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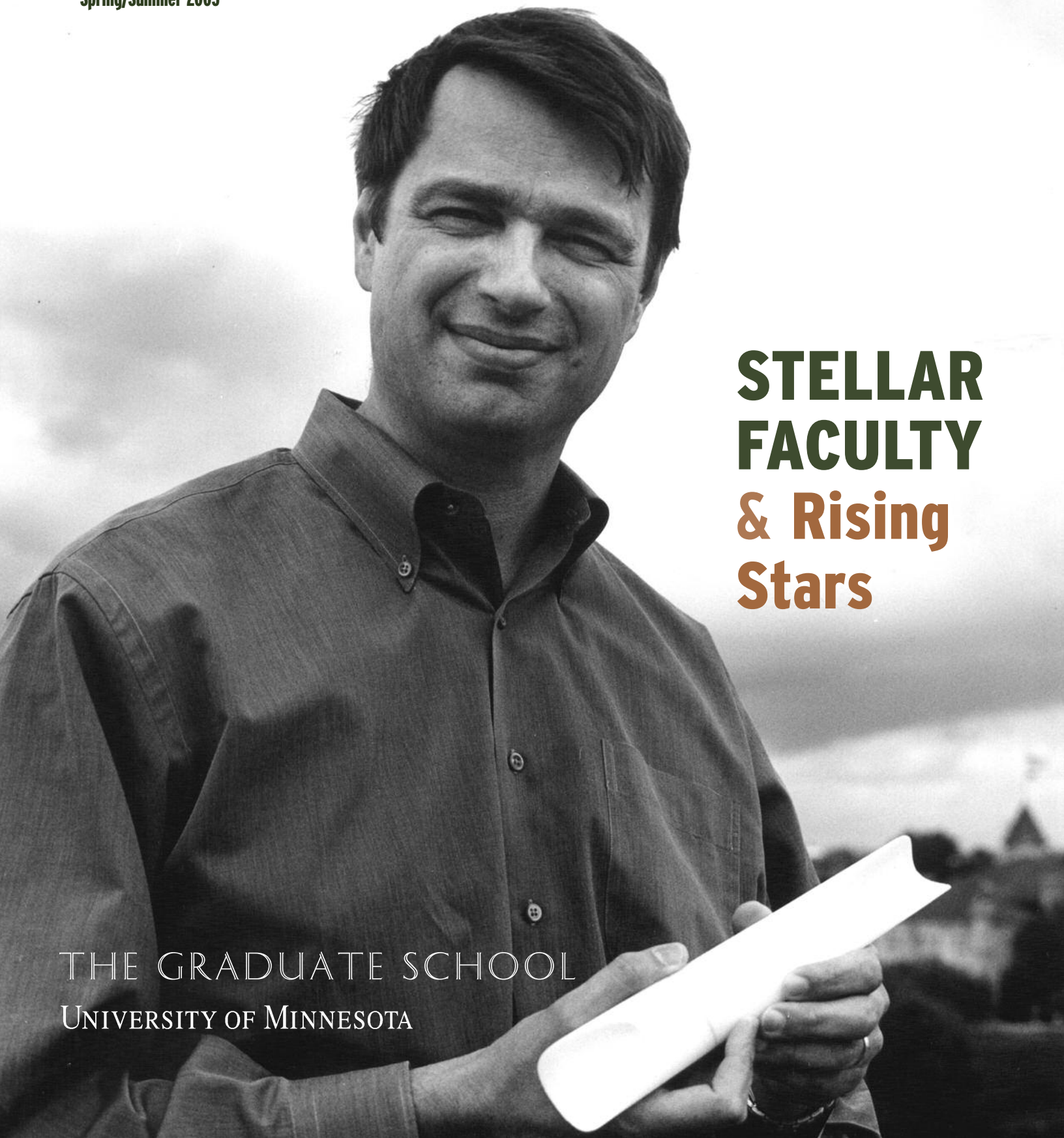
Spring/Summer 2005



STELLAR FACULTY & Rising Stars

THE GRADUATE SCHOOL
UNIVERSITY OF MINNESOTA

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STELLAR FACULTY & Rising Stars

The Graduate School serves the state, region, and nation by sustaining and developing high-quality research and graduate education programs at the University of Minnesota.

The Graduate School strengthens advanced teaching and research at the University by:

- providing efficient and innovative central services;
- promulgating best practices in graduate education;
- providing competitive support to the best faculty and students;
- fostering the most promising interdisciplinary research; and
- supporting college and intercollegiate programs.

Visit us online: **www.grad.umn.edu**

RIGHT: French & Italian department chair Daniel Brewer with Melanie Bowman and Muisi Krosi, two recipients of graduate fellowships (see page 23).

COVER: Graham Candler, Distinguished McKnight University Professor of Aerospace & Mechanical Engineering (see page 8).

DISCOVERY Spring/Summer 2005, No. 1. Published once a year by the University of Minnesota Graduate School for alumni/ae & friends. Send correspondence to the editor at the address below. For information about Graduate School programs, visit **www.grad.umn.edu**

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Meeting THE CHALLENGES of GRADUATE EDUCATION

Greetings from the University of Minnesota Graduate School. We're marking our centennial anniversary this year, celebrating the productivity, breadth, and quality that have made us a world leader in graduate education.

At the same time, we're looking toward the future with a keen awareness that graduate education today, here and across the country, faces enormous challenges.

It has been observed that of all the institutions existing in 1500, the only ones surviving today are the Catholic Church, the Parliament of the Isle of Man, and 62 universities.

The implication is that universities are the most stable institutions in society. That may be true, but they're assuredly not unchanging—and nowhere is higher education changing faster than in graduate schools.

Graduate School Centennial

WE INVITE YOU TO JOIN US this year as we turn toward the future by first acknowledging our distinguished past.

In connection with the Graduate School's centennial celebration in 2005–06, look for a new history brochure and Web site and a fanfare and chamber work commissioned from School of Music alumni.

Other activities include a special Guy Stanton Ford Lecture featuring scholar and storyteller Clay Jenkinson as Thomas Jefferson (see page 20), and a symposium on the Next Hundred Years of Graduate Education.

Please check our Web site for updates: www.grad.umn.edu

Among the many challenges we face:

- **Ensuring adequate funding for graduate education,** through additional public and private support and by finding ways to expand affordable housing options for graduate and professional students.
- **Increasing the diversity of our graduate student population,** through better-targeted recruitment efforts and by stressing a pipeline from K–12 education through graduate study.
- **Assuring the continued enrollment of highly qualified international students,** in the face of post 9/11 visa difficulties and enhanced global competition for talented students.
- **Improving Ph.D. completion and time-to-degree,** on which we are working with the Council of Graduate Schools.
- **Strengthening career advising and placement services** for graduate students and postdoctorals, one goal of our intensified collaborations with colleges, departments, and student affairs staff.
- **Expanding extra-disciplinary professional development** opportunities to better prepare students for a diversity of employment options; our efforts here include the U's Preparing Future Faculty Program and strategies to introduce students to business skills.
- **Clarifying the proper relation between regular degree-granting** graduate programs and other postbaccalaureate options, such as certificates and applied professional degrees.

Our success in meeting these challenges will determine the future of graduate education—and the futures of our students, our state, and our society.

We have exciting times ahead of us. We count on your support as we continue to ensure the excellence of graduate education at the University of Minnesota.

Sincerely, **Victor Bloomfield,** interim dean

BY THE NUMBERS

With MORE THAN 10,000 STUDENTS, the Graduate School spans both the Twin Cities and Duluth campuses of the University of Minnesota—and is the U's second-largest college (after the College of Liberal Arts).

Our student body is split almost 50-50 by gender, and our students hail from 50 states and 118 COUNTRIES (2,600 INTERNATIONAL STUDENTS in all).

Last year, we admitted about 2,100 NEW STUDENTS—and awarded about 2,200 GRADUATE DEGREES—1,600 master's degrees and 600 Ph.D.'s.

About 2,300 FACULTY teach 7,693 graduate-level courses each year.

Our programs span some 150 MAJORS—in the sciences (biological, health, engineering, physical, mathematical, and social); in education and psychology; and in language, literature, and the arts.

Photo by Mike Rolfelson

Interim Dean Victor Bloomfield, center, with Jason Harmon (entomology) and Sherri Weers Hunt (chemistry), two recipients of the Graduate School's Best Dissertation Awards (see page 15).

The Graduate School's **MCKNIGHT PROFESSORSHIP PROGRAMS** recognize both the University's most distinguished mid-career faculty and its most promising junior scholars.

HONORING THE U'S BEST

BY THE NUMBERS

Overall, 138 faculty members have been named MCKNIGHT LAND-GRANT PROFESSORS, including 9 recipients for 2004–06 and 11 recipients for 2005–07.

And 50 mid-career faculty members so far have been named DISTINGUISHED MCKNIGHT UNIVERSITY PROFESSORS, including 5 in 2004 and 5 in spring 2005.

For a complete list of winners: www.grad.umn.edu

RIGHT: **S. Douglas Olson,** Distinguished McKnight University Professor of Classical and Near Eastern Studies. A profile of Olson begins on page 5.

Also profiled in these pages: **Graham Candler,** Distinguished McKnight University Professor of Aerospace Engineering and Mechanics, page 8; and **A. David Redish,** McKnight Land-Grant Professor of Neuroscience, page 11.

Brief bios of all the 2004–06 recipients of McKnight professorships are featured throughout these pages.

ONE IS AN AEROSPACE ENGINEER whose highly specialized research makes it possible to send spacecraft to Mars. Another is a humanities scholar whose painstaking textual archaeology is making it possible to explore the world of ancient Greece as never before. Still another is an experimental neuroscientist who is drawing new maps of the brain that eventually may help unlock the mysteries of Parkinson's and Alzheimer's diseases.

THEY ARE JUST THREE OF THE DOZENS OF TRAILBLAZING faculty members honored with McKnight professorships by the University's Graduate School. The professorships are one reflection of the Graduate School's central role in developing and keeping a strong faculty at the University. They were established through a private-public partnership between the McKnight Foundation and the University—specifically, through generous gifts from the McKnight Foundation to the Graduate School, combined with a share of the Permanent University Fund dating back to the state's original land grant to the U.

Selections are presented to the Board of Regents each spring by committees of distinguished faculty from across the University.

THE MCKNIGHT LAND-GRANT PROFESSORSHIPS, established in 1987, honor junior faculty who are poised to make significant contributions to their disciplines. The program is designed to advance the careers of the most promising junior faculty (those whose work has demonstrated originality, imagination, and innovation) at a crucial period in their professional lives and to strengthen the University's faculty for the future.

This award is reserved for promising tenure-track assistant professors who earned their Ph.D.'s (or comparable professional degrees) within the past seven years and who joined the University in the past three years. It is a two-year appointment that includes a research grant in each year, plus a supplementary grant or a research leave during year two.

THE DISTINGUISHED MCKNIGHT UNIVERSITY PROFESSORSHIPS, established in 1995, honor the University of Minnesota's finest mid-career faculty members—those who have attained full professor status within the past 10 years, who have brought distinction to the University, and who are poised for still greater attainments in their fields.

Other criteria include quality of teaching and advising and contributions to the wider community. Recipients are awarded a $100,000 grant over five years for research, scholarly work, or artistic activities. They also hold the title *Distinguished McKnight University Professor* throughout their University careers.

JUST WHAT MAKES A MCKNIGHT-WORTHY FACULTY MEMBER? Perhaps the best way to answer that question is to introduce three recent recipients of these prestigious Graduate School awards.

