

Office of the Vice President for Research

Winter 2007

SEARCH & DISCOVERY

R E S E A R C H A T M I C H I G A N

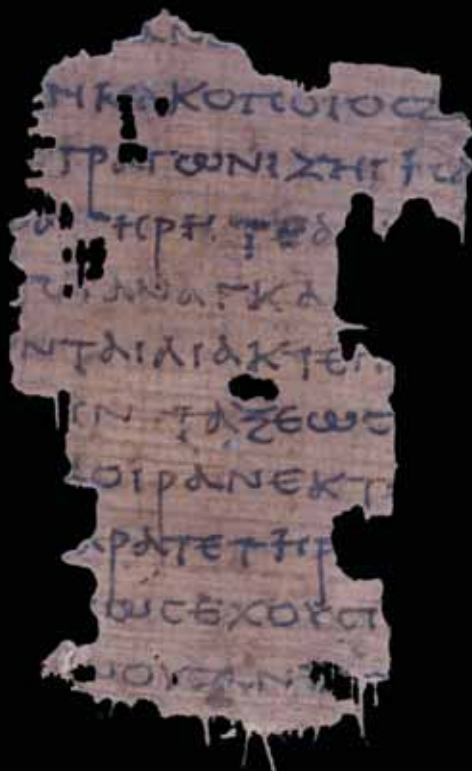
PEERING
into the
PAST



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ON THE COVER

The papyrus fragment on the cover is part of the University of Michigan collection, the largest papyrus collection in the Western Hemisphere and fifth largest in the world. The particular fragment (P. Mich. inv. 3789) contains descriptions in Greek of formulations for medicinal preparations from Egypt in the third century AD. This item was purchased in 1925 to be included in the U-M collection.



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THE UNIVERSITY OF MICHIGAN, AS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER, COMPLIES WITH ALL APPLICABLE FEDERAL AND STATE LAWS REGARDING NONDISCRIMINATION AND AFFIRMATIVE ACTION, INCLUDING TITLE IX OF THE EDUCATION AMENDMENTS OF 1972 AND SECTION 504 OF THE REHABILITATION ACT OF 1973. THE UNIVERSITY OF MICHIGAN IS COMMITTED TO A POLICY OF NONDISCRIMINATION AND EQUAL OPPORTUNITY FOR ALL PERSONS REGARDLESS OF RACE, SEX*, COLOR, RELIGION, CREED, NATIONAL ORIGIN OR ANCESTRY, AGE, MARITAL STATUS, SEXUAL ORIENTATION, DISABILITY, OR VIETNAM-ERA VETERAN STATUS IN EMPLOYMENT, EDUCATIONAL PROGRAMS AND ACTIVITIES, AND ADMISSIONS. INQUIRIES OR COMPLAINTS MAY BE ADDRESSED TO THE SENIOR DIRECTOR FOR INSTITUTIONAL EQUITY AND TITLE IX/SECTION 504 COORDINATOR, OFFICE FOR INSTITUTIONAL EQUITY, 2072 ADMINISTRATIVE SERVICES BUILDING, ANN ARBOR, MICHIGAN 48109-1432, 734-763-0235, TTY 734-647-1388. FOR OTHER UNIVERSITY OF MICHIGAN INFORMATION CALL 734-764-1817.

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RESEARCH PERSPECTIVES

One of the most outstanding aspects of the University of Michigan research community is its breadth. There is literally no topic of research or scholarly activity that is not touched upon, in some way, by our large and distinguished community of faculty and student scholars.

The cover story for this issue is a case in point. The University of Michigan has a major collection of ancient texts and papyri, and our story reports on a group of faculty who are working across barriers of time and culture by using new tech-



nologies to read and decipher those texts. One can only imagine what secrets will be unlocked as they image texts that cannot be opened because they are too fragile or degraded by their millennia of existence in adverse environments.

I was particularly impressed with the work of Professor Janko and co-workers at the University of Kentucky by their use of x-ray imaging to view unopened papyri, and also with the effort to digitize and share many of these writings through the Advanced Papyrological Information System (APIS). Bringing technology and the humanities together in such effective ways can lead to unexpected discoveries and advances that are beyond our imagination. In fact, we might consider the APIS to be a fitting precursor to Michigan's current project with Google to digitize the entire U-M library collection. So once again the thought that, "If not at U-M, then where else?" takes on renewed meaning.

Much of my first few months at the University of Michigan were spent in helping to establish the Michigan Memorial Phoenix Energy Institute (you will find an interview with its director, Professor Gary Was, on page 13). Coming from a physical sciences background, I naturally appreciate the science and technology dimensions to the energy challenges that now face humankind.

However, I was not in Ann Arbor very long when I discovered that the social science, public policy, economic, and other human impacts of our energy choices were every bit as essential to our solving these monumental problems as were the science and technology "fixes" that we apply. It is again the breadth and depth of our research community that gives the University of Michigan its particular strength, and its potential influence on the future course to be taken by our

country and the planet once we bring all of these diverse disciplines together with a focus on energy.

Those are but two examples of how OVPR is demonstrating its commitment to the social sciences and humanities, and in particular, with their relationship to other research activities on our campuses. To further enhance our effectiveness in support of these disciplines, OVPR is instituting the position of associate vice president for the social sciences and the humanities to augment the efforts of an OVPR standing committee, the Arts Funding Group. We hope that the addition of this new AVP will provide our office with a better view into our research activities in the social sciences and humanities, and will help to forge long-term and effective linkages between disciplines by working closely with our AVPs in the physical sciences and engineering (Steve Ceccio) and the health and life sciences (Jim Shayman).

In a final note, I would like to point out that this issue commemorates the decommissioning of the Ford Nuclear Reactor—a major facility that has played a distinguished role for some 50 years in research investigating the peaceful uses of nuclear energy here at U-M. It is only fitting that now the Phoenix Memorial Project, of which the reactor was the keystone, should enter a new era for exploring an even broader range of energy alternatives to fossil fuels that may ultimately lead to our exploitation of clean energy, while freeing us from our over-dependence of our vital energy needs from off-shore sources.

—Stephen R. Forrest

A handwritten signature in blue ink that reads "Step Forrest". The signature is fluid and cursive.

OVER THE SHOULDERS OF THE ANCIENTS

Finding Clues About the Past in Papyri



“It’s like looking over the shoulder of people who lived two thousand years ago,” says Arthur Verhoogt, associate professor of papyrology and Greek, as he characterized one of his current projects. Verhoogt is eavesdropping on the life of a Roman soldier and the soldier’s father, an army veteran, who lived in Egypt in the second century AD. He is able to reach back in time like this by examining the small collection of letters from the soldier to his father. The letters were found in the late 1920s inside a step in a house during a University of Michigan archaeological excavation in Karanis, Egypt.

A book about, among many others, the two *Romans, Soldier and Society in Roman Egypt: A Social History* by Richard Alston of the University of London, was originally published in 1985, and scholars have used this work and the translated letters to learn about life in Karanis and elsewhere in Egypt. However, a few years ago Verhoogt and then-University of Michigan undergraduate student, Robert Stephan, learned that the records for documents found in “House C/B167” were incomplete. Stephan and Verhoogt found in storage at Michigan another dozen unexamined texts from the same cache in the excavated house that had been overlooked during the cataloging of the site.



PROFESSOR ARTHUR VERHOOGT.
PHOTO BY SCOTT R. GALVIN.

PROFESSOR RICHARD JANKO EXAMINES PAPYRUS FRAGMENTS FROM HERCULANEUM IN AN EFFORT TO PIECE TOGETHER THEIR MEANING. PHOTO BY SCOTT R. GALVIN.

“With the recovery of further documents and artifacts,” says Verhoogt, “it’s necessary to reassess the past studies,” which were based only on the original set.

The documents already examined at length indicated that House C/B167 belonged to Tiberianus, a veteran of the Roman army. “The archive of Tiberianus is one of the most important sources for the life of active soldiers and veterans of the Roman army in Egypt,” explains Verhoogt. The letters are from the son, Terentianus, a soldier stationed in the vicinity of Alexandria, to his father, Tiberianus.

The family was well-to-do, Verhoogt continues, a conclusion based on analyzing both the texts and the artifacts from the house. Interestingly, some letters were in Latin and others in Greek, and differences in handwriting among the letters indicate that the sender was able to hire a scribe who recorded what was dictated.

“We know that the father lived in the countryside and the son in Alexandria,” says Verhoogt. The letters also indicated that the father had asked his son to send some fine glassware that was available in Alexandria, while the son requested that his father send him a new pick-

axe, to replace the one his superior officer had taken from him. Good quality glass was indeed found during excavation of the house, as was a papyrus fragment of a book about the Peloponnesian War by Thucydides. Both provided further evidence of the elevated status of the occupants of the house, since these kinds of objects were rare finds in the Karanis excavation.

Karanis offers scholars a special opportunity, adds Verhoogt. “It’s unusual to have both the texts and artifacts from the same site. We have this context and we should use it to better understand the past.”

Verhoogt’s current tasks are clear—analyze the archaeological data (which he is doing in collaboration with Robert Stephan, now a graduate student at Stanford University), edit the new papyri, and re-assess those papyri that were previously published. “Only by evaluating the text, artifacts, and architecture in tandem will we be able to fully reconstruct the life, work, and documents of Tiberianus and Terentianus.” Verhoogt and Stephan plan to publish their new interpretation of this material in 2008.

