteer efforts, which encompass several areas of need for the college. Key components that are being considered will include easy access to volunteer information, volunteer Web sign-up and/or inquiry, and formal recognition. Here's a small preview of what's on the horizon.

A new and improved Web site will provide information about a variety of volunteer opportunities, ranging from one-time assistance at a student or alumni event, to volunteering on an ongoing basis for specific programs, to making calls to prospective students, or working as a legislative advocate.

People will be able to register online or find contacts to obtain more detailed information about specific opportunities. Built into this process will be checks to ensure that we are being responsive to our volunteers. Volunteer options will expand as the Dean's office works with individual Institute of Technology departments and units to define them and develop the tools and support to carry them out efficiently.

The bottom line is that it will be easier for you to find your niche in the Institute of Technology's vast array of opportunities. In turn, we believe we will have a greater impact in bringing quality events and programs to our college alumni.

As the year progresses, there will be more information about the Institute of Technology's ongoing volunteer efforts. Institute of Technology alumni will have an opportunity to volunteer for activities that include: calling prospective students; hosting prospective students and their parents; participating in mock interviews; offering career guidance; participating in reunion activities and K-12 outreach events; supporting the legislative network, and much more.

Stayed tuned for future updates. To learn more about how you can volunteer, please contact Liz Stadther at 612-626-1802 or stadt001@umn.edu. ■

Join the UMAA and the ITAS

Become an ambassador of the University of Minnesota by joining the University of Minnesota Alumni Association. Through your membership, you enable the Alumni Association to support the University through advocacy, communications, mentoring programs, and premier events honoring distinguished faculty, alumni, and researchers.

For no extra cost, you may also join the Institute of Technology Alumni Society (ITAS), where you will have an opportunity to become involved in the events and activities of the Institute of Technology.

Members have exclusive access to dozens of benefits including career resources and networking, discounts on cultural activities, continuing education, and Gopher apparel, online access to two U of M Libraries databases, and more.

Whether you live near campus, or farther away, there is something of value for you. Take advantage of the local events, golf course, and Landscape Arboretum; receive the alumni magazine; check out the online libraries publications; and save on travel and insurance.

With your membership, you'll stay connected to the University of Minnesota. You'll receive a subscription to our award-winning *Minnesota* magazine, which keeps you informed about University research and sports, higher education topics, and association initiatives.

The UMAA monthly member e-mails will give you information about special benefits and events. ITAS will keep you in the know about the Institute of Technology. Both groups will help you network with alumni nationally and globally.

Visit **www.alumni.umn.edu/membership** for membership information.

TechFest draws large crowd to explore science and technology

RHONDA ZURN

Leonard Scott and his daughter, Leah, of Brooklyn Center, Minn., make a mini-hovercraft using a balloon, CD and film canister during TechFest 2009 at The Works museum in Edina. Held each spring, this year TechFest featured a multitude of hands-on activities including robots, aircraft, hovercraft rides, physics experiments, planetarium shows, and more. More than 1,700 people attended the event that was sponsored by The Works and the University of Minnesota Institute of Technology Alumni Society.

Robots take over sports arenas

RHONDA ZURN

FIRST Robotics Team #2503 from Brainerd makes final adjustments to their robot before competing in the Minnesota regional competitions at the University of Minnesota's Williams and Mariucci arenas this spring. More than 100 high school teams from the region competed. Many alumni and students served as mentors and judges for the competition, and the Institute of Technology was one of the competition sponsors. In addition, the University contributed to a pool fund to help outstate teams, like Brainerd, offset costs of the competition. Worldwide there are more than 1,600 FIRST Robotics teams involving 42,000 high school students.

IT ALUMNI SOCIETY

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Investing in Tomorrow
Kim Dockter
Director of External Relations

Your support means achieving dreams

For most students, your support means that they will not graduate with a crippling debt load.