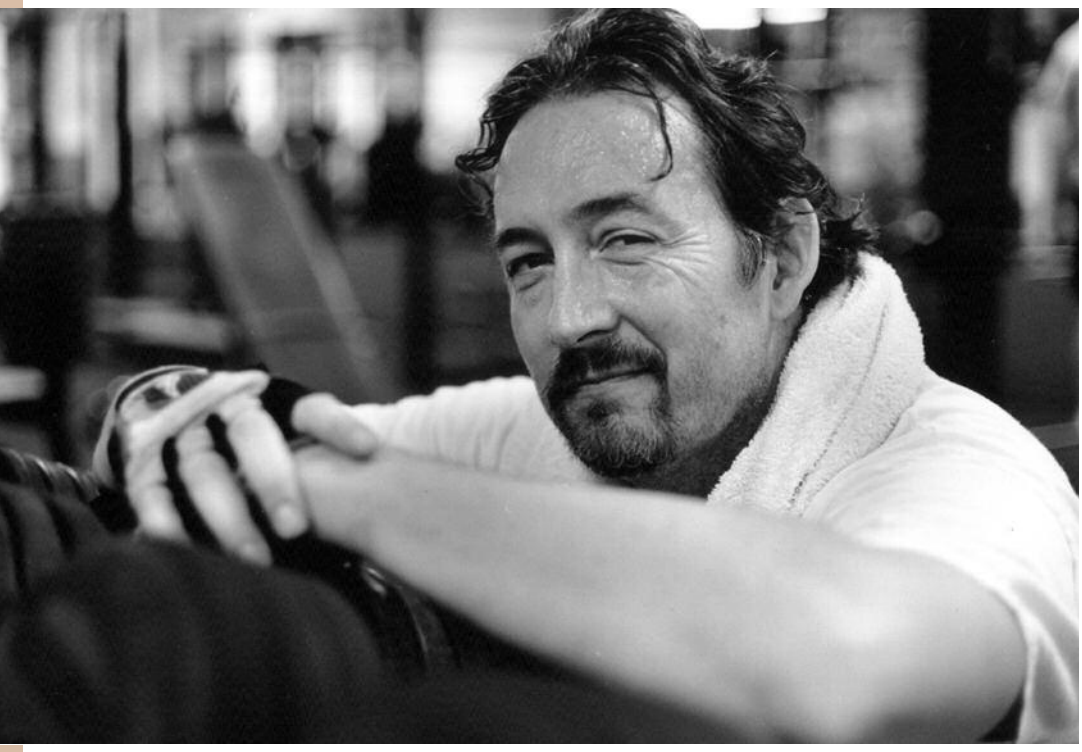
On the following pages, you'll meet **Graham Candler** and **S. Douglas Olson,** Distinguished McKnight University Professors, and **A. David Redish,** who holds a McKnight Land-Grant Professorship.

Their disciplines and topics couldn't be more different. But all three faculty members are exemplars of innovative and passionately engaged scholarship.

Whether focusing on hydrosonic fluid dynamics (Candler), ancient Greek playwrights (Olson), or brain processing (Redish), in their research and teaching they are pushing the boundaries of established knowledge, expanding how we understand ourselves and our world—and shaping our sense of future possibilities, both in conceptual and practical terms. ■

Distinguished McKnight University Professor S. Douglas Olson

Traveling to ANCIENT WORLDS



When he's not reconstructing 2,500-year-old texts, Doug Olson often can be found in the gym lifting weights. The ancient Greeks invented organized athletics, he notes—"and weightlifting is a lot like classical philology: extremely hard, step-by-step work aimed at an impossible goal, which nonetheless produces gradual progress."

FOR S. DOUGLAS OLSON, ANCIENT TEXTS are "a small, endlessly fascinating window into the past."

"It's the closest we can get to time travel," says Olson, who is a professor of classical and Near Eastern studies and one of the world's foremost scholars and editors of ancient Greek literature.

"Old books for me are like a foreign country most people can't visit—a very intriguing, distant country you can only get to if you're willing to work very hard to get there. You have a chance to explore amazing, incredibly rich treasures and then come back and talk about what you found."

Olson's explorations take him most often to the vibrant world of Greece during the classical period, spanning roughly 500 to 325 B.C.E. The cradle of Western intellectual life, and the birthplace of democracy and theater, Athens and other Greek city-states in the classical era spawned some of the most brilliant and influential literature of all time, from the philosophical writings of Plato and Aristotle to the tragedies and comedies of Aeschylus, Euripides, Sophocles, and Aristophanes.

The study of handwritten texts created 2,500 years ago is as much archaeology as it is exegesis. Most ancient Greek literature exists only in fragments; the bits and pieces may be from multiple drafts or copies of copies. Known especially for his comprehensive scholarship on the great comic playwright Aristophanes, Olson is a master of literary sleuth work, painstakingly assembling bits of papyri and examining references and quotations in countless documents and books. His objective: To create editions of original texts that are as definitive as possible, along with detailed notes and commentary other scholars can use to retrace his steps.

Few scholars do this fundamental work, Olson says. Most focus on analysis of the texts. "The problem is, if you don't know what Aeschylus wrote, you can't critique it. Something has to be reconstructed somewhere along the line.

"A lot of people think Greek texts fall from heaven—they have a copy of Homer, for example, or Euripedes, and they think the text is what's in the book they hold in their hands.

"But the texts we have are constructed things. Copies were written out by monks or early copyists or by people hired in the 9th–10th centuries to produce books for libraries. There were various additions made as the texts were copied—or stuff fell out. So the written texts disagree. What I do is try to locate as many fragmentary components as I can, sort through all the evidence, and try to reconstruct what the author actually wrote."

Olson says that documenting his own critical apparatus is as

Olson, to page 6

Distinguished McKnight University Professors

named in 2004 and 2005

David A. Andow, Entomology
Andow is a leading expert in the use of ecological and evolutionary principles to make conceptual breakthroughs in the agricultural and environmental sciences. His discoveries in the area of environmental risk management related to genetically modified crops are shaping policies worldwide. He also has made major theoretical contributions in agricultural biodiversity, sustainable agriculture, and exotic species risk management. He has been awarded a prestigious Australian McMaster's Fellowship and has published more than 140 articles and delivered more than 150 addresses.

Graham V. Candler, Aerospace Engineering & Mechanics—See profile on page 8.

Nicki R. Crick, Child Development
Crick is one of the world's most influential scholars of aggression and gender issues in children's mental health and development. Her studies have demonstrated that girls can be just as aggressive as boys, and equally at risk for problems. Her research on social information processing, relational aggression, and gender in the development of psychopathology has revolutionized theory, practice and policy related to antisocial behavior and victimization in children. Her national awards have included the American Psychological Association's highest honor for early career achievement. She also has been a fellow of Stanford's Center for Advanced Study in the Behavioral Sciences.

S. Douglas Olson, Classical & Near Eastern Studies—See profile on page 5.

Jeffrey T. Roberts, Chemistry
An internationally renowned chemist, Roberts has opened fields of research leading to better understanding of atmospheric chemistry. He is known particularly for his studies of ice and sulfuric acid and for his innovative work on size-selected aerosol particles. His investigations into chemical vapor deposition answered fundamental questions regarding the growth of materials. He conceived and directs the Research Site for Educators in Chemistry and has over 70 research publications to his credit. Previous

Distinguished McKnight U Profs, to page 9

Olson, from page 5

important as constructing ur-texts of important Greek works. "I note what my sources were, what the problems were, the judgments I make every step of the way—information that will enable other scholars to build on my work without having to redo it. The goal is to produce annotated editions of lasting value—texts that will be used for generations."

Detailed guidebooks

Olson's scholarly travels into the world of ancient Greece result not only in definitive texts, but also in guidebooks to make the world accessible to others. His meticulously researched commentaries explain day-to-day life in ancient Greece and situate the texts in the context of the times ("what the author is trying to accomplish, why this particular style and audience were used, what readers were supposed to get from the text").

"Even if you can read a text, you can't necessarily understand it unless you really unlock the context," emphasizes Olson. "Ancient Greek literature is full of references to people, objects, and customs that are not obvious anymore because ours is a very different society from 25 centuries ago."

Having immersed himself in the study of ancient Greece for nearly three decades, Olson feels he knows that world "in the same way some people feel they know their way around someplace like New York—you go there a lot, you know your way around, you can tell other people what's what."

Navigating a world through a fragmented and globally scattered body of texts is, Olson grants, more complicated than seeing it from a taxi gliding down Fifth Avenue. "The texts don't simply reveal themselves to you," he says. "Your reading is always being blocked, so you have to puzzle through problems, figure out new ways around, look at things from another distance, another angle, figure out how to see something that the text in a sense doesn't want you to see. You have to figure out how to take the right roads, or how to get off the wrong road back onto one that's going in the right direction."

The language alone is "fantastically complex," Olson says. He spends countless hours researching obscure vocabulary terms and analyzing the language of texts grammatically and stylistically.

Rewarding work

If it's daunting intellectual and detective work, Olson says, it's also an exciting and rewarding scholarly front.

"The world of ancient Greece is in many ways the basis for our own world today," he says. "This is the world where Christianity and Judaism originated. Where the idea of theater originated. All the things we think about as part of the social vocabulary and take for granted—this is where they're from."

Athenians invented democracy at the end of the 6th century, Olson notes, "and they didn't have an easy time with it. They discovered democracy to be a very messy thing. They were a slave-owning society, as ours initially was, and they grappled with political chicanery, demagoguery, self-dealing, brutal imperialistic wars, all kinds of struggle, the same problems we wrestle with. They are the first society of people we know who dealt with all this—and they did so with extraordinary sophistication and in incredibly thoughtful ways."

Olson traces his fascination with ancient Greek literature back to his childhood experiences growing up in a deeply observant Christian family in Northern Illinois. In college, at

"GETTING A MCKNIGHT AWARD IS QUITE GRATIFYING, especially for someone in classics," Douglas Olson says. "It's wonderful that this University recognizes the importance of research and teaching in the humanities. People are messing with the gene code, putting things on Mars—that sets the bar pretty high for intellectual work."

Adds Olson: "Actually, figuring out how to get to Mars is not all that dissimilar to what I do: identify an inaccessible place, and get to it if I can just figure out how. And at least I know there was life in ancient Greece!"

Olson's McKnight award has allowed him to purchase rare reference works that will further his study of ancient Greek texts.

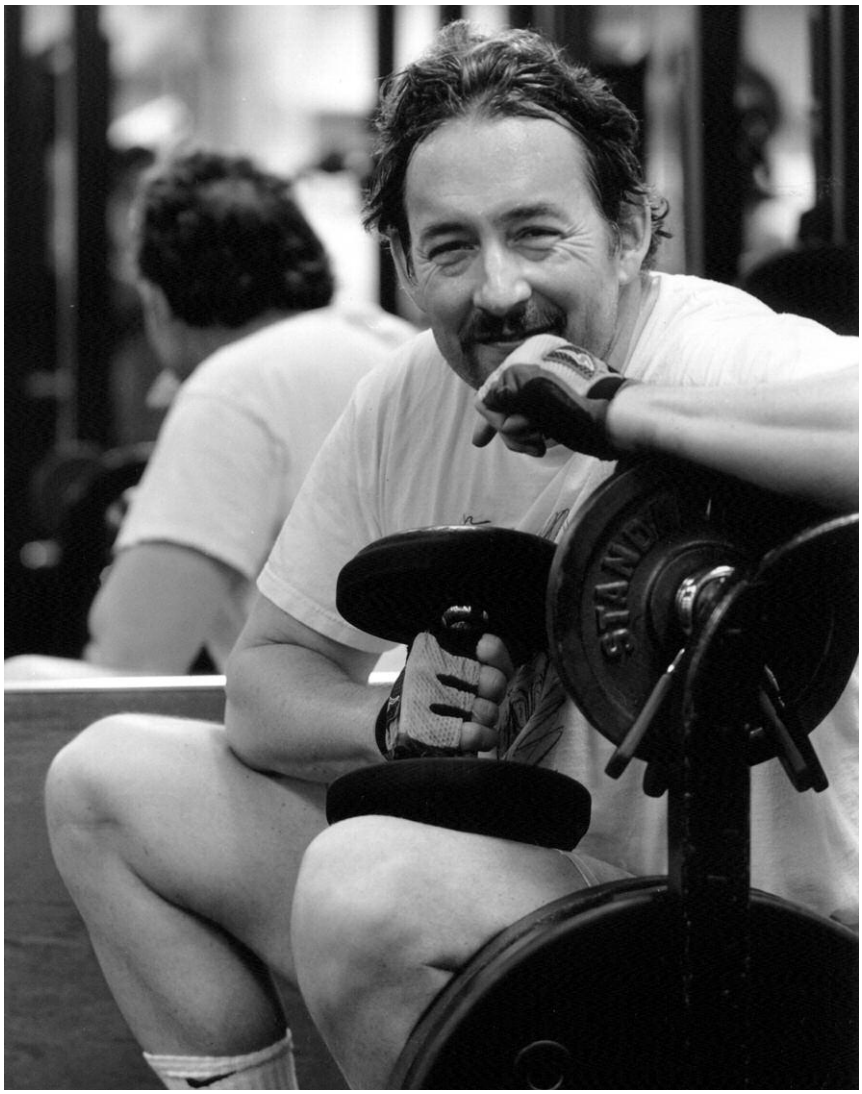
Haverford, and later at Harvard Divinity School, he pursued an interest in New Testament studies—"a very rich and complex field, very intellectually exciting, especially if you know the texts cold, which I did."