“Once we finish with this house, we can continue, house by house, to look at the archaeological objects and papyri to get a broader sense of Karanis,” explains Verhoogt. “What makes this investigation all the more remarkable is that nearly all of the material we need to look at is here on campus.”

Thanks to the Karanis expeditions and a consortium of universities that purchased papyrus documents, the University of Michigan today holds the largest collection of papyri in the

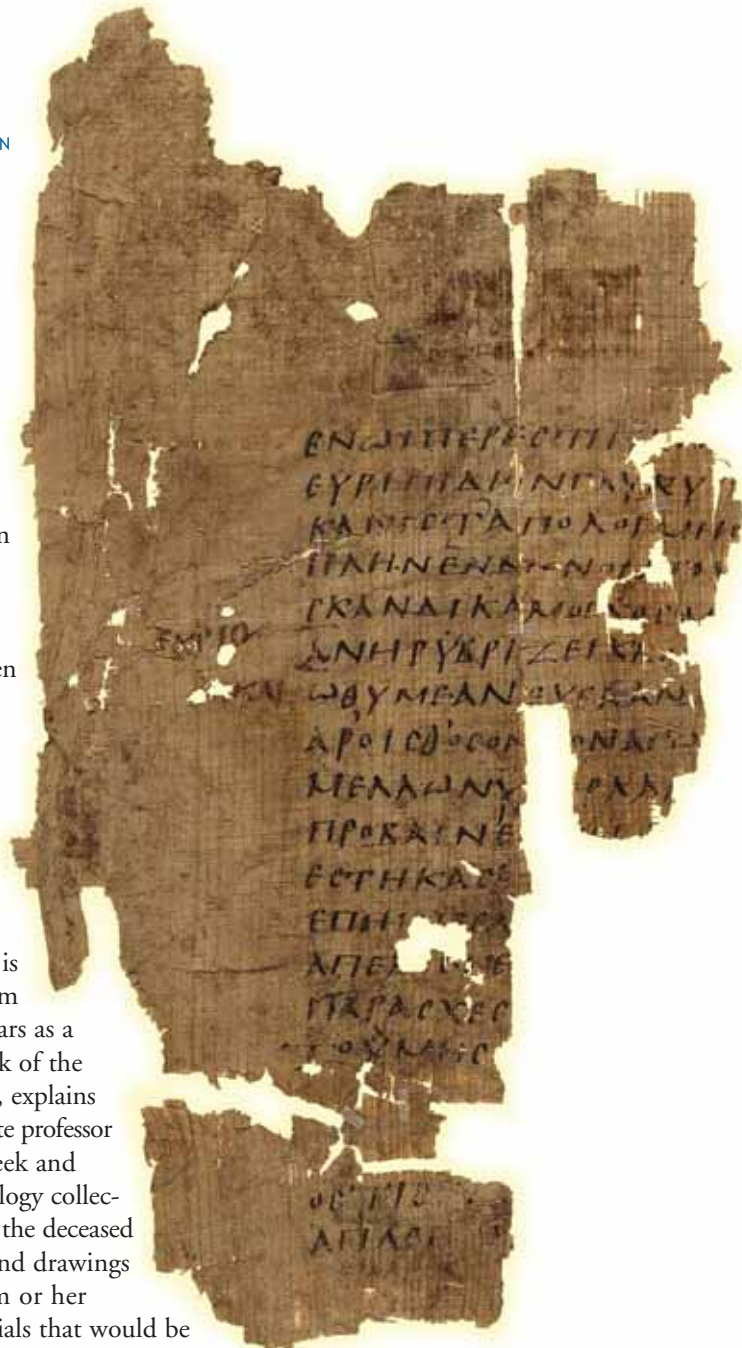
THIS PAPYRUS FRAGMENT FROM THE U-M COLLECTION IS A LITERARY WORK IN GREEK BY ARISTOPHANES FROM THE 4th CENTURY.

Western Hemisphere, and fifth largest in the world. Most of these materials are stored on the eighth floor of the Harlan Hatcher Graduate Library on campus. The collection contains more than 12,000 papyrus fragments—with over 1200 mounted between glass plates—while even more have been digitally imaged and are accessible to users around the world via the web.

The oldest document in the U-M collection is a papyrus fragment from Egypt known to scholars as a funerary text, or “Book of the Dead.” Funerary texts, explains Traianos Gagos, associate professor of papyrology and Greek and archivist of the papyrology collection, were buried with the deceased and contained spells and drawings intended to guide him or her through the various trials that would be encountered before being allowed into the afterlife. The particular funerary text fragment in the U-M collection dates to nearly 1000 BC.

Other papyri in the collection were found as part of the wrapping around mummies—in essence, the “scrap paper” used to encase those who were mummified. Many of these papyrus fragments contain illuminating records of daily life in ancient Egypt.

“We have literary texts, too,” says Gagos, such as substantial fragments of the Homeric epics, and “long lost works by Greek dramatic writers Aristophanes, Euripides, and especially Menander. “These inform us of literary traditions that were often forgotten by the medieval period.” The collection also includes works by Aristotle, the mathematician Euclid, and the earliest known copy of the Epistles of Saint Paul.



PROFESSOR TRIANOS GAGOS (CENTER) AND TWO STUDENTS PREPARE TO EXAMINE PAPYRUS FROM THE UNIVERSITY OF MICHIGAN. PHOTO BY PAUL JARONSKI.



ABOVE PHOTOGRAPH FROM THE UNIVERSITY OF MICHIGAN EXCAVATION AT KARANIS, EGYPT, IN THE 1920s SHOWING PAPYRUS ROLLS FOUND IN A HOLLOW THRESHOLD OF A DOOR BETWEEN ROOMS D AND E OF HOUSE 5026. KELSEY MUSEUM ARCHIVES 5.1801.



LEFT THESE PAPYRUS FRAGMENTS FROM THE U-M COLLECTION WERE RECOVERED FROM THE COVERING ALONG THE SOLES OF THE FEET OF A MUMMY EXCAVATED IN EGYPT.

RIGHT THIS PAPYRUS FRAGMENT FROM THE U-M COLLECTION IS AN EXCERPT OF THE TEN FIRST DEFINITIONS OF THE ELEMENTS OF EUCLID, POSSIBLY PART OF A MEMORANDUM WRITTEN BY A TEACHER TO HIS CLASS.

U-M's first papyri were acquired in 1920 through purchases coordinated with the British Museum and several U.S. universities, such as Columbia, Yale, and others. Purchases continued through about 1940. Add to these the papyri and other archaeological artifacts with writing on them found during U-M-led excavations of Karanis between 1924 to 1935, and the Michigan collection became extraordinary.

For several decades, scholars would travel to Ann Arbor to view items from the collection, many of which are very fragile, as they attempted to understand public and domestic life from the third century BC to the seventh century AD, encompassing the Hellenistic, Roman, and Byzantine periods. The process of determining the content of the papyrus texts is not a simple matter, says Verhoogt. For instance, reading the Greek letters from Karanis begins by trying to figure out where the words start and end because the text is a continuous collection of letters.

"I look for words, sentences, names," he says. Verhoogt also looks at existing dictionaries and other translations for similar constructions. "It's not a straightforward translation, as we constantly come across unknown words or names. For papyrologists, Greek is not a dead

language. It's very much alive as we keep adding to the vocabulary and even revise known words and their usage."

Over the last two decades, advances in photography and then digital imaging has greatly aided the study of papyri. "The first digital scanner that the University Library owned was purchased to begin experimenting with the digital capture of papyri," explains Gagos. This work started shortly after Gagos arrived in Ann Arbor in the early 1990s. By 1994, papyri images became accessible over the World Wide Web, well before internet browsers such as Internet Explorer or Safari came into common use.



LIBRARY IS HOME TO MANY SPECIAL COLLECTIONS

After exploring the Papyrology Collection, *Search & Discovery* became curious about the other specialized libraries and collections found on campus. Here is a quick tour of what we learned.

The **MAP LIBRARY** is the principal collection for cartographic materials at the University of Michigan, with an emphasis on both historic and modern mapping, including digital resources. It supports teaching and research activities of faculty, staff, and students in many disciplines. It is also a campus resource for spatial data, through Numeric and Spatial Data Services, which provides assistance with geographical information systems, statistical software, and relevant data in a laboratory in the Map Library. In addition, the Clements Library has extensive historic maps and atlases, and the Bentley Historical Library also holds works with a focus on Michigan history.

The **SPECIAL COLLECTIONS LIBRARY** holds internationally recognized collections of books, serials, ancient and modern manuscripts, posters, playbills, photographs, pamphlets, artwork, and other materials. Tracing their roots back to one of the earliest rare book rooms in the United States, these collections are the primary basis of research for many scholars, both from the University of Michigan and from around the world. One of the prominent subsets in this library is the Labadie Collection, established in 1911 when Joseph Labadie, a prominent Detroit anarchist, donated his library to the University. Although the Collection was originally concerned mainly with anarchist materials (the field in which it remains strongest), its scope was later widened considerably to include a great

variety of social protest literature with political views from both the extreme left and the extreme right. Other special groupings administered by this library include Literary and Dramatic Collections, Science and Technology Collections, the Transportation History Collection, and the Power Collection for the Study of Scholarly Communication and Information Transfer.