EVEN DURING THESE CHALLENGING economic times, alumni and friends of the Institute of Technology continue to amaze me with their generosity. As of this writing, with more than two months left to the end of the fiscal year on June 30, you have already made gifts in excess of $13.5 million!

This amount compares to the $13.3 million that was given in all of last fiscal year. Of this total, approximately $5 million was given in support of student scholarships and fellowships.

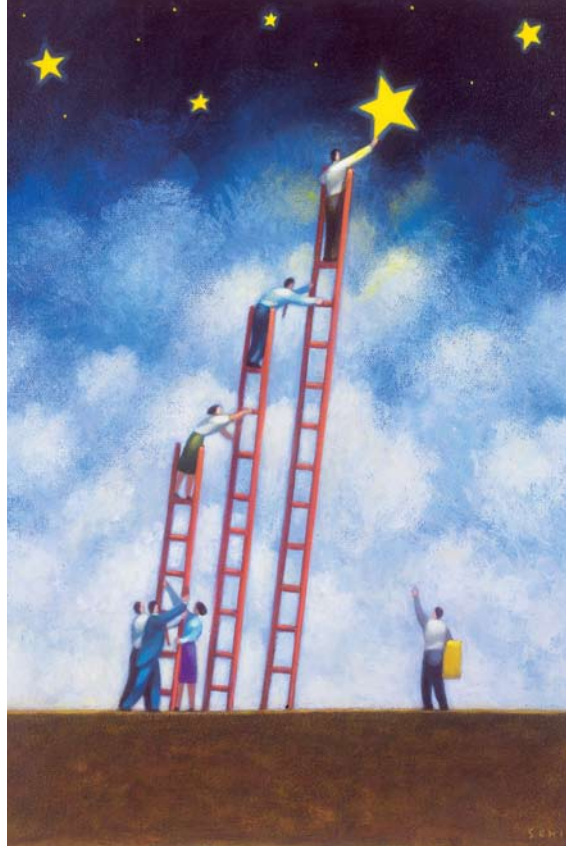
Your gifts have supported one of the most highly qualified student bodies in the history of the college. The class of 2012 entered the Institute of Technology last September with an average ACT score of 28.9; and 90 percent graduated in the top 25 percent of their high school class. There are also 34 National Merit Scholars among them, more than any other college at the University!

Not only do these talented students do well with their coursework, many expand their experience with hands-on learning opportunities and team competitions like the Solar Decathlon and Solar Vehicle Project, while others make time to give back to their communities through organizations like the Active Energy Club, Engineers Without Borders, Engineering World Health, K-12 outreach, and more.

For many of our students, your support makes it possible for them to attend college. For others, it means that they can concentrate on their studies and community volunteerism and not have to hold down a full-time job. And for most students, your support means that they will not graduate with a crippling debt load.

Those of you who have endowed graduate student fellowships and undergraduate scholarships have seen the impact of your gift double through the Promise of Tomorrow and 21st Century Match programs, which are still available at the University of Minnesota.

I would like to share with you how meaningful your support is in the words of one of our newly minted engineers, Shannon Koenig:



"When I found out that I had been accepted to the University of Minnesota, I was so excited. I couldn't believe it; all of my dreams were coming true. The only problem was that I had no clue how I was going to pay for it. I thought it was going to be impossible to pay for college without putting my family and myself so far in debt that we wouldn't be able to see the light. I figured that I would have to give up my dream of going to the University of Minnesota and settle on a smaller school that was a lot less expensive. This also meant giving up my dreams of getting a degree in civil engineering.

Then, a miracle occurred. In the spring of 2004, just before my high school graduation, I received a letter from the University of Minnesota. I had been awarded the Norman Family Scholarship, which was a $5,000 per year renewable scholarship.

I couldn't believe it, I was so happy that it brought tears to my eyes just reading the letter. I was going to be able to attend the U of M and I was going to be able to do it without having to constantly worry about money."

Koenig will graduate this spring with a Bachelor of Civil Engineering and a minor in business management. She will begin her position with WHKS & Co. in Rochester, Minn., at the end of May.