Taking courses in Greek language and literature, he found himself hooked. "These were the oldest primary texts, and I just wanted to keep pushing back and back. And then I just got more and more intrigued with the complex thought world of the ancient Greeks. I thought, 'here were the most interesting people who ever lived.' So I moved sideways from New Testament studies into ancient Greek studies."

While earning his M.A. and Ph.D. in Greek at Bryn Mawr, Olson also took courses in archaeology. That in turn, led him to spend a year-and-a-half at the American School of Classical Studies in Athens "to learn how archaeologists think—how evidence is assembled, arguments made. The questions archaeologists ask when excavating ancient ruins," Olson emphasizes, "are essentially the same ones we need to ask ancient texts."

Olson joined the University faculty in 1997, pleased to be in one of the few university classics departments "far-thinking enough to combine archaeology, religious studies, and classics" (the U is "the national model," he stresses).

His work has been honored not only with a McKnight Distinguished University Professorship, but also with a grant from the Loeb Classical Library Foundation of Harvard University and, twice, with National Endowment of the Humanities Research Fellowships.



Passionate teacher

In the classroom, Olson endeavors to pass along to his students some of his own enthusiasm and skill for "asking the questions worth asking." He teaches original language classes in Greek and Latin, as well as courses in ancient comedy, drama, and poetry.

His students, he says, "are wonderful on the whole—excited about learning. They're willing to take risks, which is really important." Ancient Greek lit, he stresses, "is not easy material. It's not always 'safe'—classical Athenian comedy in particular is vulgar, disrespectful, coarse. And its complexity is such that you can't just be handed a text, you really do have to work for it."

He hopes students will discover for themselves "the immense excitement of traveling to past worlds through literature. What I try to teach is how to figure out what kinds of questions to ask—to figure out intriguing ways to interrogate a text. That's what will unlock the incredible treasures in these texts, waiting to be discovered even after 25 centuries."

Whether piecing together papyri, decoding arcane Greek terms, or leading class discussions of Athenian democracy, Olson experiences his work as "nothing short of a great passion. Even during semester breaks, I'm still working."

Adds Olson: "I'm just starting to get a handle on all these stray bits and pieces. If my students and I could just get our arms around them all, we could shine an incredibly bright light not just on our literary past, but on our history as a civilization, as a world. That's why this work is so exciting." ■

He'll also be able to travel to European archives to scrutinize original manuscripts ("sometimes there are things written on the inner margins of a text that are incredibly important bits of information"). His award also will afford an extraordinary research apprenticeship to a graduate student.

Initiatives such as the Graduate School's McKnight awards go a long way to recruit and keep top faculty at the U, Olson says. "One good thing about universities in this country compared with those in Europe is that there are relatively few rungs to the academic ladder. But that also means that when you reach full professor, it's hard to identify something to work toward, to aspire to. The McKnight program fills that gap. It's quite impressive. I honestly don't know of other universities doing this."

Distinguished McKnight University Professor
Graham Candler

Aiming for DISTANT PLANETS

GRAHAM CANDLER SPENDS MUCH OF HIS TIME developing complex mathematical codes in his Akerman Hall research lab. Yet whether running air-flow equations on a specially programmed supercomputer at the University, or testing them in an immense "shock tunnel" in upstate New York, he is one of an elite group of scientists worldwide who make it possible to explore distant planets and return safely to earth.

Candler, a professor of aerospace engineering and mechanics, is a world leader in computational hypersonic fluid dynamics, or how atmospheric dynamics affect vehicles hurtling though space at "Mach 10" or greater—10 times the speed of sound, or about 7,000 miles per hour. His equations and models are used by NASA and the U.S. Air Force to design vehicles capable of withstanding the extreme physical stresses of high-speed flight.

Specifically, Candler's work predicts the flows of air and other gases around high-speed spacecraft entering planetary atmospheres, whether landing on Mars or returning to Earth. The reactions in these gas flows produce shockwaves that surround a vehicle with intense energy and heat—forces that could easily incinerate the vehicle, its astronauts, and its payload.

Candler's models are essential because no laboratory can replicate the extreme conditions that hypersonic spacecraft will encounter. His numerical methods were used by engineers (among them many of Candler's former graduate students) to develop heat shields for the Mars Pathfinder rover and for the Stardust spacecraft now en route back to Earth carrying valuable samples of comet dust.

His work also will be instrumental in the design of thermal protection equipment for future expeditions to Jupiter and Neptune, for the redesign of the space shuttle, and for an experimental hypersonic vehicle called a "scramjet" that the U.S. government will test this year in Australia.

Aerodynamically inclined

High-tech space vehicles are at the center of Candler's research, but his interest in aerodynamics started with the likes of sailboats and bicycles. "I always liked things driven by aerodynamics, figuring out how the weather and wind would affect my sailing or cycling," recalls Candler.

As the son of a peripatetic economics professor, he found himself having sailed and cycled in a surprising number of places all over the world—New Zealand, California, the Midwest, Canada—by the time he was 18.

He also liked fixing and building things, starting with the repair of drafty windows or leaky faucets and moving on to the design and construction of treehouses, cabinets, and fine furniture. At McGill University in Montreal, he focused primarily on mechanical engineering, with aerodynamics secondary. High-speed aerodynamics became his passion during graduate school, at Stanford, under the tutelage of professors involved in space-shuttle research at the nearby NASA Ames Research Center.

Entering the field at an inauspicious time—a period in the mid-1980s when many scientists were retiring from or scrupulously avoiding the then-languishing U.S. space program—Candler worked at the Ames lab himself for a year and then with researchers at NASA Langley Research Center (as a faculty member at North Carolina State University). By the time he joined Minnesota's faculty 12 years ago, space exploration had again become a national priority and Candler had emerged as one of the premier experts in hypersonic aerodynamics.

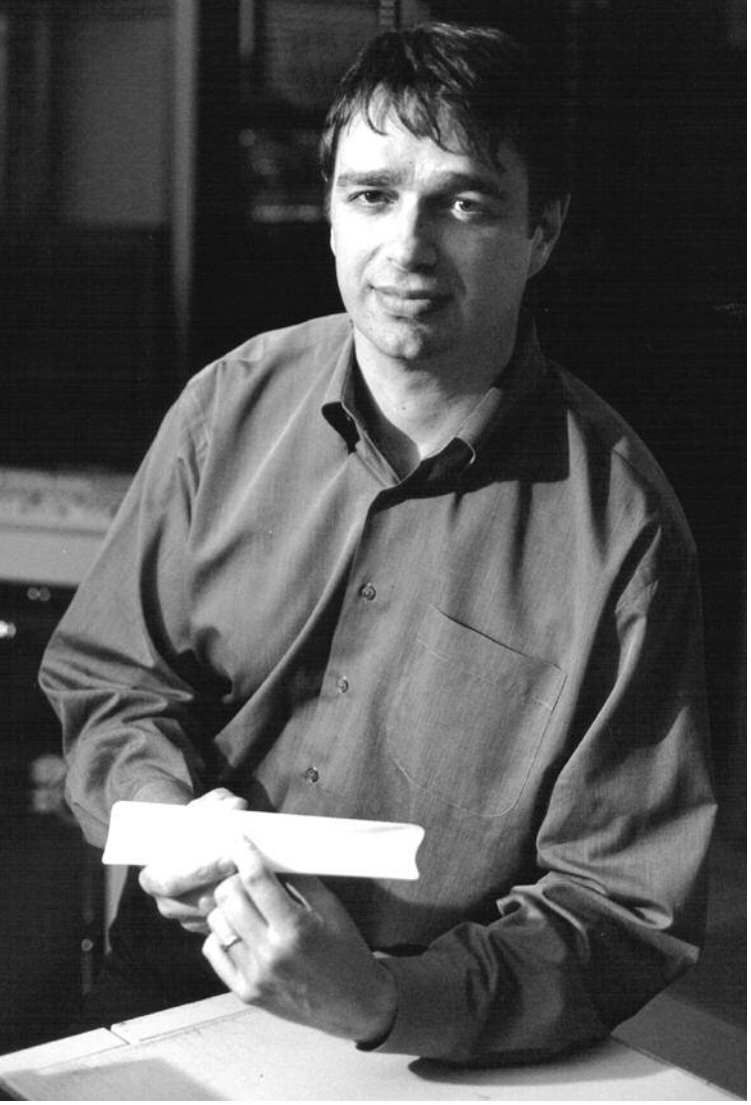
His unparalleled expertise in a crucial and highly complex area of engineering has made his University of Minnesota lab a magnet for the best and brightest graduate students in the field. "By far this is one of the biggest academic research programs of its kind in the country, and there are just a few dozen people within the academic world doing this kind of thing," says Candler, who employs a dozen aerospace engineering graduate students and postdocs as research assistants each semester.

"During the period when the space program wasn't active, people got out of the business, including most of those who worked on the Apollo and space shuttle," he says. "Now there's money again for high-speed research, but almost everyone who does it is at NASA or Department of Defense labs. I'm here [at the University of Minnesota] because I really like working with students. Minnesota attracts very good students, and they teach me new ways of looking at things. It makes my work a lot more rewarding, and fun."

High-stakes research

The fun helps when the stakes are as high as they are in Candler's lab. The cost of designing, machining, and testing spacecraft based on Candler's numerical methods and models runs into the millions of dollars. And to a striking degree, the safety and success of the U.S. space program depends on Candler's work and on the expertise of engineers who trained in his research lab.

"I have to think twice before I commit to the geometry," allows Candler. "It helps that I have a good understanding of physics as well as of numerics. I'm essentially an engineer who likes to build things and see them fly. I got into numerical



Graham Candler in his U of M research lab, in Akerman Hall. In his hands is a miniature model of the "scramjet," a hypersonic vehicle that the U.S. government soon will test based on Candler's complex research.

method development because it's too expensive or completely impractical to do flight testing of most space vehicles."

Candler's work is singular enough that he hasn't been entirely surprised to spot copies of his Ph.D. thesis lying around when he's toured European research labs. "One problem is that no one in industry or government funds work in numerical method development—everything is geared to real problems. Basic research is left to the few of us who work in universities, and even then to get a grant you have to have a specific application in mind."

The numerical models Candler develops simulate the kinetic and thermal forces that slam into high-speed aircraft as they enter a planet's atmosphere. "If you're coming back from the moon, typically the speed is 11 kilometers per second, or around 23,000 miles per hour," he explains. "So if you think about the energy in this gas [air] at that point, there are about 60 million joules of energy per kilogram. That's about 12 times greater than the energy per kilogram in a high explosive."

As Candler elaborates, he takes on the mien of the avid scientist, speaking more and more rapidly and reaching to scribble equations and circles on a whiteboard. "When atmospheric forces bring this enormous energy to rest on the nose of a spacecraft, you have kinetic energy converted to thermal energy. Specifically, the heat of the air flowing past the aircraft … translates into about 100,000 degrees Fahrenheit."

Given that the surface temperature of the sun is 11,000 degrees, "this is not an inconsequential air flow," Candler stresses, still scribbling—and also noting that other complex chemical reactions are taking place at the same time.

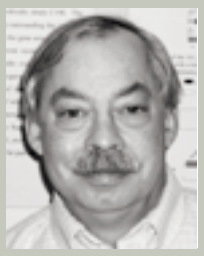
Candler's work is aimed at predicting, through computer simulations, how the physics of the air flows will affect spacecraft under various conditions. Focused in part on understanding infinitesimal changes in the conditions of gas, his sketches and calculations are staggeringly complex; even a bare-bones summary of his work brims with references to such things as oblique shock, contact surface, density, Mach number, transmitted shock, and vibrating temperature, among many other concepts and variables.

His most promising equations are tested using models at the sprawling

Candler, to page 10

awards include a Sloan Fellowship, the Dreyfus New Faculty Award, and the Special Creativity Award from the National Science Foundation. As an assistant professor, Roberts held a McKnight Land-Grant Professorship.

Michael J. Sadowsky, Soil, Water, & Climate



Internationally renowned for his research in environmental microbiology, Sadowsky has significantly advanced understanding of the genomics, genetics, and biochemistry of the microbial degradation of environmental pollutants. He has made major contributions related to the microbial ecology of bacteria in soils and water and how global change influences soil microbial processes. Known for his interdisciplinary collaborations to answer complex microbiological questions, Sadowsky has published 90+ articles and has addressed over 50 conferences. He is a fellow in the prestigious American Academy of Microbiology and past editor of the journal *Applied and Environmental Microbiology.*

Guillermo Sapiro, Electrical & Computer Engineering

Sapiro is leading a mathematical renaissance in image processing and computer vision. His innovative use of partial differential equations, differential geometry, and numerical analysis have made him one a world expert in the area of image-based differential equation models. He is sought after by artists, art restorers, and people in the entertainment industry for his application of these techniques to image restoration. His collaborative work with biologists is providing groundbreaking tools for processing high-dimensional biomedical imagery ranging from functional magnetic resonance images of the brain to electron microscope images of the HIV virus. He is a recipient of the prestigious U.S. Presidential Early Career Award in Science and Engineering.