The **DOCUMENTS CENTER** is a central reference and referral point for government information, whether local, state, federal, foreign, or international. Its web pages are a reference and instructional tool for government, political science, statistical data, and news. Last fall, you could find materials such as the Iraq Study Group (Baker-Hamilton Commission) Report; a link to all electronic versions of U.S. Census publications at the University of Michigan Library; a reference, called “Legistorm,” to the salaries paid to all congressional staff members; and the myriad official reports and documents that are published daily.

The **AREA PROGRAMS LIBRARIES** consist of the Near East Division, the Slavic and East European Division, the South Asia Division, and the Southeast Asia Division. These libraries exist within the Graduate Library, with each division an independent unit which selects and acquires library materials, solicits and accepts purchase recommendations, catalogues the collection, provides assistance to library users in the use of the unit’s collection, and offers formal instruction in the bibliographic resources in the unit’s area of expertise.

A complete list of the libraries and collections on campus can be found at www.lib.umich.edu/libinfo/alphalist.html.
S&D

In 1994, the U-M also joined with five other universities—Duke, Berkeley, Columbia, Princeton, and Yale—to establish a national consortium for the construction of the Advanced Papyrological Information System (APIS). Today, some 20 institutions are active contributors of papyrus scans with another eight soon to join the consortium.

Items catalogued in the APIS database now number 35,000, with more than 20,000 individual images of papyri contributed by the member institutions. The consortium has also developed standards for scanning, so that digital images provide the quality needed to support successful scholarship.



PROFESSOR RICHARD JANKO.
PHOTO BY SCOTT R. GALVIN.

“For papyrologists, Greek is not a dead language. It’s very much alive as we keep adding to the vocabulary and even revise known words and their usage.”

Funding for scanning and cataloging papyri at the U-M and the other partners has been provided by the National Endowment for the Humanities. In 2005, APIS became a nonprofit entity and the members are building an endowment to make sure the project will survive indefinitely, says Gagos.

Papyri exist today because conditions were right in some parts of the ancient world to allow the reed-based paper to survive over centuries. “There are two basic ways for papyri to survive — by being kept dry, as occurs in places like Egypt, or by being burned incompletely, as happened in Herculaneum,” says Richard Janko, professor and chair of Classical Studies.

Herculaneum was an Italian city that was buried under some 30 meters of lava, mud, and ash following the eruption of Mt. Vesuvius in 79 AD. The texts found during the excavation of this site had been “carbonized,” which preserved them, but in an extremely hard-to-read condition compared to papyri from places like Karanis. For the most part, texts from Herculaneum are black. However, notes Janko, “Over the last 20 years, new tech-

ENLARGEMENT OF THE SPINE FROM A 15th CENTURY LEATHER-BOUND BOOK THAT WAS EXAMINED USING PROFESSOR BRENT SEALES’ SPECIALIZED CT SCANNING TO SEE THE WRITING ON INNER LAYERS OF PARCHMENT THAT WERE USED TO REINFORCE THE SPINE. THE SECTION SHOWN IS A PASSAGE FROM THE HEBREW BIBLE. COURTESY OF U-M CLASSICAL STUDIES.



HANDLING PAPHYRUS, WHICH IS USUALLY FRAGILE, TAKES GREAT CARE AND PATIENCE. PHOTO BY PAUL JARONSKI.

nologies have been brought into use to help scholars who examine pieces of papyri. The development of multi-spectral imaging and even Photoshop (software for image processing commonly used by graphic artists and photographers) have made it possible to read many of these documents.”

There is a further barrier to study in the case of some preserved materials. For example, the Herculaneum texts that Janko is studying include hundreds of charred papyrus rolls that are too fragile to unroll for examination or even to move from the glass cases where they are current stored in the National Library in Naples, Italy.

Then, about a year ago, Janko had a discussion with Professor Brent Seales of the Department of Computer Science at the University of Kentucky. Seales has developed specialized software for the interpretation of CT scans in order to view the images on pages of ancient texts that are either stuck together or rolled up and cannot be separated without destroying the objects. “[Seales] had successfully tested it on model papyri that he had made and inscribed with ink,” says Janko. But to apply this technology to the Herculaneum scrolls in Naples would require a portable scanner that doesn’t yet exist.

Before taking that step, Janko suggested that Seale test his system on actual papyri. “I suggested that we should look in the collection of the University of Michigan to see what pieces were sufficiently sturdy to travel to the existing equipment, which is at the Center for Non-Destructive Analysis at Iowa State University in Ames, Iowa.”



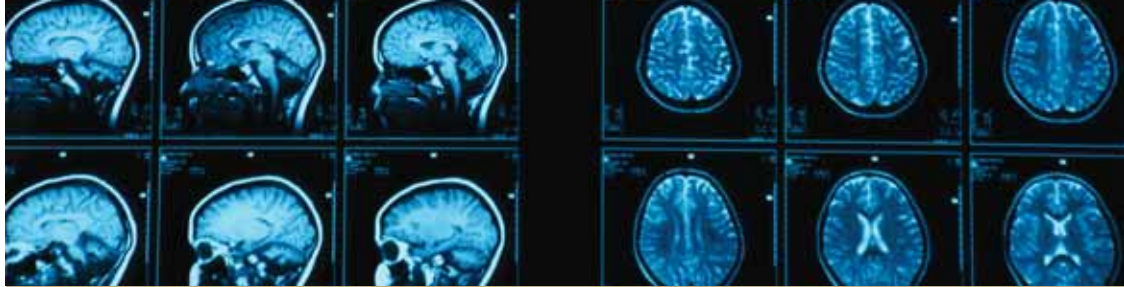
Two pieces were selected for the experiment—a fragment of a papyrus roll and the spine of a parchment codex (book) from the 15th century, which consisted of several layers of parchment glued tightly together. “As always happens with medieval codices,” says Janko, “the spine of the book was made up of unwanted written matter, and it would be useful to know what writing was on the interior layers.”

Seales has scanned the U-M items and sent several images to Janko for examination. The first image, an underlying layer from the book spine, contains a short section from the book of Ecclesiastes in the Hebrew Bible. Professor Yaron Eliav from the U-M Department of Near Eastern Studies provided the analysis and further concluded that the fragment came from a scroll and not another codex.

“This may seem like a small beginning, but it can lead to great things,” says Janko. “One problem with unrolling even sturdy scrolls is that cracks and breaks can be mistaken for certain characters. One advantage of digital unrolling, beyond gaining access to extremely fragile materials, is that we won’t have to decipher what is a crack and what is a letter.”

Janko hopes to continue the collaboration with Seales and, with some luck, travel to Italy with him and a portable scanner so that they can begin to look at the many, many texts that have never been opened. Janko suggests that this project may prove to be “extraordinary in the history of classical scholarship.”

S&D



HI-TECH IMAGING IS EVERYWHERE

Imaging technology has spread to many uses in science, medicine, and even the humanities, as evidenced by the development of CT scanning to “read” the inside layers of a papyrus scroll. There are so many different methods being used or studied, that a quick Google of campus activity turned up many more examples that we can cite here. The Department of Electrical Engineering and Computer Science (EECS) in the College of Engineering (COE) is home to the Image Computing Laboratory. This lab is involved in several types of medical imaging—positron emission tomography (PET) and magnetic resonance imaging (MRI), to name just two—plus the development of ways to combine several imaging techniques to improve their ability to tease out details from the tissues that might be examined.

Another COE lab where faculty “like to make pictures” is the Biomedical Ultrasonics Laboratory in the Department of Biomedical Engineering. Many of the research projects there combine ultrasound with other technologies to produce images. The union of ultrafast optics with high-frequency ultrasound imaging is being used to make images of molecules or for use in therapeutic applications. “Elasticity microscopy” is another area of work, which is based on interactions between microwave energy and high-frequency ultrasound for imaging fatty molecules.

Remote sensing is an area of research in several departments. In COE’s Department of Atmospheric, Oceanic and Space Sciences, a number of projects involve the design, development, fabrication, and testing of advanced microwave remote sensing instruments for earth and space science applications. The Radiation

Laboratory in EECS has faculty involved in many aspects of applied electromagnetics, including the development of technology for active and passive microwave remote sensing and the interpretation of the images obtained from ground-, air- or space-based detectors.

Electron microscopy is another important research tool, and you can find a number on campus. In particular, the Electron Microbeam Analysis Laboratory (EMAL) is a University-wide user facility for the microstructural and microchemical characterization of materials through the production of images for study. Being a user facility with electron microscopes (as well as other instruments) on both North Campus and Central Campus, EMAL is open to anyone in the University research community.

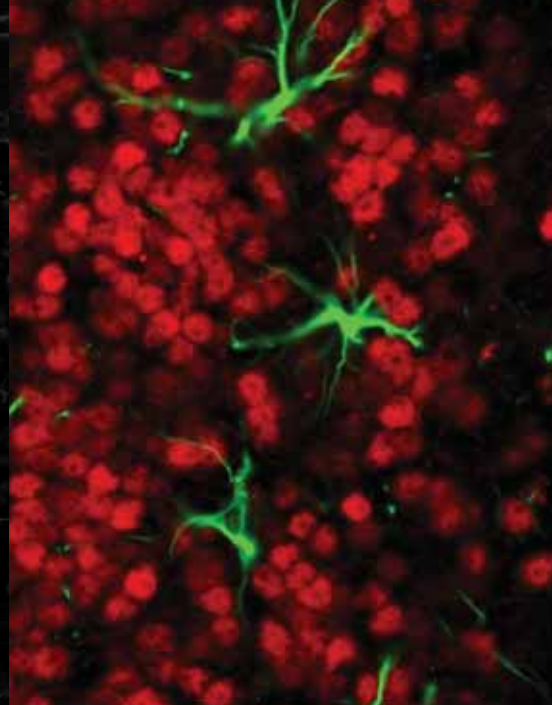
The U-M Health System has many imaging technologies both in use and under study. For example, the Comprehensive Cancer Center has a Molecular Imaging Program in which modern tools of cell and molecular biology are combined with state-of-the-art, non-invasive imaging technologies to monitor biological processes in living organisms. Current clinical studies include investigating the use of diffusion weighted MRI as an early predictor of tumor response to the timing and dosing of therapy.