I want to thank you—especially in these days of tight budgets—for continuing your philanthropic support of our students, faculty, and programs. As in Shannon's case, your gift, combined with many others, makes a world of difference for so many young people preparing to take on the challenges ahead of us all.

If you are interested in changing an Institute of Technology student's life through a private gift, please contact me at dockter@umn.edu or 612-626-9385. ■

3M makes grant for scholars program

The Institute of Technology has received a $300,000 grant from the 3M Foundation to fund the 3M Scholars Program, a pilot effort to recruit and retain a larger number of students who are pursuing degrees in the Institute of Technology.

About 80 students will be accepted into the program that is targeted toward students of middle-income families. They will be exposed to a number of "experiences" that include exploring science and technology-related careers; interacting with faculty outside the classroom; going on corporate site visits; meeting with corporate mentors; networking with people in industry; setting personal goals; and more. The students also will be encouraged to pursue internships and/or research opportunities.

To assess the student's progress, each student will be required to participate in a minimum number of experiences. Students in the program will officially be known as "3M Scholars" and will receive scholarships after program benchmarks have been achieved.

"Our goal is to develop experiences outside the classroom that engage, enlighten, and motivate students to overcome the challenges they have during their early years in the Institute of Technology," said Paul Strykowski, Institute of Technology associate dean for undergraduate programs. "Through this program, we can help them overcome barriers and achieve success. We are grateful for 3M's generous support."

Annual S & T Banquet raises funds for student scholarships

MAXINE SMITH

Tyler Kuhlman (ME '05) of MTS Systems discusses the University of Minnesota's solar car with David Towey (left), a senior in aerospace engineering and mechanics and Solar Vehicle Project team member, at the Institute of Technology's 2009 Science & Technology Banquet. This year the event featured keynote speaker Cynthia Lesher, retired president and CEO of Northern States Power Company-Minnesota; student speaker Andrew Jones, a senior majoring in chemical engineering and chemistry; and members of the University of Minnesota Solar Vehicle Project team.

Gift annuities benefit the donor and the college

Are you tired of watching your assets fluctuate with the markets? Do you want to make a gift to benefit the Institute of Technology that would also provide you with fixed payments in return?

As a giving option, gift annuities provide a stable, regular stream of payments that can be an attractive income supplement in these uncertain economic times. A donor establishes a gift annuity by irrevocably transferring cash or stock to the University of Minnesota Foundation. The minimum gift amount is $10,000. The Foundation agrees to make regular payments to one or two persons based upon a rate determined by the age(s) of the annuitant(s). Donors receive an immediate income tax benefit when the gift annuity is established and a portion of the annuity payments are tax-free. When the gift annuity terminates at the death of the last annuitant, the assets remaining in the annuity are transferred to the fund at the University that has been designated by the donor.

For example, Bob, a widower who is age 81, makes a gift of $50,000 in cash to establish a gift annuity that will eventually benefit a fund in the Institute of Technology. The annuity pays him a rate of 7.30 percent that translates to an annual payment of $3,650, of which $2,847 is tax-free. These payments continue unchanged for Bob's life and at his death, the remaining assets pass to the Institute of Technology to be used as he has directed. He also receives a charitable income tax deduction of $24,651, which he can claim on this year's tax return.

For more information on charitable gift annuities and a personalized illustration, contact Kim Dockter at dockter@umn.edu or at 612-626-9385.

DEVELOPMENT TEAM

The Institute of Technology's experienced development team can help you determine your best options for supporting the college.

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Engineering alters face of rural America

UNIVERSITY OF MINNESOTA ARCHIVES

The Department of Bioproducts and Biosystems Engineering has been at the forefront of agriculture, natural resources, and the environment

FOR YEARS, MINNESOTA'S agricultural and natural resources-based industries continue to be an icon of economic strength. Those who have played a vital role in keeping the state at the forefront of agriculture, natural resources, and the environment include the faculty, staff, and students of the Department of Bioproducts and Biosystems Engineering (BBE)—an affiliate department in the University of Minnesota's Institute of Technology. This year marks 100 years of innovative engineering education, research, and extension for the department.