Shashi Shekhar, Computer Science & Engineering

Shekhar is a world leader in the area of spatial databases, an interdisciplinary area at the intersection of computer science and geographic information science. His work advances understanding of the computational structure of large spatial databases needed by physical

Distinguished McKnight U Profs, to page 10

Candler, from page 9

National Shock Tunnel Facility in Buffalo, New York, one of the few places in the world capable of simulating the high-energy, high-heat conditions of hypersonic flight. The facility is part of the Calspan-University of Buffalo Research Center, a partner in the University of Minnesota-based National Hypersonics Research Center, which Candler directs.

Modeling has its limitations, Candler notes. "We test and model certain conditions. There's always the risk that we're using the wrong assumptions, solving the wrong equations."

In particular, models can't always take into account every conceivable worst-case scenario. One such scenario, Candler notes, led to the tragic explosion of the space shuttle Columbia in February 2003 killing all seven astronauts on board. One of Candler's graduate students was the key technical expert in evaluating the disaster.

"We now know exactly what happened to the Columbia," Candler says. "There was light coming off of the flow field during reentry to the Earth's atmosphere—people filmed it. The shuttle's left wing was damaged during launch—there was a huge hole on the leading edge of the wing.

"When the shuttle reentered the atmosphere, traveling at Mach 22 [22 times the speed of sound], the shockwave that hit the nose of the shuttle created such intense heat that gas shot into the hole on the wing and basically incinerated it.

"Just in terms of the energetics involved—these are not forces you exactly want to mess around with."

"Just in terms of the energetics involved—these are not forces you exactly want to mess around with," emphasizes Candler. "All we can do is keep trying to make better and better models that account for as many scenarios as we possibly can."

Looking to the future

One of Candler's current preoccupations is helping to perfect the design of a new high-speed aircraft called a "scramjet." This new type of hypersonic vehicle is intended as a quick, economical, and reusable means of launching a satellite into orbit. The scramjet will be designed to burn hydrogen using air in the atmosphere—eliminating the need for heavy tanks of oxygen carried by conventional rockets.

The result will be a lighter, more efficient, and cheaper aircraft that "can fly up on short notice, launch something, and then fly down and refuel," explains Candler.

Candler hopes to observe a scramjet test flight this fall in Australia. "It will be great if we can fly this thing and make it work," he says.

"That's the down side of what I do—spacecraft aren't developed every day, and it's so expensive to do flight testing that you almost never see things flown. But when it happens, it's unbelievably exciting." ■

Distinguished McKnight U profs, continued

sciences and engineering disciplines. He is the author of 2 books and more than 160 refereed papers and is sought out by policymakers for his expertise. Some of his research findings are playing a key role in the context of U.S. homeland security. His earlier research developed core technologies for in-vehicle navigation devices as well as Web-based routing services, which revolutionized urban navigation. He is a fellow of the Institution of Electrical and Electronics Engineers and serves on the National Academy of Science/National Research Council Mapping Science Committee.

Kathryn A. Sikkink, Political Science

Sikkink is one of the world's foremost scholars of transnational politics. She has been central to the development of a school of social constructivist theory that has profoundly shaped theoretical agendas in the fields of international relations and comparative politics. Her primary focus has been on the transnational politics of human rights, especially the development and effectiveness of human rights polices in the Americas. One of her books, *Activists Beyond Borders: Advocacy Networks in International Politics,* won two major awards and is one of the most cited works in international relations and comparative politics. She is a fellow of the American Academy of Arts and Sciences and a member of the Council on Foreign Relations. Earlier, she held a McKnight Land-Grant Professorship.

Nevin Dale Young, Plant Pathology

Young is internationally renowned for his research in legume genetics and genomics/bioinformatics. His research on gene discovery and genome mapping provides useful applications in agriculture by defining genes that affect plant disease resistance, seed quality, and responses to environmental stresses. He was the first researcher to demonstrate the use of DNA markers to pinpoint disease-resistant genes and other important genes in plant breeding. He also was a pioneer in marker-assisted selection (a technique now used worldwide to identify and select for important traits) and was the first to prove that genes affecting plant development are conserved among plant species at the molecular level. He has served on the editorial boards of leading plant genetics journals and on advisory boards. He now leads the international effort to sequence the first legume genome. ■

McKnight Land-Grant Professor A. David Redish

Telling the BRAIN'S STORY

A. David Redish, with grad student Jadin Jackson in the experimental room where rats run a maze. The experiments offer clues about the role of the brain in navigation.

TALK ABOUT CROSSING BOUNDARIES. He's a poet, a playwright, and a computer scientist. He's a member of the Playwright's Center and of the Society for Neuroscience. He's the author of *Beyond the Cognitive Map: From Place Cells to Episodic Memory,* a book about the brain that has been called "an astonishing piece of work."

A. David Redish is an assistant professor in the Department of Neuroscience. He does basic brain research that could one day solve the puzzle of devastating illnesses such as Alzheimer's. But not one of his degrees is in medicine or neuroscience, or even biology or psychology.

Like so many pathbreaking researchers, Redish has not followed a conventional path. "Every life has its narrative arc," he says. The arc that connects Redish the poet and Redish the scientist reflects a passion for storytelling. "When I give talks," he says, "it's always about telling a story. We are narrative creatures. One of the wonderful things about being a scientist is that it's a great story, an interesting story, an important story."

As an undergraduate at Johns Hopkins University, Redish mixed it up as a double major in creative writing and computer science. Later, as a computer science graduate student at Carnegie-Mellon, he became disenchanted with the engineering side of artificial intelligence and took the introductory course in neuroscience that led to his eureka moment.

On the first day of that course, the instructor described how early experiments showed that neurons had a voltage difference between the inside and the outside of the cell. From the capacitance measures of the electrical signal, one could determine the width of the neuronal membranes (barriers) that build resistance and change the dynamics of the current.

It wasn't until 50 years later that the electron microscope showed those predictions were correct. "This was a quantitative prediction and it was right on the mark," Redish recalls. "I saw the excitement and beauty of this kind of science and switched my focus as a computer scientist from artificial intelligence to neuroscience. I never looked back."

Behavior and the brain

To tell the neuroscience story, Redish must first spend many hours in his lab measuring "how the brain represents the world outside and how those representations are maintained and updated through experience."

Many of the diseases that plague the brain are systems-level diseases such as Parkinson's and Alzheimer's. The work of Redish and others is creating the knowledge to help us under-

Redish, to page 12

Redish, from page 12

stand those systems. It's about building "comprehensive theories of brain function," says Redish.

In a nutshell, what Redish does is to try to understand how the brain processes information and coordinates behavior. Drawing on his computer science background, Redish notes that "if you want to know how the brain works, you have to ask questions about the information it gets and acts on. Computer science gives us a way of thinking about these things, of doing the experiments. The brain isn't digital, but in some ways we can think of the brain as a kind of computer. It takes information in, processes information, and you act on that information.

"Half of what I do is theoretical neuroscience. With my computer science background, that's where I fit. But the other half is experimental science. It's exciting to do both."

Scientists know that the information the brain takes in is carried by neurons. Neurons transmit information to other neurons by firing "spikes," one-millisecond changes in electronic voltage differences between the inside and outside of a neuron. By looking at those spikes, scientists can see how information (say, a representation of a color) is carried.

"By identifying which neurons fire, when they fire, and how they fire, we can determine what information is carried and how that information is processed," Redish explains. "Once we understand this, our knowledge has predictive value—that is, we can draw conclusions about how the brain is likely to behave in similar circumstances in the future, and we can recognize when things go awry."

Space, memory, and mind reading

It's especially important for scientists to understand spatial cognition, Redish says, because "spatial reasoning can serve as an entry point into our understanding of brain function." Cells in the hippocampus, a central brain structure involved in learning and memory, have what Redish calls a *place field.* Each hippocampal cell in an animal's brain fires spikes when the animal is in a specific location in a specific environment.

"We can track an animal's movements to one centimeter—literally—by watching their place cells firing," says Redish. "In other words, we can 'read the rat's mind.'"

One project under way in Redish's lab looks at how the place cells "replay" a behavior during sleep. Studies of neural activity document that the same sequence the place cells showed during a behavior are rerun during sleep afterward. Those sequences were not there before the behavior, Redish emphasizes. One of the aims of his project is to determine just how those sequences are learned and stored during the behavior for nocturnal replay.

Behavior, says Redish, arises from an interaction of multiple different memory systems, and careful experiments can differentiate the effects of those systems. Two systems Redish studies are declarative memory, which stores facts—where the car is parked, for example—and procedural memory, which stores habits—such as braking and accelerating while driving.

Redish explains that declarative memory is conscious and deliberate. Navigation with declarative memory is map-based. In contrast, procedural memory is unconscious, habit-based. Navigation with procedural memory is route-based.

"If you want to know how the brain works, you have to ask questions about the information it gets."

"The first time you go to work at a new place, you need a map, you need to read street signs, you need conscious efforts to get there," says Redish. "Do it for a year, and you can do it without thinking. That's automaticity, which happens when you switch from the conscious, map-based system to the unconscious route-based system."

In Redish's lab, "We teach a rat to run on a path in which it must make a sequence of choices. Over time, it switches from map-based to route-based navigation strategy. Designing an experiment that requires the rat to switch gives us the ability to study the two systems and their interaction."

MCKNIGHT LAND-GRANT PROFESSORS 2004-06 & 2005-07

Baoquan Chen (Ph.D., State University of New York, Stony Brook). **Computer Science & Engineering.**
Time-critical & illustrative visualization.

Alec T. Habig (Ph.D., Indiana University). **Physics/UMD.**
Particle astrophysics.

Reuben S. Harris (Ph.D., University of Alberta). **Biochemistry, Molecular Biology & Biophysics.**
How our cells use intentional mutations to protect us from pathogens.

Heiko O. Jacobs (Dr.sc.Techn., ETH/Zürich). **Electrical & Computer Engineering.**
Nontraditional micro and nanotechnologies to enable the manufacture of novel devices.

Alex Kamenev (Ph.D., Weizmann Institute of Sciences). **Physics.**
Theoretical condensed-matter physics and its applications to semiconductor quantum devices, magnetic materials, and superconductivity.

Dan S. Kaufman (M.D., Ph.D., Mayo Medical School & Graduate School). **Medicine.**
Human embryonic stem cell biology.

Jonathan S. Marchant (Ph.D., Cambridge University). **Pharmacology.**
Intracellular signaling: The molecular syntax of cellular conversations.

Michelle N. Mason (Ph.D., University of Chicago). **Philosophy.**
Cultivating character: A theory of moral virtue.