The U-M Cardiovascular Center has now upgraded its facilities to include “64-slice CT scanners,” one of the most advanced heart-imaging technologies available. Such CT machines allow physicians and researchers to capture a detailed image of the heart and coronary arteries in just a few seconds. **S&D**

GENE RESEARCH

Identifies Important Association Between

AGING & CANCER



The natural consequences of growing old include slower wound-healing and a brain that makes fewer new neurons because old tissues have less regenerative capacity. What has not been clear is why. A trio of papers published in September 2006 in the journal *Nature* shows that old stem cells don't simply wear out, they actively shut themselves down, probably as a defense against becoming cancerous from genetic defects that accumulate with age.

"The good news is that we can get older before we get cancer," says Sean Morrison, director of the Center for Stem Cell Biology at the University of Michigan, and lead author on one of the three papers. "The bad news is that our tissues can't repair themselves as well."

Though science has long known about the reduced regenerative capacity in aging tissues, the actual mechanisms are only now coming to light. What Morrison and his colleagues at Harvard University and the University of North Carolina have found is that a gene called Ink4a actively interferes with the ability of stem cells to divide in several different types of tissue, including the brain, the pancreas, and the blood-forming system of the bone marrow.

Under optimal circumstances, stem cells are able to copy themselves and differentiate into other cells, thus replenishing their numbers and acting as a repair system for the body. The Ink4a gene appears to be widely active in locations where stem cells regenerate new tissues.

Morrison's team has shown that eliminating Ink4a partially restores the renewal of neural stem cells in some parts of the brain. "This is the first time that anyone has demonstrated it is possible to delete a single gene and rescue declines in either neurogenesis or stem cell function with age," Morrison says.

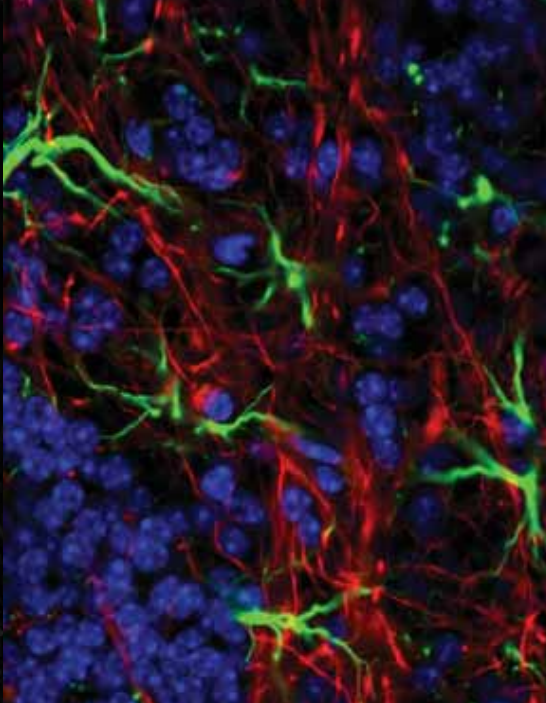
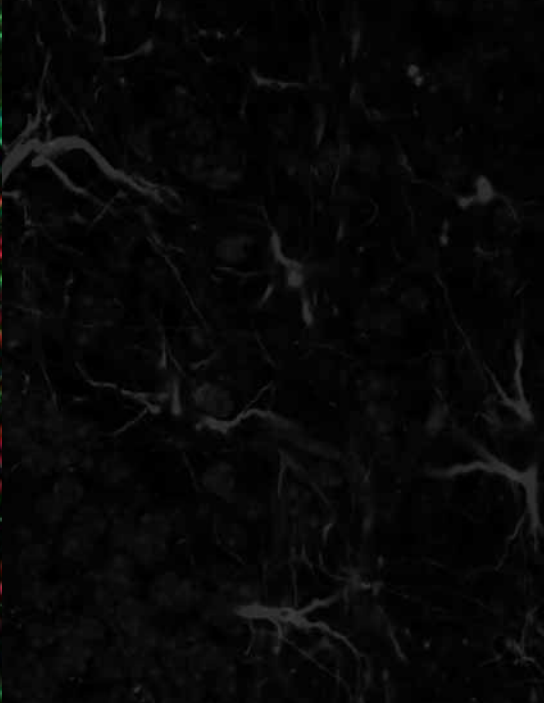
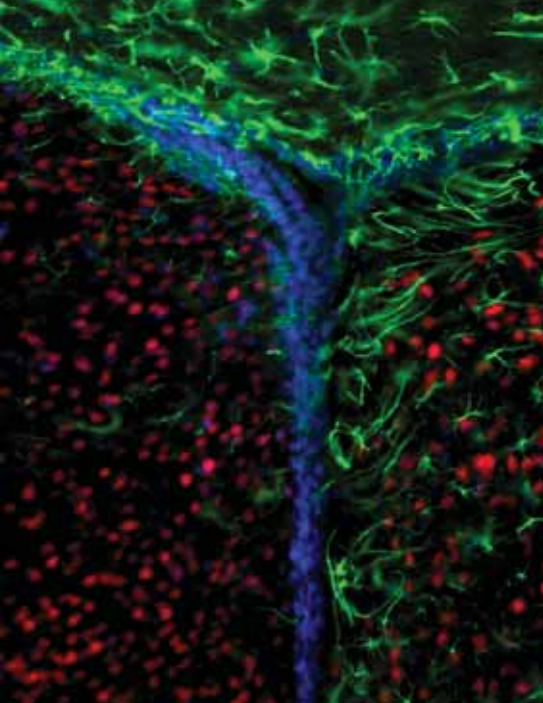
Though mice with deleted Ink4a had more regenerative capacity in tissues like the brain and the pancreas as they aged, they started dying of a wide variety of cancers at one year of age. So it can't really be said that losing the gene helped them live longer.

"If you had a drug that could inhibit Ink4a function, you'd potentially have a therapy against degenerative diseases," notes Morrison. "But you'd have to watch patients carefully for cancers. By the same token, drugs that mimic Ink4a function could be used to fight cancer."

Ink4a was known to be a tumor-suppressor gene that becomes more highly expressed with age, eventually triggering the cell to shut down replication. An important natural regulator of Ink4a is a gene called Bmi-1 that promotes stem cell maintenance and cell regeneration, but can also spur cancerous growth. Stem cells balance their levels of Bmi-1 and Ink4a to maintain themselves throughout adult life.



SEAN MORRISON



Morrison says these are both pieces of a finely calibrated system that allows needed cell replication to occur, but can shut it down when things get out of control. His team would like to find out more about the multiple factors that change Ink4a expression with age. He notes also that Ink4a doesn't affect all of the cells of the nervous system in mice, just a subset of them.

Morrison's work was supported by the National Institute on Aging and the National Institute of Neurological Disorders and Stroke, both parts of the National Institutes of Health and the Howard Hughes Medical Institute. Morrison's research team included graduate students Anna Molofsky and Nancy Joseph, and research fellow Guy Slutsky. **S&D**

STEM CELL RESEARCH EFFORTS BROADEN

The University of Michigan has raised a start-up fund from private sources to support a project on human embryonic stem cell research currently not eligible for federal funding. The project will be part of the U-M Center for Stem Cell Biology, which was launched last year with \$12M in funding from U-M and which is based in U-M's Life Science Institute.

"On the day President Bush vetoed the legislation in late July, I asked a group of the Institute's stakeholders to help us stay leaders in the field by funding this critical area of research until the federal restrictions are eased. The response was positive and immediate," says Alan Saltiel, director of the Life Sciences Institute.

In less than three months, the Institute raised \$283,000 with a goal to raise an additional \$1M to fund the project for four years. The donors include current and former U-M regents and many local and national leaders who believe this research is vital to find cures to the most devastating diseases.

"Our funders are representative of the majority of the public who are in favor of embryonic stem cell research; it offers the best hope to speed the pace of discovery for treatments and cures for diseases like diabetes, Parkinson's, and cancer," Saltiel says.

"We are already at a disadvantage in Michigan because of our state law restrictions. That makes this support even more critical for our Center," says Sean Morrison, director of the U-M Center for Stem Biology. "In the areas where Michigan can conduct stem cell research, we have been recognized as among the best institutions internationally. It is important to remember that these restrictions under Michigan law do not protect a single embryo from destruction; they only delay medical research." **S&D**

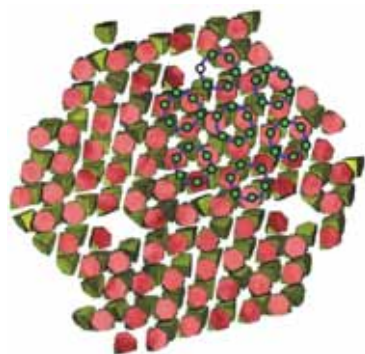
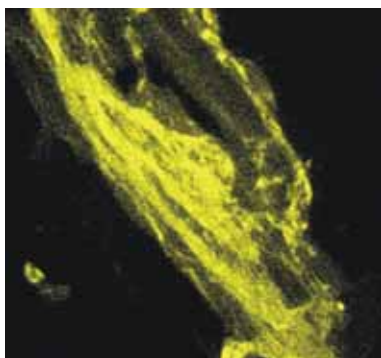
SELF-ASSEMBLY

U-M Researchers Induce Nanoparticles to Amass into Larger Structures

One of the intriguing objectives for researchers interested in nanotechnology is the development of methods to direct and control the self-assembly of these ultra-small particles into still-small and complex structures.