Bringing bright ideas to farm life

It was just before Christmas 1923 that a group of nine farms near Red Wing, Minn., received their first taste of electrical power as part of a University research project. The researchers were interested in testing the feasibility and value of bringing electricity to rural America. They found that electricity could jolt agriculture into the modern era. Subsequently, farm life in Minnesota would never be the same. Within three years, the farmers were using electricity for everything from harvesting grain to pumping water for their barns and homes to separating cream from milk.

"One can look back 50 years from now and compare it to the Internet of today," said Shri Ramaswamy, BBE professor and head of the department. "Rural electrification is one of the key facets by which we essentially leapfrogged the possibilities for growth. The success in Red Wing helped lead to rural electrical development nationwide."

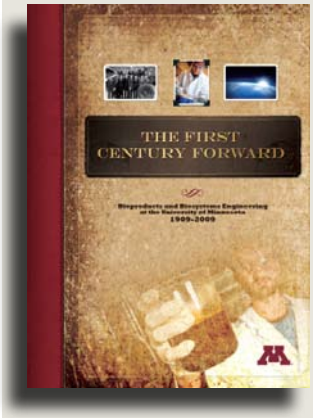
Founding fathers

The University of Minnesota's Division of Agricultural Engineering was officially created on July 1, 1909, bringing together curricula in farm structures, farm mechanics, and agricultural physics that had existed since the late 1800s. The four-year engineering curriculum was approved in 1925 and has been accredited since 1948.

By 1995, the Department of Agricultural Engineering became the Department of Biosystems and Agricultural Engineering, and in 2007, the University Regents approved a merger of the Biosystems and Agricultural Engineering and Bio-based Products Engineering programs forming the new Bioproducts and Biosystems Engineering major, offered through the Institute of Technology.

Playing an important role in putting the engineering into agriculture was William Boss who came to the School of Agriculture in 1890 as an assistant to teach students about the engineering needed to run a creamery. He eventually became an instructor in steam engineering, carpentry, power machinery, and the chief engineer for the power plant. In 1905, he became a professor of farm structures and farm mechanics, and the head of the department in 1919.

From 1919 to 1938, Boss led the division and promoted the benefits of mechanized agriculture and farming expansion. That mission continued up until the late 1960s when it became evident that



"The First Century Forward"

For a century, the Department of Bioproducts and Biosystems Engineering has played a key role in many projects that have improved life for rural Minnesotans. To learn more about what contributions the department has made in the past, as well as how the department is positioned to meet the challenges of the 21st century, visit **www.bbe.umn.edu.**

UNIVERSITY OF MINNESOTA ARCHIVES

THEN

(Far left) Undergraduates in 1919 are receiving instruction in a short course on threshing, a four-week class taught by department faculty. The "blanket test" shows how to determine whether the threshing machine is operating properly. (Left) This photo from the early 1950s shows former professor Ralph Hossfeld working on wood chemistry-related research to modify wood properties and performance.

American farms were producing surpluses and increasingly the focus turned to addressing environmental impacts of farm-related activities—such as drainage—were damaging the environment. One means to reduce the harm was to use natural organisms as the basis for farm-related technologies. Reflecting this focus, Agricultural Engineering became Biosystems and Agricultural Engineering.

Similarily, the lineage of forest products—the other major BBE research component—dates from the forest products program in the School of Forestry in the late 1920s. One of the founding fathers of the department and the college was Frank Kaufert who worked on the biological deterioration and preservation of wood. The forest products effort grew considerably during the 1960s. The school became the College of Forestry in 1971 with the formation of the Department of Forest Products, which changed to Wood and Paper Science and Bio-based Products, acknowledging its broader range of research and education in the science and engineering of biomass-derived materials and products.