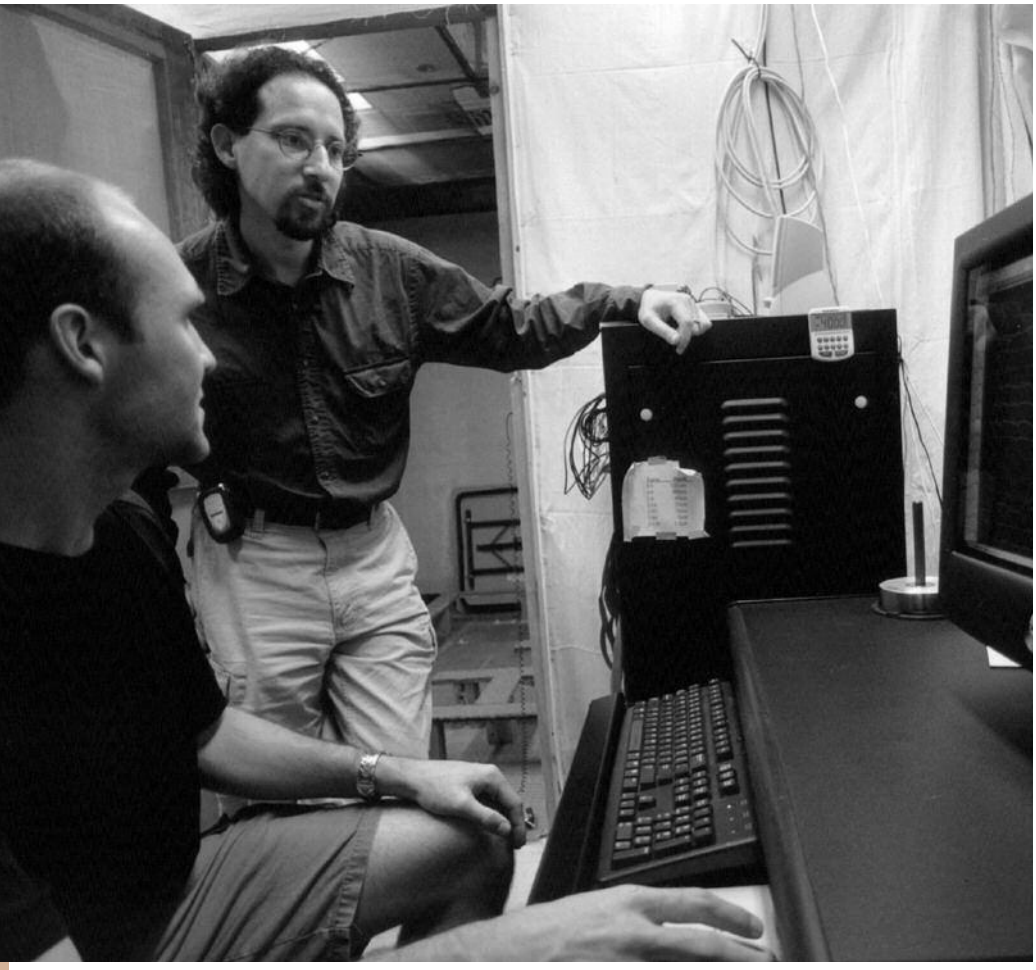
Kristopher McNeill (Ph.D., University of California, Berkeley). **Chemistry.**
Environmental chemistry: Mechanisms of chemical reactions in aquatic environments.

Stuart McLean (Ph.D., Columbia University), **Anthropology.**
Cultural identity, historical memory, and the material environment in Ireland and the European Union.

McKnight Land-Grant, to page 14

To "read" how the brain reads or processes its spatial environment, Redish implants electronic chips in the brains of anesthetized rats and then sends the awakened rats through a series of navigational exercises, to see how they orient themselves spatially and find their way to destinations (rewards) using a kind of coordinate system. Then he changes the environment and sends them off again to find their way.

His purpose is to probe the brain's role in navigation—to see how the brain represents space and how it allows an animal whose environment has been altered to "self-localize, to reset an internal coordinate system from external cues."



In short, Redish is demonstrating how the brain not only helps us find our way in new and unfamiliar territory but also keeps us from getting lost when external cues are changed. His findings could one day help us understand precisely which brain mechanisms are misfiring when people with memory loss wander away and cannot find their way back. This is a common problem among Alzheimer's patients, Redish notes ("one of the main brain structures affected by Alzheimer's is the hippocampus").

Humane science

As he tests his complex theories on maze-navigating rats, Redish emphasizes that he takes the issue of animal welfare very seriously. "It's essential that we do everything we can to ensure animals are well-treated," he says.

For one thing, "stress changes an animal's behavior, just as it does human behavior. We do everything possible to alleviate stress."

But his concerns aren't just pragmatic. "I think communication between scientists and animal rights groups is essential," he says. "On the one hand, many animal rights activists are more knowledgeable about animal care than scientists realize, and on the other hand, scientists are more concerned about animal welfare than many activists realize."

Scientific research with animals "clearly has led to huge advances in medicine," Redish underscores. "But still, there are tough questions involved, and I believe that we need to weigh the issues carefully every time we use an animal in research. I think people would be reassured to know just how thoughtfully neuroscientists are asking themselves these questions."

From basic to translational research

The world is watching closely the work of neuroscientists such as Redish, hoping that their work will yield long-awaited clinical applications and translate into cures for such diseases as Parkinson's and Alzheimer's. Indeed, Redish's work might very well lead to such life-changing medical breakthroughs.

But Redish is quick to point out that basic science is painstaking work, and the knowledge breakthroughs are incremental. More important, he stresses, the goal of basic science has always been knowledge, not solutions or products.

"The purpose of basic research, of neuroscience, is not to cure disease or make human lives better any more than the purpose of physics is to build a computer," says Redish.

"Using physics knowledge of the past 400 years, we've been able to do incredible things. But Newton didn't discover the laws of motion so that we could build a rocket. In 1924, when Wolfgang Pauli came up with idea of quantum spin—who would have imagined functional MRI?"

Stresses Redish: "Most great discoveries are related not to solving special problems, but to understanding overall what's the reality out there."

The neuroscience revolution

Neuroscience is to the 21st century what physics was at the dawn of the 20th, says Redish. "If you were starting out in science in 1900, you'd be in physics. That's where the action was. Physics had a confluence of new technology, new mathematics, new ideas. That's how it is for neuroscience today. We have the technical skills, the math, the experimental paradigms. The changes occurring now are, scientifically speaking, phenomenal."

Redish, to page 14

Redish, from page 13

But Redish cautions that the revolution is young. "Theoretical neuroscience is still learning its language. We don't yet know what a good theory is. Before Galileo, it was hard for physics to know what measurements to take. We're where Galileo was. After Galileo, Newton could say, 'Given these measurements, we can build a theory.' Neuroscience is still determining what the right measurements are."

Most exciting to Redish is simply that we're figuring out how the brain works: "We see all over in the field of neuroscience, 'Aha, we can use that … .' But the underlying knowledge of the brain is interesting and important for its own sake," he says.

Besides his recent McKnight Land-Grant Professorship from the University's Graduate School, Redish (who joined the U's faculty in 2000) has received a Sloan Fellowship from the Alfred P. Sloan Foundation, a National Research Service Award from the National Institutes of Health, and a National Science Foundation Fellowship. Redish says he is flattered and heartened by the votes of confidence in his work.

Such awards are "a statement by the world outside your lab that you're doing well," he says modestly. That helps in a field where progress is measured not in overnight miracles but in incremental progress over a long haul.

"It's hard to do this work," he grants. "The process from start to finish, to do the experiments and mine the data, takes two years or more, just to know if you have anything or just the same old thing everyone else is seeing."

"Even if you seem to have something, and you eventually publish your results (which takes more time), you're still not sure what it means. In science, it's often hard to get a sense of where you are."

"Most people wouldn't notice if there were no basic scientists—for about 30 years. But then they'd be screwed."

Long-term view

The world is impatient for solutions, but few people understand how those solutions evolve, muses Redish.

"Most people would never notice if there were no basic scientists—for about 30 years. But then they'd be screwed. Today's medical breakthroughs, advances in technology, portable computers—all are based on discoveries of 30 to 40 years ago. Fifty years from now, who knows what we'll do? We'll build on today's breakthroughs in basic knowledge in ways we can't foresee.

"I'm not a doctor. But I have faith that basic knowledge will have an impact. You never know what you're going to find or where it might lead."

Teaching, mentoring, and sharing

Of course one place where the basic knowledge will lead is into the active neural pathways of his students' brains—one of the reasons Redish says, "This is my dream job."

The quality of his students (both undergraduate and graduate students are "phenomenal," Redish emphasizes) is one of many reasons he's happy to be at Minnesota. "This is a great University—I didn't know just how great when I first went looking for jobs. Minnesota doesn't know how to brag. My jaw dropped when I saw who was on the faculty here."

His computer science background helps Redish be not only a good scientist but also a good colleague. One of the software programs he has developed is MClust (Matlab Clustering Program) for spike sorting.

"Spike sorting is the first step in the work we do," Redish says, "so I made it freeware; everyone uses it now. Giving it away was the smartest thing I ever did. At conferences, people come up to me and say, 'I love that program.'"

Sure, there's competition for grants and laurels, but Redish says the name of his game is teamwork. "Be generous with your time and effort—and expect other people will be generous with theirs," he says.

"That's what makes science fun—not going off in a corner and doing your thing, but being part of a larger community of scientists who are expanding knowledge. All the breakthroughs—when they come—rest on that." ■

MCKNIGHT LAND-GRANT PROFS, continued from page 12

Ezra Miller (Ph.D., University of California, Berkeley). **Mathematics.**
Research at the interface of combinatorics, geometry, and computation.

Joachim Mueller (Ph.D., Technische Universität München). **Physics & Astronomy.**
Fundamental principles that govern the world of proteins.

Aaron David Redish (Ph.D., Carnegie Mellon University). **Neuroscience.**
The dynamics of information processing (see profile on page 11).

J.B. Shank (Ph.D., Stanford University). **History.**
An historical inquiry into the unfamiliar disciplinary culture of Early Modern European learning.

Randall S. Singer (D.V.M., Ph.D., University of California Davis). **Veterinary & Biomedical Sciences.**
Infectious disease impact on human and animal health.

N. Shuman (Ph.D., Brown University). **Geography.**
Patterns and consequences of past climatic change: Tracking the availability of water.

T. Andrew Taton (Ph.D., Harvard University). **Chemistry.**
Integrating nanoparticles with molecules and materials.

Kathleen M. Thomas (Ph.D., University of Minnesota). **Child Development.**
How brain development and function is related to children's thinking and learning.

Eric Van Wyk (Ph.D., University of Iowa). **Computer Science & Engineering.**
Extensible programming languages for cost-effective development of software systems.

George D. Weiblen (Ph.D., Harvard University). **Plant Biology.**
Biodiversity in tropical rainforests, the evolution of plant/insect interactions. ■

Notable Ph.D. PATHBREAKERS

Each year, the Graduate School recognizes the U's top Ph.D. graduates by presenting BEST DISSERTATION AWARDS in each of four areas: arts and humanities (including history and philosophy), biological and medical sciences, physical sciences and engineering, and social and behavioral sciences and education. Nominated by grad programs and judged by faculty, the awards (which carry $1,000 honoraria) go to students whose research shows striking originality and importance and who seem likely to make significant contributions to their discipline. Two recent winners are featured here.

Michèle Tertilt

Polygyny and the global economy

MICHÈLE TERTILT LIKED MATH. She also aspired to improve the world. And so it was only natural, she says, that she became a macroeconomist keen to understand how aggregate economic outcomes break down into family-level realities across the globe. To complete her Ph.D. at the University of Minnesota, she thought nothing of scouring through anthropological journals for a meaningful dissertation topic. The result, "Essays on Social Institutions," was a pathbreaking analysis of the economic impact of polygynous marriage in developing countries.

Photo by Dong Oh

By all accounts, Tertilt's project seemed more like the canny analysis of a World Bank economist than the debut disquisition of a 20-something graduate student. Named one of the best four dissertations at the University of Minnesota in 2004, Tertilt's written Ph.D. work helped her cinch a coveted faculty position at Stanford University. Yet her core thesis—that in polygyny-based countries, capital goes into buying wives and selling daughters at the expense of overall economic growth—began as little more than a hunch, as Tertilt noodled over an intriguing empirical puzzle.

"I started thinking about the extreme poverty of sub-Saharan Africa," recalls Tertilt. "It's a region of subsistence farming that has not grown at all in the last 40 years—even other undeveloped areas are catching up. The question was, 'Why?'" The extremities of the desert climate did not alone seem sufficient to explain the disparity, Tertilt says. Turning to anthropology for insights, "I got to thinking about the fact that some of the poorest countries have a marriage system where men marry multiple wives. I wondered what that might have to do with economics."

Quite a lot, as it turns out. Although initially worried that "experts would dismiss this as a totally crazy notion," Tertilt went on to make a compelling case that countries with polygynous marriage systems can't help but be poorer than those with monogamy-based systems. That's because of the divergent economic impacts of the brideprice (the payment that men in polygynous countries make to brides' fathers) and the dowry (the payment that parents in monogamous countries bestow on daughters at marriage).

The economics of polygyny

Tertilt's work rests on sophisticated "theoretical modeling," in the vernacular of her field. But she translates it so deftly into everyday language that it's easy to see why she's won praise for her teaching as well as for her research. In polygynous countries, she explains, men buy wives as an investment, expecting that each purchase will reap a major return—multiple daughters to be sold in 20 years or so. By the time their daughters hit the market, the male heads of household are getting older, not working much. The money—or more typically, animals—they get as a brideprice are a form of old-age support. Whether cash, cattle to sell, or camels to milk, the proceeds are used to meet current consumption needs, Tertilt emphasizes—not used to improve farms or otherwise invest in physical capital.

"In polygynous marriage systems, competition for women drives up the price—and investment in women-as-assets crowds out investment in physical capital," Tertilt says. That's a problem because from an aggregate perspective, investment in physical capital is important for a country's overall economic growth. "Investment in women does not add anything to the productive capacity of the country."