University of Michigan researchers have discovered a way to make nanocrystals in a fluid assemble into free-floating sheets the same way that some protein structures form in living organisms.

“This establishes an important connection between two basic building blocks in biology and nanotechnology, proteins and nanoparticles, and this is very exciting for assembling materials from the bottom up for a whole slew of applications ranging from drug delivery to energy,” says Sharon Glotzer, professor of chemical engineering and materials science and engineering.



MICROSCOPE IMAGE OF THE SELF-ASSEMBLED SHEETS OF NANOPARTICLES (TOP) AND GRAPHICAL REPRESENTATION OF THE INTERNAL STRUCTURE OF THE FILM FROM SIMULATION PREDICTIONS (BOTTOM). COURTESY OF U-M NEWS SERVICE.

Glotzer and Nicholas Kotov, associate professor of chemical engineering, and their postdoctoral researchers have co-authored a paper that appeared in the October 13, 2006 issue of the journal *Science*.

“The importance of this work is in making a key connection between the world of proteins and the world of nanotechnology” Kotov says. “Once we know how to manipulate the forces between the nanoparticles and their ability to self-organize, it will help us in a variety of practical applications from light-harvesting nanoparticle devices to new drugs which can act like proteins, but are actually nanoparticles.”

The sheets, which can appear bright green to dark red depending on the nanoparticle size when illuminated with UV light, are made from cadmium telluride crystals, a material used in solar cells. The sheets are about two microns in width, about one-fifth the thickness of a human hair.

Scientists have long known how to coax nanoparticles into forming sheets, Glotzer says. But those sheets have only been achieved when the particles were on a surface or at an interface between two fluids, never while suspended in a single fluid.

The work started in Kotov’s lab three years ago when he and his team observed the sheets in experiments. Though they created them, they weren’t sure how.

“We were aware of certain proteins in living organisms that self-assemble into layers, called S-layers,” Kotov says. S-layer proteins comprise the outermost cell envelope of a wide variety of bacteria and other single-celled, prokaryotic organisms called archaea, and they are able to form two-dimensional sheets with square, hexagonal, and other packings at surfaces and interfaces, as well as suspended in fluid. The group sought to make the connection between the forces governing

S-layer protein assembly and the forces governing the nanoparticle assembly. That’s when Glotzer’s group, whose expertise is in computer modeling and simulation, became involved.

“We suspected that the forces between S-layer proteins were similar to that of the nanoparticles,” Glotzer says. “Computer simulations allowed us to further develop and test this hypothesis.”

Post doctoral researcher Zhenli Zhang of Glotzer’s group tried various combinations of forces based on information gleaned from experiments performed by post doctoral Zhiyong Tang of Kotov’s group. The team discovered that the unique shape of the cadmium telluride nanocrystals gave rise to a combination of forces that led to the unusual two-dimensional packing. Subsequent experiments by Kotov’s group showed that if any of the forces were missing, the sheets would not form, confirming the simulation predictions.

“Self-assembly is nature’s basic building principle for producing organized arrays of biomolecules with controlled geometrical and physicochemical surface properties,” Glotzer says. “In the fabrication of functional nanoscale materials and devices, self-assembly offers substantial advantages over traditional manufacturing approaches if we can design the building blocks appropriately. This is what we’re trying to do.”

The work was partially supported by seed funds provided by the U-M College of Engineering’s Nanotechnology Initiative and by the Department of Energy, the Air Force Office of Scientific Research, and the National Science Foundation. **S&D**



MEET GARY WAS

Director of the Michigan Memorial Phoenix Energy Institute

In September 2006, the University established the Michigan Memorial Phoenix Energy Institute (MMPEI) and named Gary Was as the Institute's first director (above in photo by Lin Jones). Was is a professor of nuclear engineering and radiological sciences and of materials science and engineering, and former associate dean for research in the College of Engineering. Although the Institute has only been in place a few months, *Search & Discovery* wanted to find out what the director has in mind for this new entity.

S&D: Why has the Institute been created? What special role will it play?

Was: The creation of MMPEI was, in a sense, a natural evolution of the original Michigan Memorial Phoenix Project. That project, established in the 1940s, was dedicated to the peaceful uses of nuclear energy. With the increasing realization of the importance of energy in the prosperity and health of the globe, expanding the scope to include all of the energy realm was a logical transition for the Project.

The mission of the MMPEI is to develop, coordinate and promote energy research and education at the University of Michigan. We will do this by providing a unified voice on campus in energy research, policy, and education, serving as a platform to expand energy research, facilitate multidisciplinary research, help faculty to compete for major block and interdisciplinary grants, partner with other academic institutions and industry, link to other U-M

initiatives, and support the development of the regional and state economies and their energy needs.

S&D: What are your plans for the next few months? For the next year?

Was: We have a lot of activities underway and planned for the next year. An Energy Workshop is planned for January 18, 2007, to be held in the Michigan League. The purpose of this workshop is to provide faculty an opportunity to showcase their research to other faculty, to identify potential collaborators, to discuss new ideas, to assess our strengths, and to look for new opportunities.

On February 13 and 14, the U-M is hosting a symposium on energy science, technology, and public policy at the Rackham Amphitheatre. This symposium brings together many influential people from government, industry, and academia to present their views on science, technology, and policy in the energy field. Invitees include Samuel Bodman, the U.S. secretary of energy; Larry Burns, vice president for research at GM; Gerhart Schmidt, vice president for research at Ford; John Dearborn, vice president for energy at Dow Chemical; James Rogers, president and CEO of Duke Energy; Professor Ernest Moniz of MIT; Professor Nathan Lewis from CalTech; Margo Oge from the U.S. EPA; William McDonough of McDonough & Partners; and others. (Symposium details are online at www.mmpei.umich.edu/symposium.html).

We are also seeking to build our expertise in several areas, and we have commitments for the establishment of chaired faculty positions in energy-related disciplines from the College of Literature, Science, and Arts and the College of Engineering, with matching resources from the Office of the Vice President for Research to fill these positions.

S&D: What strengths does the University of Michigan have in energy research?

Was: If we take stock of our strengths, they fall into two categories. Those areas where we are recognized as leaders include automotive engineering, nuclear engineering (the top-ranked graduate department in the country), low power/solid state electronics, and hydrogen. These are fields of strength that will form the backbone of our efforts and programs.

S&D: What research areas does the University need to strengthen or create?

Was: Areas where I believe that the U-M can achieve an identifiable presence and rise to a position of national leadership include solar power (or photovoltaics), lighting, energy storage, and public policy. While other areas may rise into this category, these are the areas that today are in a position where we believe we can excel, especially with the addition of resources and key faculty hires.

S&D: How will decisions be made about what areas of research to pursue or support? Is new faculty hiring part of the Initiative or MMPEI activities?

Was: MMPEI was established to be an inclusive activity. The Institute is really an enabling organization. As such, we would like to encourage students and faculty from all facets of the energy realm to participate in MMPEI. No one is excluded, and MMPEI will help to foster collaborations and enable faculty to be successful in any energy area. That said, with limited resources we must be selective in those areas where we think we can make a major impact. We don't want to spread our resources so thinly across too great of a landscape that we end up being sub-critical in all areas. This is the reason for targeting areas where we believe we have the foundation to make a major impact.

Faculty hiring is indeed a large part of the initiative, and it is in these areas targeted for growth where faculty hires will make the largest impact. Faculty and departments are encouraged to identify leaders in these targeted fields and bring forth their suggestions for discussion. Faculty know best who are the leaders in their fields and who can make an impact in the areas targeted for development.

S&D: What are the payoffs for establishing the MMPEI and the U-M Energy Initiative?

Was: The payoffs will come from coordinating our energy activities on campus by providing a more unified face to the outside world, which will be important in engaging industry and the federal government and in identifying opportunities. And by encouraging multidisciplinary activities and collaboration between units, we will open up opportunities that cannot be effectively addressed by a single discipline. Seeding projects and renovating the Phoenix Memorial Laboratory will

provide resources for faculty to carry their research to a new level in order to be more competitive and successful. Partnering with other institutions will expose us to additional opportunities, and teaming with industry will bring practical outlets to our fundamental research and will provide additional resources.

S&D: What would you like to see taking place at the University in the broad area of energy research in five years? In ten years?