If they could see us now

If the founding fathers could see the department now, they would be amazed by the direction it has taken. "The result is today's BBE Department, with its focus on the key global concerns regarding the environment, energy, and sustainability," said Ramaswamy.

Today, department faculty and students conduct world-class, translational and solution-driven research that ranges from molecular to ecosystem levels that contribute to sustainable and environmentally friendly manufacturing, use, and application of bio-based products; environmental quality; enhancement of agricultural production; energy efficient "green" buildings; and production of safer and healthier foods.

The BBE student has also been transformed over the years. In the past, the majority of students were young men from rural Minnesota. Now about one-third of BBE undergraduates are women and the department boasts an international faculty and draws an increasing number of students from urban areas.

"Our vision is to be global leaders in the discovery, development, and application of renewable resources and sustainable technologies to meet society's needs while enhancing the environment in Minnesota and beyond," Ramaswamy said. ■

BY SILVA YOUNG with contributions from DEANE MORRISON

JASON GILMOUR

NOW

Today, the Department of Bioproducts and Biosystems Engineering is a leader in addressing environmental sustainability in the burgeoning bioeconomy. The department works to advance the forefront of science, engineering and management knowledge in bioproducts and biosystems.

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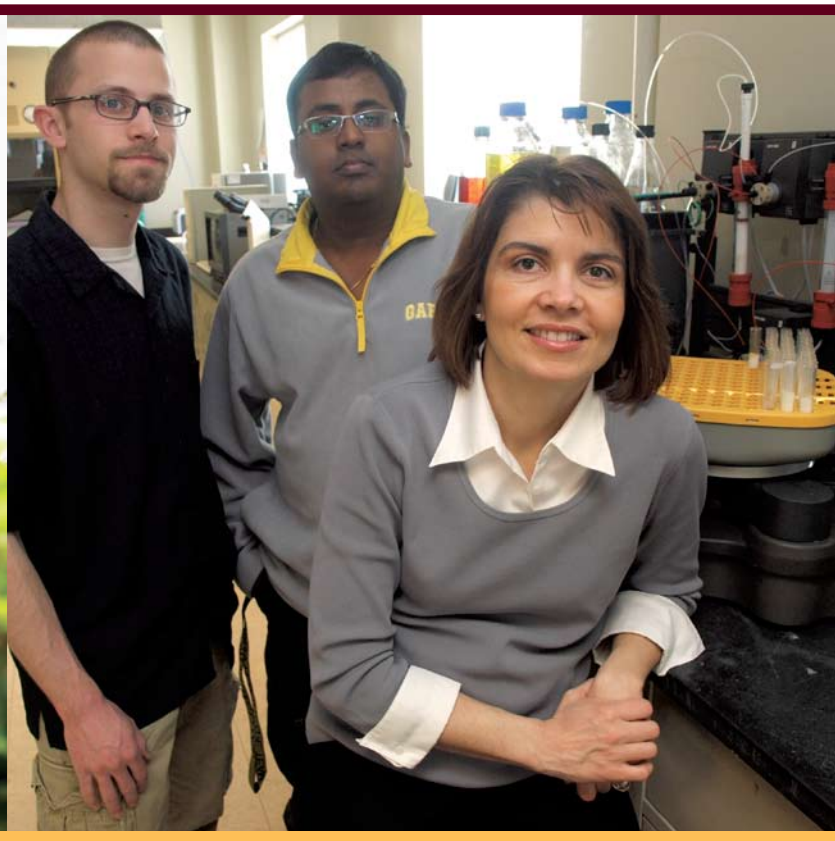

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Efie Kokkoli, assistant professor of chemical engineering and materials science, and graduate students, Todd Pangburn and Ashish Garg, are researching ways to specifically reach cancer cells while avoiding healthy organs. Using targeted nanoparticles to encapsulate and deliver drugs to a cancer site can significantly inhibit tumor growth, reduce tumor metastasis, and the associated side effects of cancer therapies. It also can improve overall quality of life post cancer survival.