Countries without good tractors, Tertilt observes, "can't produce much or support good wages. They'll stay mired in poverty

Tertilt, to page 16

Tertilt, from page 15

while other countries not dependent on the brideprice system pass them by economically—which is what's occurring."

Now firmly on the tenure track in Palo Alto, Tertilt is pursuing several projects to expand understanding of the family-level decisions and practices that shape big-picture economics.

One of her studies aims to isolate the variables involved in the rising number of consumer bankruptcies in Canada and the United States. Another, with U of M economics professor Larry Jones (Tertilt's Ph.D. adviser), looks at fluctuations in U.S. fertility rates since the Civil War, documenting how income and occupation have affected family decision-making about childbearing and family size.

"Theoretical economists are similar to laboratory physicists," says Tertilt. "The idea is to come up with a theoretical or mathematical model that works fairly well to describe the state of the world—and which then can be used as a tool by policymakers, planners, and researchers."

Tertilt allows that her Ph.D. work "earned me a few brownie points for novelty," but she's as eager to talk about "the wonderful mentoring I had at Minnesota" as any triumphs of her own. The cooperative ethos of Minnesota's econ program, Tertilt emphasizes, is exceptional in the cutthroat (and male-dominated) field of economics. "Faculty at Minnesota really believe in students and say so," she says.

"That kind of positive feedback can make a huge difference," Tertilt adds. Research suggests that's especially true for women in the sciences and economics, she notes. (At Stanford, where she is one of 3 women on a faculty of 40, Tertilt is often told by students that she is their first woman economics professor. Women make up little better than a fourth of all newly minted Ph.D.'s and just 10 percent of all tenured econ faculty nationally.)

The Minnesota difference

Tertilt came to Minnesota knowing only that its economics program was top-rated. Germany's famously threadbare universities had not prepared her for the "extraordinarily supportive environment" she found on the Twin Cities campus. "The encouraging faculty, the outstanding libraries and computer resources, the interdisciplinary programs, the financial support—there's just this amazing abundance of resources here," she says.

Tertilt notes that at strategic junctures, her maturation as a scholar was nudged along in important ways by the U's Graduate School. Even before the "Best Dissertation" award, the school gave Tertilt a doctoral fellowship in support of her research. It came with a bonus: the chance to participate in an interdisciplinary exchange program in which students from different disciplines presented their work at research seminars—an experience Tertilt found "interesting and inspiring."

Perhaps the most important benefit of that program, Tertilt says, "is that I had to think about my work from different angles and figure out new ways of explaining why what I do matters."

Adds Tertilt: "I've become more pragmatic than when I started out. I do still think I can make useful contributions to the world as a scholar. But I've also come to see that I can have a big impact as a teacher. I hope to mentor students as well as I was mentored at Minnesota." ■

Sherri Weers Hunt

Molecular bonds and the environment

WRITING HER UNIVERSITY OF MINNESOTA PH.D. DISSERTATION on the structure and interactions of molecules, Sherri Weers Hunt couldn't stop thinking about how her micro-level work might figure into larger environmental puzzles such as global warming.

Once a music major who spent hours each day practicing the cello, Hunt knew the importance of "focusing on the fundamentals," whether painstakingly eking out the right intonation or meticulously charting minute changes in molecular structure and dynamics. But the same itch for "practical problem-solving" that had nudged her from music to science also made her a restless practitioner of basic research.

"Fundamental science is interesting and critically important," says Hunt, who cut her teeth as a standout graduate student researcher in Professor Ken Leopold's physical and environmental chemistry lab. "But as I developed a solid base in understanding physical chemistry, I found myself thinking all the time about how chemical interactions would work outside the controlled lab—how they related to complex problems in the atmosphere. That was the direction of my particular temperament—I wanted to do scientific problem-solving more directly related to the real world."

During a speakers' series Hunt helped to coordinate in the chemistry department, she found herself riveted by a talk given by Barbara Finlayson-Pitts, whose California lab focused on how certain chemical processes affect air quality. "When I was almost done with my graduate work, I called Barbara on the phone," Hunt recalls. "Essentially, I said, 'Can I come work in your lab?'"

That's how Hunt, a native of Georgia, began her career journey from laboratory-based physical chemistry researcher at the U to oceanside environmental scientist in Southern California to Washington-based government policy wonk. She spent two years as a postdoctoral fellow at the University of California, Irvine, where she worked with Finlayson-Pitts and other experts to investigate how components of sea salt ultimately affect ozone levels. Last fall, she moved into the realm of scientific policy-making at the U.S. Environmental Protection Agency (EPA).

"There's a clear continuum from my Ph.D. work to what I'm doing now," Hunt says. "You could say that the picture's gotten bigger, but all the molecules are still there. I've moved from fundamental chemistry problems to broader, more applied work that is built on a thorough understanding of fundamental problems."

Best Dissertation Award Recipients, 2004 & 2005

Arts & Humanities

Margot Canaday, History (Barbara Welke and Sara Evans, advisers). **"The Straight State: Sexuality and American Citizenship, 1900–1969."** Now: Cotsen-Perkins Fellow, Princeton University.

Jennifer Mary Guglielmo, History (David Roediger, adviser). **"Negotiating Gender, Race, and Coalition: Italian Women and Working Class Politics in New York City, 1880–1945."** Now: Assistant professor, Smith College.

Biological & Medical Sciences

Jason Paul Harmon, Entomology (David Andow, adviser). **"Indirect Interactions among a Generalist Predator and its Multiple Foods."** Now: Postdoctoral fellow, University of California, Irvine.

James Michael Russell, Ecology, Evolution, & Behavior (Thomas Johnson, adviser). **"The Holocene Paleolimnology and Paleoclimatology of Lake Edward, Uganda-Congo."** Now: Assistant professor, Brown University.

Physical Sciences and Engineering

Sherri Weers Hunt, Chemistry (Kenneth Leopold, adviser). **"Structural Studies of Partially Bonded and Hydrogen Bonded Molecules."** Now: Environmental science and technology policy fellow, U.S. Environmental Protection Agency.

Liuqing Yang, Electrical Engineering (Georgios B. Giannakis, adviser). **"Ultra-Wideband Communications: From Concept to Reality."** Now: Assistant professor, University of Florida.

Social & Behavioral Sciences & Education

Michele E. Tertilt, Economics (Larry E. Jones, adviser). **"Essays on Social Institutions."** Now: Assistant Professor, Stanford University.

Joel D. Wainwright, Geography (Bruce Braun and Abdi Samatar, advisers). **"Decolonizing Development: Colonialism, Mayanism and Agriculture in Belize."** Now: Assistant professor, Ohio State University (1/06).

Breakthrough research

Hunt's Ph.D. work was based on breakthrough research she did with Leopold, her adviser. This work illuminated the interactions of molecular complexes that behave differently from others—a novel class of molecules the researchers called "partially bonded."

Hunt explains: "Most atoms—the building blocks of everything in the universe—are either just hanging out next to each other or interacting in such a way that they create a bona fide chemical bond—they share or transfer electrons. But we observed molecules with interactions in the middle of these extremes."

Such molecules seem to have a particularly high sensitivity to the presence of other surrounding molecules, says Hunt, whose dissertation probed "the structure of the molecules that formed these partial bonds and when and why these unusual changes took place."

Specialized though this work is—Hunt's experiments involved using a microwave spectrometer and high-level quantum chemical calculations—it has far-reaching implications.

"I'm a scientist who wants people to be able to breathe clean air."

"Knowledge of molecular structure and how molecules interact is essential for understanding the dynamics of just about everything, whether you're designing effective drugs or improving air quality," notes Hunt. Beyond that, elucidating the impact of 'near-neighbor' molecules "underscores the importance of the local environment on chemical reactions"—which may be of particular interest to environmental scientists.

To study atmospheric chemistry and air quality, Hunt says, "Scientists have to figure out how a wide range of gases and particles interact—whether naturally occurring emissions or particles from smokestacks, diesel truck fumes, or many other sources. There are all these chemical and physical processes going on at the same time. It could be that observing partially bound molecules could help us better understand the fundamental processes."

Hunt carried insights from her dissertation work to her postdoctoral research on the West Coast, where she and her colleagues studied how airborne droplets of sea salt affect air pollution. Her team focused on understanding the complex set of chemical reactions that occur when sea salt is sprayed into the air—with an emphasis on reactions that occur right at the surface of these atmospheric droplets.

The goal: To discover how these reactions might affect ground-level concentrations of levels of ozone, which is harmful to breathe and one of the main components of air pollution.

Real-world impact

"I wanted real-world complexity, and I got it," Hunt observes cheerfully, describing both the ambitious scope of the project and its intricacies. (Her experiments involved such work as "examining the chemistry at the surface of the droplet and how it might affect the way sodium bromide [in sea spray] interacts with ozone to produce molecular bromine.")

Hunt originally had expected to pursue an academic career. But especially since last fall, when she began "an excursion in the policy world," she's thinking her calling may lie "where I can bridge the gap between science and policy."

Thanks to a prestigious fellowship from the American Association for the Advancement of Science ("the 'Best Dissertation Award' from the Grad School definitely helped my application stand out"), Hunt now anticipates spending the next two years as an environmental science and technology policy fellow at the EPA's National Center for Environmental Research. The post gives her the autonomy to shape her own projects, most of which involve analysis and synthesis of scientific findings.

EPA officials devising air quality regulations for states and cities, for example, might rely on Hunt's explanation of new research to help them analyze the ramifi-

Hunt, to page 22

Two U of M graduate programs have been tapped for the CARNEGIE INITIATIVE ON THE DOCTORATE, a multiyear project to strengthen doctoral education at American universities.

ALL THE

IT'S NOT AS IF BILL ENGELAND DIDN'T HAVE ENOUGH TO DO. As director of the graduate program in neuroscience—one of the U of M's largest and most complex academic programs—Engeland already was overbooked. But when he learned in 2003 that the Carnegie Foundation for the Advancement of Teaching was seeking select neuroscience programs to create new models of excellence for graduate education, he jumped at the chance to get the U's multidisciplinary program involved.

"It was too good an opportunity to pass up," says Engeland, whose program was among just nine such programs nationwide selected to participate in the Carnegie Initiative on the Doctorate (CID). "It offered us a way to take a good look at everything we were doing and to energize our program—and to be part of a nationwide conversation about graduate education."

An ambitious, ground-up reexamination of the mission and structure of doctoral education at American universities, the CID grew out of several years of discussions and study spearheaded by the Carnegie Foundation. Some 84 departments and disciplinary communities in six fields of study—chemistry, education, English, history, mathematics, and neuroscience—are participating, including the U's programs in both neuroscience and history.

"THE CID IS A VERY HIGH-MINDED and forward-looking project," says Chris Golde, the CID's research director. "It's a way of getting back to first principles, of seeing how our country's most advanced teaching and training programs are fulfilling their central purpose."

That purpose, as the foundation has defined it, is to produce the first-rate scholars and expert practitioners who will be, Golde explains, "the stewards of disciplines—those we entrust with the vigor, quality, and integrity of various fields, both inside and outside of the academy."

The CID will help ensure that Ph.D. programs produce the first-rate scholars and expert practitioners needed to ensure the vigor, quality, and integrity of various fields.

The Carnegie Foundation provides what Golde calls "scaffolding" for the institutional self-assessment, inter-university dialogue, and research and program innovation that will occur over several years. The initiative's mandate is deliberately open-ended, eschewing prescriptives in favor of "helping the conversation unfold in a considered and thoughtful way," Golde says. Participating departments themselves frame issues and strategies at annual "convenings" hosted by the foundation.

Participants are taking on considerable work, from task force meetings to surveys to ongoing Web-based exchanges. Indeed, foundation officials feared the initiative might be a tough sell to already overburdened faculty and students. Golde jokes that rolling it out at national disciplinary gatherings "felt like announcing that we were throwing a party but there would be no drinks, and guests would have to bring the food and do the cooking. We really wondered if anyone would show up."

Fortunately, says George Walker, director of the CID, "We found that departments were highly motivated to improve what they do and eager to share knowledge and ideas. Departments tend to feel isolated and competitive with each other, yet there's this awareness that we're all basically in this together—'your students will be my faculty later.'"

MINNESOTA'S NEUROSCIENCE PROGRAM, for one, was "very much on the CID wavelength, interested in making our program and the discipline as strong as possible," recalls Engeland. Discussions of key issues, such as the design of exams, were already under way.

"We were interested in getting beyond the tunnel vision of our own thinking," says Engeland. "The CID created a dynamic discussion framework that simply didn't exist before. We could take stock of how we're doing in interaction with other programs and with expert guidance from the Carnegie Foundation."