Was: While the mission of MMPEI is directed largely toward the development of University resources and capabilities, the ultimate goal is for the U-M to help chart the path to a clean, affordable, and sustainable energy future. It is my hope and expectation that ten years from now, the nation's energy policy, research directions, and commercialization activities will have been, at least in part, shaped by the activities of the faculty and students of the University of Michigan, and that the MMPEI will be recognized for playing a key role in making these contributions possible. [S&D](#)

**Energy Science,
Technology, and Policy**

FACING THE CHALLENGE

A UNIVERSITY OF
MICHIGAN SYMPOSIUM
ORGANIZED BY THE
OFFICE OF THE
VICE PRESIDENT
FOR RESEARCH
AND THE MICHIGAN
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February 13–14, 2007

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and other information is available
at [http://www.mmpei.umich.edu/
symposium.html](http://www.mmpei.umich.edu/symposium.html)



GE

There are few contemporary challenges facing humankind more threatening than the unsustainable nature of our current energy infrastructure. Every aspect of present-day society is dependent upon the continuing availability of clean, affordable, and flexible energy resources. Yet our current energy infrastructure, heavily dependent upon fossil fuels, is unsustainable. Global oil production is expected to peak within the next several decades, with natural gas production peaking soon afterwards. While there are substantial reserves of coal and tar sands, the mining, processing, and burning of these fossil fuels poses increasingly unacceptable biological and environmental risks, particularly within the context of global climate change. Furthermore, the security of our nation is threatened by our reliance on foreign energy imports from unstable regions of the world.

The likely collapse of the traditional fossil fuel energy economy at some point in the

not-too-distant future poses a particular challenge for the state of Michigan. As a state that remains heavily dependent upon the design and manufacture of the automobile, energy availability and cost for both this industry and transportation in general have a special impact. Furthermore, the Great Lakes states are both the largest producer and consumer of electrical power, which still depends primarily upon coal-fired plants. Hence the implications of the unsustainable nature of fossil fuels are very serious for the future of our state. Given this urgency, we believe the University of Michigan has capacity to build a world-class capability in energy research, with a particular focus on advanced energy sources, more efficient energy utilization, energy policy, and global sustainability.

In response to these challenges, the University of Michigan has set forth an Initiative on Energy Science, Technology, and Policy. Researchers across the University are already engaged in a wide variety of

energy related research and education. Our initiative is meant to strengthen these existing activities while developing leadership in emerging areas of energy research. An important part of our initiative will be the establishment of the Phoenix Memorial Energy Institute, a University-wide organization that will aid in the development and growth of our energy-related research and teaching enterprise. This institute will build on the tradition of the Michigan Memorial Phoenix Project, which was founded at the end of the Second World War as a memorial to those from the University who lost their lives during the war, and is dedicated to the peaceful use of nuclear energy.

As part of our establishment of the Phoenix Memorial Energy Institute, the University is organizing this two-day symposium to bring together many influential people from government, industry, and academia to present their views on science, technology, and policy topics in the energy field.

KEYNOTE ADDRESS

- **Samuel W. Bodman**
U.S. Secretary of Energy

SPEAKERS INCLUDE:

- **Dennis N. Assanis**
University of Michigan
Advanced powertrains
- **Rosina M. Bierbaum**
University of Michigan
Climate change science and policy
- **J. Christopher Brown**
DTE Energy
Addressing consumer needs
- **Lawrence D. Burns**
General Motors
Transportation options

- **John R. Dearborn**
Dow Chemical
Challenges for the chemical industry
- **James J. Duderstadt**
University of Michigan
Energy policy
- **Stephen R. Forrest**
University of Michigan
Indoor lighting
- **Kenneth Keegstra**
Michigan State University
Biofuels
- **Gregory A. Keoleian**
University of Michigan
Energy sustainability metrics
- **Nathan S. Lewis**
California Institute of Technology
Sustainable energy technology
- **Thomas P. Lyon**
University of Michigan
Carbon constraints and energy investment
- **William McDonough**
William McDonough + Partners
Design for sustainability
- **Ernest J. Moniz**
Massachusetts Institute of Technology
Nuclear options
- **Margo T. Oge**
Environmental Protection Agency
Energy and pollution
- **James E. Rogers**
Duke Energy
Fuel diversity for utilities
- **Gerhart Schmidt**
Ford Motor Company
Environment and energy security
- **Daniel Sperling**
University of California-Davis
New fuels and vehicles
- **Levi T. Thompson**
University of Michigan
Hydrogen technologies
- **Gary S. Was**
University of Michigan
Energy research at U-M

ANALYSIS OF RESEARCH FUNDING FORECASTS NEW CHALLENGES

Challenging times are ahead for researchers seeking funding for their ideas, according to an examination of national and U-M trends in research support. The recent Congressional decision to freeze nearly all domestic spending (see View from Washington, page 20) puts the squeeze on research-dollar hungry universities. However, even if the FY 2007 budget had been enacted as originally envisioned, research universities would still end up competing for a research pie that isn't growing as much as their collective appetite.

The one program in the proposed budget that will probably be missed most are the likely budget increases associated with the American Competitiveness Initiative (ACI) for agencies such as the National Science Foundation (NSF), Department of Energy (DOE), and National Institute of Standards and Technology in the Department of Commerce. The ACI proposal calls for doubling the budgets of these agencies over ten years. Many universities, including U-M, are waging an aggressive campaign along with our corporate partners to reinstate these increases in FY 2007 to enable U.S. higher education to fulfill its promise to promote global economic competitiveness. Other planned growth in the now-suspended FY 2007 budget proposal included new funds for Department of Defense weapons development and NASA space vehicle development.

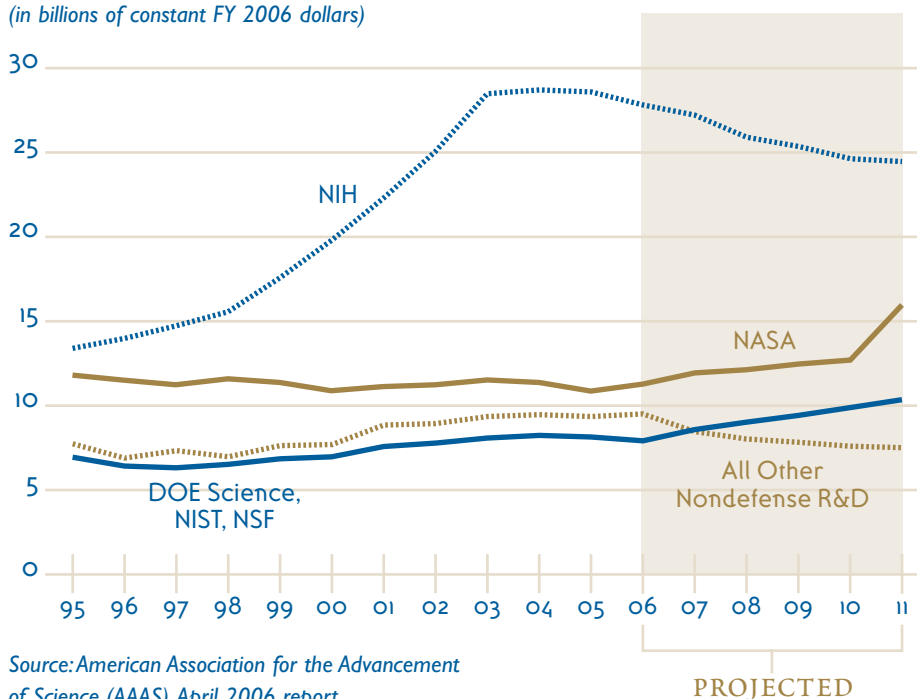
The recently approved National Institutes of Health (NIH) "reauthorization" bill, will, among other things, require NIH to provide more detailed reports on its research plans and progress in studying specific diseases. It also calls for a cap on NIH budget increases at 6 percent in FY 2007 and 8 percent in FY 2008. Furthermore, Congress did not support a request to assign a portion of any NIH funding increases for interdisciplinary research as outlined in the "Roadmap for Medical Research" initiated by 2003 by the NIH director. As most biomedical researchers know from the markedly increased difficulty in securing NIH funding, the agency's budget has become virtually flat since the "doubling" period ended in FY 2003. In fact, when adjusted for inflation, the NIH budget has actually declined the last few

years, just as U-M and many other campuses have enlarged their life sciences and biomedical research facilities and increased the number of investigators.

Looking at the long-term trend, as indicated in Table 1 showing the impact of the proposed non-defense President's R&D Budget, FY 2006-2011, there is no question that, despite the potential budget increases in DOE, NSF, and NIST, we are faced with a relatively flat or declining federal source for research funding. While many universities are looking for ways to optimize funding from other sources such as industry and foundations, trends in industry funding for universities also appear flat; while foundation funding, such as that from the Gates Foundation, are very specific in their targets for growth.

TABLE 1: PROJECTED NONDEFENSE R&D IN THE PRESIDENT'S BUDGET, FY 2006-2011

(in billions of constant FY 2006 dollars)



Source: American Association for the Advancement of Science (AAAS), April 2006 report

Reviewing research U-M expenditures for FY 2006 (Table 2), Michigan shows a very modest rate of overall growth at 2.4 percent, which is the same rate of growth as for our federal sponsors. The strongest gains in the federal arena have been in HHS expenditures, which represent 50 percent of our federal funds. HHS research spending increased 7 percent in FY 2006 in contrast to non-federal funds, which declined 6.5 percent while comprising 11 percent of total U-M expenditures. This decline in non-federal expenditures stems from downturns in industry and foundation funding, as these arenas continue to become more competitive. The University, continuing a long tradition, provides strong internal support for research; research spending from U-M sources increased 10.5 percent and represents 15.2 percent of our total expenditures.

Overall U-M continues to be a strong research force on the national level. As long as the schools, colleges, and OVPR continue to look for new ways to support faculty efforts in securing traditional federal support, as well as in reaching out to industry and foundations, Michigan should remain competitive. Clearly, the challenges will grow, and some predict that the continuing pressure to foster economic growth through the research engine of U.S. academe will require new sources of federal funds. However, pressures on the Congressional budget from domestic non-discretionary “entitlements,” the ever-increasing costs related to the U.S. presence in the Middle East, and the concern with terrorism at home and abroad may limit the potential for a large infusion of new federal funds. As always, the key to success will be the entrepreneurial efforts of our world-class faculty supported by an effective research infrastructure. *S&D*

—Marvin G. Parnes, Associate V.P. for Research; and Executive Director, Research Administration

TABLE 2: RESEARCH EXPENDITURES BY SOURCE OF FUNDS

	FY 2005	Percent of total	FY 2006	Percent of total	Percent change
FEDERAL SOURCES					
<i>National Institutes of Health</i>	362,368,568	46.6%	388,341,125	48.7%	7.2%
<i>Other Health and Human Services</i>	13,668,334	1.8%	13,917,666	1.7%	1.8%
<i>National Science Foundation</i>	68,062,430	8.7%	63,663,033	8.0%	-6.5%
<i>Department of Defense</i>	59,938,908	7.7%	52,241,692	6.6%	-12.8%
<i>Energy</i>	19,242,840	2.5%	17,569,419	2.2%	-8.7%
<i>N.A.S.A.</i>	16,732,514	2.2%	16,635,867	2.1%	-0.6%
<i>Transportation</i>	9,480,253	1.2%	6,917,453	0.9%	-27.0%
<i>Commerce</i>	5,077,822	0.7%	6,289,628	0.8%	23.9%
<i>Education</i>	5,336,965	0.7%	5,411,580	0.7%	1.4%
<i>Environmental Protection Agency</i>	2,447,804	0.3%	2,933,752	0.4%	19.9%
<i>Social Security Administration</i>	2,018,663	0.3%	2,404,122	0.3%	19.1%
<i>Justice</i>	1,664,471	0.2%	1,494,572	0.2%	-10.2%
<i>Other Federal</i>	5,468,762	0.7%	7,411,546	0.9%	35.5%
Total Federal Government	\$571,508,335	73.5%	\$585,231,455	73.4%	2.4%
NON-FEDERAL SPONSORS					
<i>Industry</i>	34,702,641	4.5%	33,585,188	4.2%	-3.2%
<i>Foundations</i>	19,902,948	2.6%	18,124,274	2.3%	-8.9%
<i>Universities & Gifts</i>	7,774,819	1.0%	7,582,775	1.0%	-2.5%
<i>Public Charities</i>	10,745,800	1.4%	10,549,039	1.3%	-1.8%
<i>State of Michigan</i>	12,136,369	1.6%	9,790,688	1.2%	-19.3%
<i>Endowment</i>	4,849,532	0.6%	4,837,267	0.6%	-0.3%
<i>Trade and Professional Associations</i>	6,810,927	0.9%	5,597,769	0.7%	-17.8%
<i>Other</i>	224,416	0.0%	733,982	0.1%	227.1%
Total Non-Federal Sponsors	97,147,452	12.5%	90,800,982	11.4%	-6.5%
TOTAL SPONSORED RESEARCH					
	\$668,655,787	85.9%	\$676,032,437	84.8%	1.1%
UNIVERSITY OF MICHIGAN FUNDS					
	109,405,940	14.1%	120,932,949	15.2%	10.5%
TOTAL RESEARCH EXPENDITURES					
	\$778,061,728	100.0%	\$796,965,386	100.0%	2.4%

Source: U-M Division of Research Development and Administration

ON YOUR LAPTOP, ANYTIME, ANYWHERE

Couch potatoes are freed from their couches now that Zattoo, a start-up company based on University of Michigan technology, is providing broadcast television on a computer. The service is currently available only in Switzerland, but when Zattoo expands its offerings around the globe, anyone will be able to watch TV anywhere you can connect to the internet—in a fast food outlet, at the airport, in your office.

Zattoo is “peer-to-peer” internet protocol television—or “P2P IPTV” in the shorthand of computerdom. It is a live video streaming protocol but without the halting and skipping and other quality issues that plague much video on the internet. Unlike the brief clips that make up most web video, Zattoo offers television while it is being broadcast, just as if you were tuning in on a TV set.

Zattoo was created by Sugih Jamin, U-M associate professor of computer science; research assistant Wenjie Wang; and several U-M undergraduate students. “The Zattoo technology actually began seven or eight years ago as a research project,” Jamin explains. “Initially, it was used to broadcast university conferences.” Now it could be used to watch TV on your laptop in your dorm room without disturbing your roommate, he says.

In March of 2005, Jamin and his longtime friend, Beat Knecht, decided to bring the technology to market. The start-up company obtained an exclusive license from the University for the source code. The Office of Technology Transfer aided the company by introducing the Zattoo team to venture capitalists and other start-ups in the Ann Arbor area. Student interns from the U-M Ross School of Business also worked with the fledgling company.

Knecht, who has an MBA and experience with several companies, provided a solution to a problem that bedevils many start-ups—finding the business expertise needed to run the company.

Jamin took a year-long leave to get the company off the ground, but has returned to the faculty and now juggles his University responsibilities with his position as chief technology officer of Zattoo. “I oversee the general direction of the technology development, but leave the day-to-day work to the programmers,” he explains.

Zattoo kicked off its broadcasting with the kick-off of the soccer World Cup tournament in June 2006. Now the company is adding channels and expanding its service to countries throughout Europe.

Unlike existing broadcasts where every few minutes the user must click to continue to choose content, Zattoo shows the live broadcast continuously just as a regular TV broadcast. It is possible to change channels just by clicking a new “button” on screen, and the delay to start the new video is a mere few seconds.

Content owners license their programs to Zattoo, which uses its peer-to-peer technology to deliver it to computer users. Peer-to-peer means that each user connected into the service rebroadcasts a bit of the stream to other users. That can greatly reduce network and server costs to provide the programming.

For broadcasters, the cost of adding new viewers will remain consistently low no matter how many viewers join a stream. With traditional web broadcasting, if you have 100,000 users, you need to send 100,000 copies. With Zattoo, you reduce that by a factor of ten, says Jamin. To serve 100,000 users, you need only 10,000 copies.

In its “teething” stage, says Jamin, Zattoo is currently free of charge. Eventually Zattoo may provide a basic package of free content, with premium packages for a fee and perhaps some pay-per-view events.

Zattoo is based in Ann Arbor, with corporate offices in San Francisco and Zurich, Switzerland. The Zattoo website is at www.zattoo.com. **S&D**



TECH TRANSFER PROGRESS CONTINUES

The University of Michigan's technology transfer program continues to grow at a healthy rate. The data for fiscal year 2006 tallied 288 new invention disclosures, nine business startups, and 97 license agreements. U.S. Patent applications for U-M inventions rose slightly over last year to 136, and 79 patents were issued.

The royalties and sale of equity in FY 2006 generated \$20.4 million in revenues for the University, up 22 percent from \$16.7 million the previous year. These funds were shared by the inventors, their departments, schools and colleges, and central administration.

More than 600 U-M inventors participated in technology transfer activities during the year.

"The quality and diversity of research at the University of Michigan provides great strength to our institution and to our region," said Stephen R. Forrest, U-M vice-president for research.

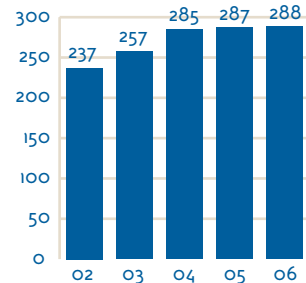
The nine new companies bring the total number of U-M startups launched over the last five years to 43, more than half of which are businesses headquartered in Michigan, primarily in the greater Ann Arbor area.

"We're very proud of this performance as it indicates the quality of our research discoveries and the capabilities of our inventors, industry partners, and tech transfer staff," said Ken Nisbet, executive director of U-M Tech Transfer. "The creativity, talent, and resources of the University of Michigan are playing a significant role in the transformation of our Michigan economy and enhancing our quality of life." [S&D](#)

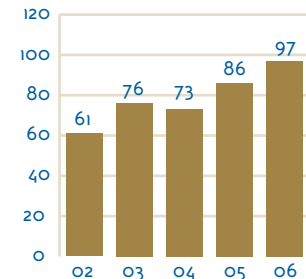
Start-Ups Launched in FY 2006

- **MedSpoke**
Organ transplant information system
- **Cielo MedSolutions**
Software and IT services to primary care health providers
- **SensiGen**
Diagnostic to detect early kidney disease
- **Compendia Bioscience**
Molecular oncology tools, data, and analysis software
- **Zattoo**
Global virtual cable network bringing live TV to the Internet
- **NanoMag**
Grain refinement technology for magnesium and other metals
- **CastAnalysys**
Fly casting training aid using MEMS gyros and software
- **Pipex**
Developing treatments for neurologic, fibrotic, and inflammatory diseases
- **Cyclos Semiconductor**
Ultra-low power semiconductor chips

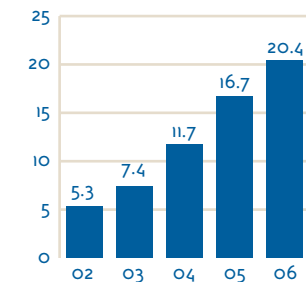
Invention Disclosures



License Agreements



License Revenue (in millions of dollars)



(from royalties and equity sales)

U-M Technology Transfer Five-Year Cumulative Data

1,354	Disclosures
393	License/Option Agreements
656	U.S. Patent Applications
353	U.S. Patents Issued
43	Start-Ups Launched
\$63.6 M	Revenues (royalties and equity sales)

Source: U-M Office of Technology Transfer

2006 ELECTIONS BRING NEW OPPORTUNITIES AND CHALLENGES TO THE FEDERAL RESEARCH AGENDA

The Democratic Party won control of the U.S. Senate and House of Representatives last fall for the first time in 12 years. This change ushers in new priorities in 2007—priorities that are likely to affect the research goals and concerns of the University of Michigan community.