Says Walker, "What the CID asks a department like Engeland's to do is to assess thoughtfully how everything that goes on fits with department and disciplinary goals. For neuroscience Ph.D.'s, what do we expect in terms of experiences students are exposed to, habits of mind they develop, the content knowledge they acquire?"

"NEUROSCIENCE IS A STERLING example in terms of what

From left, Ph.D. student Katherine Himes, professor Ginger Seybold, and graduate studies director Bill Engeland are among those in the U's neuroscience department who are working to advance the important goals of the Carnegie Initiative on the Doctorate.

Besides neuroscience—a multidisciplinary program that includes faculty across many departments and colleges—the U's graduate program in history also is taking part in the national initiative.

BOATS RISING

we're after with the CID," says Golde. "We wanted to focus on disciplines across the sciences and humanities that were broadest in scope and most central to both graduate and undergraduate education. Neuroscience teaching and research are integral to biology, to psychology, and to breakthrough fields such as genomics—and also to clinical practice in areas such as neurology and psychiatry. It's a high-impact field that will allow the CID to influence many other fields of study."

"THE BOUNDARIES OF OUR FIELD are almost limitless," confirms Engeland, noting that the program's 105-member faculty comes from 28 departments in 8 colleges. "That's one of our challenges—how to pull together and harness the strengths and energies of our multidisciplinary faculty."

"We know we're asking a lot of departments," underscores Walker. "There's push and pull in many directions, and the 'tyranny of the immediate'—the everyday stuff that fills up all your time and effort."

That busy programs like Engeland's have made room for CID work vindicates the Carnegie Foundation's view that "a project like this really couldn't be more timely," Walker says. U.S. graduate programs "have, on the one hand, been fairly successful historically," he observes. "On the other hand, there are a number of 'stressed canaries in the mine'—high attrition rates in Ph.D. programs, and funding crunches, for example—and public universities like Minnesota know that as well as anyone."

Walker, himself a former graduate dean at a Big Ten university (Indiana U), emphasizes that "excellent public institutions like Minnesota are the very backbone of this project. They take very seriously their responsibilities to their disciplines and to society at large."

These institutions educate most of this country's undergraduates, he notes—"and also produce a large number of the Ph.D.'s, who think about things on the frontiers of knowledge and who go on to become leaders in the academy, in government, and in industries across all sectors of society."

Student involvement has been pivotal—just as CID staff had hoped. "We pushed to include students as equal partners in the conversation to provide a more nuanced view of program realities," Golde says.

The resulting discussions, she says, are "often eye-opening to faculty—they realize how un-transparent their programs are. Students assume a grand design has shaped their programs. Faculty have to say, 'Well, no, it's just the way we've always done it.' That's a productive conversation on both sides."

The CID's "exceptionally dynamic framework" makes those conversations possible, stresses Engeland. "The input from students and the dialogue with other universities set this project apart. When we think about our written and oral prelims, for example, we have fresh perspectives, new questions to ask."

It's exciting, says Engeland. "Essentially, everything is on the table. We're taking things apart at the roots: What's the purpose? What are the goals? With our exams, are they just a hurdle to get over, or do they really help students integrate their knowledge? How does everything we do fit with the highest goals of our discipline?"

THEMES THAT EMERGE from the CID's many overlapping conversations will be harvested over the long term by Carnegie Foundation researchers for further study and dissemination. And with the groundwork laid, departments and CID staff will experiment with new strategies intended "to more purposefully structure aspects of doctoral programs," says Golde, adding, "This project is part of a long process."

"We're not knocking on doors to say, 'We have a better Ph.D. for you.' We've created a framework to engage disciplines in figuring out what doctoral education should be at its best, and what works to achieve those ideals."

Adds Golde: "We hope this will start to change the tides of doctoral education nationwide. There's a lot at stake, and we need 'all the boats rising.'" ■

About Guy Stanton Ford

Guy Stanton Ford (1873–1962) was a pivotal figure in the U's history. He was president from 1938 to 1941 but may be remembered best for his long tenure (1913–1938) as dean of the Grad School.

Ford (for whom the U's Ford Hall is named) transformed the Graduate School into one of the nation's most respected centers of research and learning. He reorganized it as a unified entity, developed standards for graduate faculty, and acquired funds for students. His leadership inspired many great scholars to make Minnesota their academic home. He was also a much-honored professor whose knowledge of modern European history made him a valued adviser to the U.S. government during World War I.

Endowed by Ford's family, friends, and colleagues and coordinated by the Grad School, the Guy Stanton Ford Memorial Lecture each year brings to campus distinguished scholars and artists. Among recent lecturers have been historians David McCullough and Stephen Ambrose, novelist Margaret Atwood, paleoanthropologist Richard Leakey, jazz pianist Billy Taylor, and historian and biologist Richard Dawkins.

FORD LECTURE TO FEATURE NOTED JEFFERSON SCHOLAR

IN CONNECTION WITH THE GRADUATE SCHOOL'S CENTENNIAL CELEBRATION IN 2005, the school is presenting a special Guy Stanton Ford Lecture combining solid historical research with dramatic performance. Clay Jenkinson, a scholar (and University of Minnesota alumnus) noted for his historical interpretation of Thomas Jefferson, will portray Jefferson discussing his views on education.

A humanities scholar and author—as well as a cultural commentator, public radio personality, and humorist—Jenkinson is the recipient of the highest award given by the National Endowment for the Humanities for his humanities-based first person interpretation methodology.

In 1996, Jenkinson was the chief adviser on Ken Burns's critically acclaimed PBS documentary "Thomas Jefferson," and he hosts a nationally syndicated radio show called "The Thomas Jefferson Hour. A former Rhodes and Danforth scholar, Jenkinson is the author of the book *The Character of Meriwether Lewis* and has additional books in the works on several topics.

Jenkinson's lecture will take place in fall 2005. For details, check the school's Web site (www.grad.umn.edu) or call 612-625-2809.

Humanities scholar Clay Jenkinson has drawn acclaim for his historical interpretation of Thomas Jefferson.

GRADUATE SCHOOL NEWS

BEST DIRECTORS OF GRAD STUDY

With Ph.D. and master's programs in some 150 disciplines, the Graduate School relies on directors of graduate studies and their assistants in each department. They keep programs humming along and play a key role in attracting and mentoring top students. In 2003, the Grad School implemented the Best Director of Graduate Study (DGS) and best DGS Assistant awards, each of which carry a $1,000 honorarium.

The 2005 Best DGS awards were given to: **Steven Girshick,** mechanical engineering; **Claudia Neuhauser,** ecology, evolution, and behavior; **Edward Schiappa,** communication studies (pictured at left); and **Evan Skillman,** astrophysics.

The 2005 Best DGS Assistant awards went to: **Jessica Eastman,** curriculum and instruction; **Sharon Kressler,** geology; **Julie Prince,** chemical engineering and materials science; and **Terence Rafferty,** architecture.

NEW GRADUATE SCHOOL DEAN TO START IN LATE SUMMER '05

Gail Dubrow will take the reins in late summer 2005 as the newly appointed dean of the University of Minnesota Graduate School and vice provost. Dubrow most recently has been graduate associate dean for academic programs at the University of Washington, where she also is a professor of architecture, landscape architecture, urban design, and planning (with adjunct appointments in history and women's studies).

At Minnesota, Dubrow will have responsibility for administrative and policy issues affecting graduate education, faculty research support programs, and interdisciplinary initiatives. As vice provost, she also will take the lead in advancing interdisciplinary teaching and research across the U's campuses. She will build on the work of past leaders including Victor Bloomfield, who will return to the faculty as a professor of biochemistry, molecular biology, and biophysics after serving as interim dean for the past three years.

GRAD SCHOOL A NATIONAL LEADER IN POSTDOCTORAL TRAINING

Just two years after it was started, the Graduate School's Office of Postdoctoral Affairs has been recognized as one of the top operations of its kind in the country.

The school established the office in 2003 to enhance the quality of postdoctoral training for the approximately 1,000 postdoc trainees at the U. It is directed by Esam El-Fakahany (professor of psychiatry and former Graduate School associate dean) and affiliated with the National Postdoctoral Association, whose aim is improving the postdoc experience at U.S. universities.

Activities at the U include monthly "survival skills" workshops for postdoctoral trainees, many of whom are poised to make the transition from advanced training in their fields to career paths. Topics include grant writing, interviewing in academia and industry, and evaluating job offers.

A recent study by *The Scientist* confirms the success of these efforts. Among 929 institutions nationwide, the U of M was ranked 11th in satisfaction among postdoctoral trainees.

CREATING A VIBRANT COMMUNITY AMONG SCHOLARS OF COLOR

TWO NEW INITIATIVES WERE LAUNCHED LAST FALL by the Graduate School's Community of Scholars Program (COSP), a six-year-old program that builds community among the University's 450 graduate students of color.

The COSP provides academic and professional support for students of color across disciplinary boundaries. Activities include forums and seminars, professional development workshops, travel grants, research symposia, and close interaction with faculty and staff.

One new initiative is a collaboration with the Office of Multicultural and Academic Affairs to involve COSP students in the educational and cultural lives of undergraduate students of color. A primary goal is to encourage undergraduates to go on for advanced degrees.

Also new is a mentoring program that connects COSP students with community youth. Through partnerships with the St. Paul Public Schools and a nonprofit organization in North Minneapolis, the COSP students will share their knowledge and experiences with 5th–10th-grade students of color and will serve as role models, encouraging the young people to complete school and to attend college.

The program reflects the U's strong commitment to civic engagement and urban outreach. For more about the COSP, visit www.grad.umn.edu/outreach/cosp.

The Graduate School's longstanding commitment to diversity is evidenced not only by the Community of Scholars Program (highlighted at left), but by the Summer Research Opportunities Program (SROP), which helps talented undergraduates in varied fields to develop research and inquiry skills.

SUMMER RESEARCH OPPORTUNITIES PROGRAM

Established in 1986, the mentoring and community-building program is for academically promising first-generation college students and members of groups historically underrepresented in disciplines. Each student works with a faculty mentor one-to-one or as part of a research team. Participants are eligible for up to $6,000 of support.

In summer 2003, the U of M hosted a SROP conference for all CIC institutions (Big Ten universities and the U of Chicago). The event, which rotates among CIC schools, drew to campus 500 undergraduate students and 100 faculty and staff. It featured research presentations by SROP alumni, who also offered insights into the realities of graduate school. Speakers included Orlando Taylor, dean of the Graduate School at Howard University.

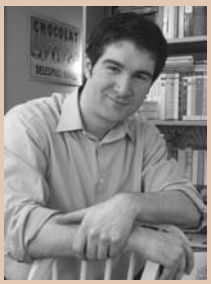
GRADUATE SCHOOL PEOPLE TO WATCH

EMERGING LEADERS

Each year up to 25 talented University of Minnesota staff members are selected for the President's Emerging Leaders Program. This year the Graduate School is represented by two individuals: **Vicki Field,** associate to the dean, and **Etty DeVeaux Westergaard,** assistant to the dean. The 12-month program includes educational seminars, an experiential component, and coaching. Participants also work on University improvement projects. Field, whose coach is Professor Katherine Fennelly of the Humphrey Institute, is helping to redefine the University Archives for a digital age. Westergaard, whose coach is Kathy O'Brien, vice president for University services, is working to define a strategic vision for implementing management development projects.

NOBEL PARTICIPANT

Aaron McGowan, a Ph.D. student in physics, is one of 50 grad students nationwide chosen to attend the 55th Meeting of Nobel Laureates in 2005. After an orientation in Washington, D.C., he will travel to Lindau, Germany, for lectures by the Nobel Laureates and meetings with Nobel winners. McGowan was nominated for the honor by the Graduate School. His adviser is physics professor Marvin Marshak.



LUCE RECIPIENT

Richard Hermes, a recent M.F.A. (creative writing) graduate, was one of 15 scholars nationwide to receive a Luce Scholarship for a professional internship in Asia. After an intensive Thai language course and an orientation program, Hermes headed to Thailand for an assignment with the Bangkok Press.

ACADEMIC LEADERSHIP PARTICIPANT

Patricia Jones-Whyte, director of the Grad School's Diversity Office, participated this past year in the Academic Leadership Program (ALP) of the Committee on Institutional Cooperation (a consortium of the Big Ten universities plus the University of Chicago). The invitation-only program develops the leadership skills of faculty and staff who have demonstrated exceptional ability and administrative promise. Jones-Whyte's ALP seminars have focused on human resources (hosted by the University of Iowa), strategic planning and budgeting (hosted by the University of Illinois-Chicago), and "The Future University: Motivating and Sustaining Change" (hosted by our very own University of Minnesota).

FULBRIGHT WINNERS

Jennifer M. Illuzzi, a Ph.D. student in history, is among the U of M graduate students awarded prestigious Fulbright Scholarships for 2005–06. Illuzzi will travel to Italy to advance her research into the history of Gypsies and their interactions with national and local authorities and communities in Italy during the late 19th and early 20th centuries. Illuzzi also was awarded the Myrna G. Smith International Research Grant.

Other recent U Fulbright recipients (with majors, destinations, and subjects of study) include:

- **Barbara T. Martinez** (conservation biology, Madagascar, endangered primates and forest fragmentation).
- **Lynne S. Newton** (anthropology, Oman, religious pilgrimage and trade in southern Arabia).
- **Jeanine Refsnider** (conservation biology, New Zealand, how a rare reptile has survived large-scale climate changes).
- **Robert G. Strand** (business administration, Norway, socially responsible businesses).
- **Michelle L. Wieland** (conservation biology, Democratic Republic of Congo, biodiversity in and around Conkouati-Douli National Park).
- **Jane A. DeRonne** (communication studies, Germany) and **Jason Schaller** (sociology, Korea)—both will teach abroad under Fulbright teaching assistantships).

OFFLOADING THE HEADACHES:
New Graduate School Admissions System

WITH 12,000 STUDENTS A YEAR applying to study in master's and Ph.D. programs, the towering piles of paperwork finally got to Andrea Scott.

The traditional paper-based application system had become onerously time-intensive, costly, and frustrating, says Scott, the Graduate School's director of admissions and recruiting. The need to simplify the process was clear—but how?

Scott found the solution in ApplyYourself i-Class, an innovative Web-based system from a Virginia firm. Its implementation by the Graduate School last year replaced the paperwork piles with a state-of-the-art admissions operation that has, Scott says, ended staff headaches, pleased applicants, improved efficiency, and cut costs.

In addition to processing applications more effectively, the system offers benefits such as secure online decision notification and detailed reports. Scott notes that the up-front investment in the system paid off quickly in reduced staffing costs and drops in postage, printing, and supply expenses.

Scott happily ticks off the new system's many benefits. Applications get to departments for review in under an hour. Applicants have direct access to their application status (40 percent fewer applicants come into the office to check their status and 14 percent fewer call for updates). And international students can get a decision online within 24 hours—compared with up to two weeks by mail.

Scott considered other vendors, but went with ApplyYourself in part because the Grad School's information technology experts "have great confidence in this firm's ability to maintain the security of the U's data."

The system includes a password-based feature that ensures the confidentiality of admissions decisions and provides the U with confirmation that applicants have opened online "decision letters."

"THE SUCCESS OF THIS INITIATIVE can't be measured just in terms of time and money," emphasizes Scott. "There's also the change in the admissions office from a hectic environment to far less stressful one.

"And most important, we've really made our prospective students happy." ■

Hunt, from page 17

cations of the proposed policy and "what possible things might affect the regulations 5 or 10 or 50 years down the road," Hunt says. "For example, what if the population grows, or auto emissions rise or fall, or if the weather changes?"

When deciding which issues to address, how best to allocate funds, or how to devise smart policies, policymakers by necessity turn to scientists with a firm grasp of the details, an eye for the big picture, and a gift for translating specialized information into lay terms—a description that seems to fit Hunt well.

"I do have this sense that I'm pretty good at this—pulling together vast quantities of scientific information in a way that's helpful to nonscientists making policy decisions," says Hunt. "It uses my scientific training, my problem-solving skills—and also my teaching skills."

Hunt isn't sure if she's in the policy arena to stay, but she knows that her bent for solving problems of atmospheric chemistry has bloomed into a deep concern about environmental issues. "I'm a scientist who wants people to be able to breathe clean air," she says. "I've realized I'm happiest in a context where there's a commitment to 'good science for a public good.'" ■

Among the students benefiting from the 21st-Century Graduate Fellowship Endowment are Melanie Bowman, left, and Muisi Krosi, right. Both received fellowships through the Daniel E. Peterson Fellowship in French. At center is Daniel Brewer, chair of the Department of French and Italian.

Bowman is a second-year Ph.D. student who came to the University after earning her B.A. at Miami University of Ohio. She is focusing on discourses on the body and the ordering of knowledge in 16th- and 17th-century French literature.

Krosi came to the University after completing an M.A. in French at Columbia. He is completing his Ph.D. dissertation on the intersection of literature, the construction of gender, and medical theory.

FIRST Rewarding

IT ALL STARTED, SAYS ROBERT VINCE, with an attempt to "make a molecule that would fool an enzyme." With that, the U of M pharmacy professor started down the research road that ultimately would lead to a breakthrough AIDS drug—and a boon for graduate research and education at the U.

Vince, a medicinal chemist, still vividly recalls the phone call he received one morning in 1981 from an excited official at the National Institutes of Health. "He had tested a bunch of compounds we sent him, and he said that they were the most active he'd seen against the HIV virus [which causes AIDS] since AZT," Vince says. (AZT, a 1960s-era anticancer compound, was for years the only drug available for AIDS).

What Vince and colleague Mei Hua had developed was a family of antiviral compounds called *carbovir,* essentially synthetic molecules that, by "fooling" an enzyme in the HIV virus, chemically disrupt the reproduction of the HIV virus in the body. In 1998, their discovery was marketed as the commercial drug Ziagen—the first drug developed specifically to combat HIV/AIDS.

SALES AND LICENSING REVENUES HAVE reaped multiple benefits for graduate teaching and research at the U. Beside the 21st-Century Graduate Fellowship Endowment (see above),

THINGS FIRST

research

the revenues gave rise to the Center for Drug Design, which opened this past spring.

THE CENTER SUPPORTS promising drug design research by faculty and grad students from across the health sciences (and a few maverick scientists from the pharmaceutical industry). New antiviral and anticancer drugs and new antibiotics are priorities, says Vince. Down the road, the center may focus on drugs for neurological diseases such as Alzheimer's and Parkinson's.

"With the research talent we have here and the royalty revenues for startup, we're poised to become the one of the best drug design centers in the world," says Vince. He intends to make sure the center has staying power when the Ziagen royalties stop at the end of this decade.

"People who have family members with cancer or other disease tend to donate money to the clinic where they went for treatment," notes Vince (who used his personal royalties "to give my salary back to the U so we could hire a few new assistant professors").

"Labs like ours invent the life-saving drugs their doctors give them, but people don't see us. If they did, they might realize their gifts here could do tremendous good."

Robert Vince did the drug research on which the 21st-Century Graduate Fellowship Endowment rests. He keeps a photo in his office of a music student who benefited from the fellowship fund.

JUST AS IMPORTANT TO VINCE is support for graduate students—tomorrow's pathbreakers. He keeps a framed photo in his office of a music student who benefited from the 21st-Century Fellowship Endowment that his work made possible.

"I met her at a banquet last year honoring students who'd gotten fellowships," he says. "Until then, I didn't fully realize the powerful impact of the 21st-Century fund. This young woman played the piano so beautifully, and then talked about the fellowship, how it was the reason she was able to study music. It was a nice evening." ■

THE 21ST-CENTURY GRADUATE FELLOWSHIP ENDOWMENT ensures that the U has the funds to recruit and keep top graduate students.

WHEN IT COMES TO DEFINING excellence in graduate education, what might come to mind first are factors such as acclaimed faculty, innovative research, and great libraries and other resources, says Daniel Brewer, chair of the Department of French and Italian.

"But the lifeblood of any graduate program is good students, and without fellowships, we wouldn't have competitive programs."

Making sure the U's 150 graduate programs are able to recruit and retain the best and brightest students is the goal of the 21st-Century Graduate Fellowship Endowment. Established by the Graduate School in spring 2000 with royalties from an AIDs drug developed by a U professor (see below), the fund matches, dollar-for-dollar, the payout of newly established graduate fellowship endowments of $25,000 or more.

Since 2002, five students in Brewer's department have held fellowships through the Daniel E. Peterson Fellowship in French—one of 200 such funds across the U established by private gifts and instantly doubled through matching grants from the 21st-Century fellowship fund.

"GRADUATE FELLOWSHIPS are critical to our students and programs," emphasizes Jennifer Clarke, development officer for the Institute of Technology. "They ensure that outstanding graduate students come to us, and that they can focus on their learning and academic research. The caliber of our students has everything to do with the strength and and stature of our graduate programs. Supporting our students is a matter of putting first things first."

So crucial are fellowships that Clarke's goal is "to be able to fully fund every one of our graduate students." Meeting that goal will be easier thanks to the 21st-Century fund, she says. She cites a group of Minnesota surveyors and engineers that recently endowed a fellowship in civil engineering.

"They could have set up their endowment through any institution, but the incentive of a match from the U was too good for them to pass up," she says, adding that the group also was impressed by the investment returns of the University of Minnesota Foundation. ■

A Beacon Bright and Clear

THE UNIVERSITY AND THE COMMON GOOD

Excerpts from the May 2005 Graduate School Commencement address by Sara M. Evans, Regents Professor of History

RITUALS LIKE THIS ARE POWERFUL. They mark a liminal moment. One phase of your life is completed. The next ... is about to begin.

I want to think with you today about the fact that we are also in a liminal moment in this University—and in public higher education generally—and ask you as you move into the next phase of your lives to take a message with you about the university as a public institution whose products—educated students and new knowledge—are public goods.

Read the complete address online: www.grad.umn.edu/

THERE IS A SERIOUS MOVE AFOOT to redefine both education and knowledge as private goods, of benefit to individuals rather than to society. This is a dangerous direction, signaled by higher tuition and falling state support. It is up to us to respond, to proclaim "near and far" that the University of Minnesota is a "beacon strong and clear" [in the words of the U of M song "Hail! Minnesota"] to all the people of the state.

AN EDUCATED CITIZENRY IS A PUBLIC GOOD, fundamental to a democratic society. The production of knowledge is a public good when scholars are free to pursue questions of their own choosing and when the results are openly shared.

WHAT WOULD IT MEAN for all knowledge to be defined as a private good? It is easy to see the danger of defining the purpose of science as in the service of immediate profits: avoiding research that might step on powerful toes, or be less profitable as in the case of "orphan drugs" for rare diseases or basic science whose possible uses are unknown.

In my field of history, stories of the past would be in the hands of elites who use it to authorize their own power, like the southern whites I grew up with who said that slavery was benign.

INDEED, A WORLD IN WHICH knowledge is a private good would have little use for the intangible benefits of the liberal arts, preferring instead the more instrumental benefits of "training" over "education." Yet the presence of this university has made Minneapolis and St. Paul major centers for literature and the arts. It was a basic education in the arts and sciences that set most of you on the path to professional education.

Finally, a world in which knowledge is a private good would be a world in which professional education would become prohibitively expensive, and some of it might well be turned over to corporations as professions lose their independence. The fact that 40 percent of the professionals in this state—physicians, lawyers, social workers, teachers, artists—were trained right here at the U would probably change, and frankly I don't really know how we would manage to sustain the remarkable, educated labor force that we now enjoy.

I KNOW THAT I AM TALKING A ST THE GRAIN here. Public support for this University (like public research universities across the country) is in decline. Today it is about 24 percent of our budget. The day is not far away when tuition will bring in more funding than state allocations.

This is the context for our new strategic planning initiative. This University is making it clear that it intends not only to remain one of the best but to get even better. I believe that it is essential that we be very, very clear that we value excellence as a public good. The case for public research universities is precisely that. I would argue that nothing is more basic to the future of our democracy.

IN THE CURRENT POLITICAL CLIMATE the very concepts of "public purposes" and "the common good" are under fire. Now back to you. You are the ones we have been waiting for. We proudly send you out, ready to engage the world with the knowledge and skills you acquired here, prepared to continue the search to understand the world in new ways, to offer it new discoveries and new works of art, and to participate wherever you are as active, engaged citizens. Carry this with you. It is up to you to ensure that what you have had will remain available to future generations. Help us to spread the word that public universities—but most especially this University—must remain "beacons bright and clear" for the common good. ■

Excerpted and abridged from a much longer and richer address with Evans's kind permission. Please check out the complete address on the Web: **www.grad.umn.edu/**.

Evans, left, served on the task force charged last year with articulating the University's value. The group's report ("A Lighthouse Build On A Rock-Solid Foundation: Lighting The Way For A Bright Future") is at **www1.umn.edu/usenate/fee/lighthousereport.html.**

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