As the 110th Congress convenes in January, the new committee rosters are expected to impact research university interests. For example, Michigan's own Senator Carl Levin and Representative John Dingell will return to the chairmanships of powerful committees that they held before the Republican Party gained majority control of Congress in 1994. Senator Levin will lead the Senate Armed Services Committee, which plays a significant role in defense research policy and in efforts to strengthen the Department of Defense's science, math,

As chair of the Energy and Commerce Committee, Congressman Dingell will oversee the stem cell research debates expected early in 2007 in the House of Representatives. The election has created a more supportive environment in Washington for advocates of stem cell research. Newly-designated Senate Majority Leader Harry Reid (D-NV) has made funding this research one of his top priorities for 2007—guaranteeing a high profile for this issue. However, the change brought on by the election may move the debate forward only so far. Support within Congress is still insufficient to overcome a presidential veto of any legislation to expand federal funds for human stem cell research.

Climate change and energy policy also will be examined in a different light by the new Congress. Members of both the House and the Senate leaderships are planning to spotlight these issues with hearings starting in January, along with legislation to curb greenhouse gas emissions and to encourage development of alternative energy sources. Within these bills, provisions on emissions technology and energy research and development—especially in the area of biofuels—can be expected in the coming months.

In some areas vital to university-based research, little change may be seen. Recipients of funding from the National Institutes of Health (NIH) are likely to continue to witness little growth in the agency's budget. The NIH Reauthorization Act, passed the last hours of the 109th Congress, authorizes increases of up to 6 percent for FY07 and 8 percent for FY08. However, the actual dollar amount that the NIH will receive will probably be smaller than these percentages.

Furthermore, to address the unfinished FY07 appropriations bills left behind by the previous Congress, the newly appointed chairmen of the House and Senate appropriations committees have announced that they plan to freeze all funding for domestic federal programs at the FY06 levels for a year. The NIH and other agencies such as the National Science Foundation, NASA, NOAA, and the Department of Energy's Office of Science fall under the category of agencies that may see their budgets frozen. This freeze, if agreed to by the other members of Congress and the White House, will postpone plans for any new programs and changes to currently existing ones until the end of 2007.

White House Office of Management and Budget Director Rob Portman has stated in response to the plan that "while it is not our preference to have a year-long continuing resolution, we will certainly work with the agencies and the Congress to ensure there are no major disruptions to essential government services. Should there be a long-term continuing resolution, the Administration would want to assure we maintain fiscal discipline and avoid gimmicks and unwarranted emergency spending."

The plan also eliminates all FY07 money for earmarks and would place a moratorium on all earmarks until reforms are in place. In a press release, the two chairmen explain that this decision was made "to restore an accountable, above-board, transparent process for funding decisions and put an end to the abuses that have harmed the credibility of Congress." Debate of this plan and the future of earmarks is likely to be one of the first fights at the start of the new Congress and could set the tone for the next two years. **S&D**

—Sarah Walking, Director of Federal Relations for Research and Assistant Director of the U-M Washington D.C. Office



NATIONAL INSTITUTE OF HEALTH

and languages graduate fellowship program. Representative Dingell will chair the House Energy and Commerce Committee. This influential House committee oversees legislation on topics ranging from health policy to climate change and U.S. energy policy.

RESEARCH NOTES

Reactor Decommissioning Proceeding, But Doesn't End Energy Research

The blue glow from the nuclear reactor pool will be no more. The radioactive fuel is gone, as is the pool's water. After a service life of nearly 50 years and more than 200,000 hours of operation, the removal of the Ford Nuclear Reactor (FNR) is proceeding on pace to be complete by summer.

The University of Michigan became one of the first universities to house a nuclear reactor with the construction of

the Ford Nuclear Reactor in 1955, as a companion to the Michigan Memorial Phoenix Project. The Phoenix Project was dedicated to the peaceful use of nuclear energy, and served as a living memorial to U-M faculty, staff, and students who lost their lives during World War II. The reactor, constructed with a generous gift by the Ford Motor Company, has been used for research and education, supporting a range of experiments that require materials to be irradiated. Over the years, the FNR facility has been used to advance nuclear science and engineering and has contributed to the advancement of knowledge in fields such as medicine, anthropology, and geology.

In 2000, the U-M leadership studied the costs and benefits associated with the continued operation of FNR, and they concluded that the time had come to decommission the reactor. But even while this planning was taking place, another group on campus soon began laying the groundwork for a new energy initiative, which resulted in reviving the Phoenix Project as the Michigan Memorial Phoenix Energy Institute. Last fall, the Institute was formally established and its first director named. You can read a Q&A with Director Gary Was in this issue of *Search & Discovery*.

One of the big milestones in the decommissioning was removing the radioactive fuel from the reactor. That was accomplished in July 2003, thus ending the FNR operations. (Since first "going critical" in 1957, the FNR operated for a total of 218,995 hours.)

A committee of campus and external experts created the decommissioning plan, which detailed the engineering and regulatory steps that would be needed to complete the safe disassembly and disposal of the reactor, as required by federal regulation and law. In July of 2006 the U.S. Nuclear Regulatory Commission

approved Michigan's decommissioning plan allowing the process to commence.

With the assistance of several outside contractors, the materials made radioactive by the operation of the reactor were disassembled. Many of these items had to be cut into pieces to fit into one of the two shielded containers that were then shipped to the licensed disposal facility in Barnwell, South Carolina. Another contractor has been employed to remove the 30-foot long, 10-foot wide, and 28-foot deep reactor pool.

This process employs diamond wire saws to cut the cement pool into about 90 fifteen-ton blocks, which will be removed and shipped for burial at the licensed disposal facility in Clive, Utah. As of December 2006, more than 99 percent of all the radioactive materials at the reactor site has been removed. By summer 2007, the remaining one percent will be removed. Then a detailed assessment of the site will be performed to confirm that the cleanup is complete. Finally, the U.S. Nuclear Regulatory Commission will review the decommissioning activities as well as conduct its own surveys to confirm the absence of any contamination. This last step may take two to three years so that in 2010, the University expects to receive approval to begin using the site of the FNR for another use. [S&D](#)



IMAGE OF THE CORE OF THE FORD NUCLEAR REACTOR. PHOTO BY MARTIN VLOET.

Bolcom Wins National Medal of Arts

University of Michigan Music School professor and acclaimed composer William Bolcom was honored with the National Medal of Arts for his “significant and enduring contributions to the nation’s cultural life” at a White House ceremony on Nov. 9, 2006.

Bolcom is one of ten Americans who received the nation’s highest public artistic honor, given annually to those who have demonstrated a lifetime of creative excellence, according to the National Endowment for the Arts (NEA), which oversees the selection of the recipients.

“It’s a privilege and deep honor to be considered alongside many artists whose work I admire and who’ve contributed greatly to American culture,” says Bolcom, who received the Pulitzer Prize

in 1988 for “12 New Etudes for Piano” and three Grammy Awards in 2006 for his composition of “Songs of Innocence and Experience,” inspired by the writings of English poet William Blake.

Throughout his career, Bolcom, a pianist, has attracted critical acclaim for the performance and recording of his work. He and his collaborator and wife, Joan Morris, have recorded 20 albums, specializing in show tunes, cabaret, and popular songs from the early 20th century. He has received two Guggenheims, four Rockefeller Foundation awards, and four NEA fellowships. Since the fall of 1994, Bolcom has held the title of Ross Lee Finney Distinguished University Professor of Composition at U-M. He joined the faculty in 1973.

Past National Medal of Arts recipients with U-M ties include two alumnae, playwright Arthur Miller and actor James Earl Jones.



“With the National Medal of Arts award, Bill Bolcom joins a Who’s Who list of American artists,” says President Mary Sue Coleman. “While working on his compositions and performances that have distinguished him as being among the top echelon of international artists, Bill continues to inspire students, teaching them about the vital connection between art and bringing joy to audiences.” **S&D**

UMTRI Helps Drivers Avoid Crashes

The University of Michigan Transportation Research Institute (UMTRI), along with the U.S. Department of Transportation and partners such as Honda, Cognex, Eaton, Battelle, Visteon, and the Michigan Department of Transportation, has been engaged for several years in the development and evaluation of several warning systems to help drivers avoid crashes. Recently UMTRI was awarded \$25 million by the U.S. Department of Transportation to further develop and evaluate these technologies. Along with its partners and an additional \$6.6 million in cost-share funding, UMTRI will develop and test a new, integrated crash warning system in a fleet of passenger cars and heavy-duty trucks to be evaluated by a representative sample of drivers.

The program, Integrated Vehicle-Based Safety Systems Program Field Operational Test, will help address the crash types that account for approximately 67 percent of all motor-vehicle crashes in the United States. The pro-

gram will develop integrated, advanced technologies that will warn drivers when they may be about to leave the roadway, are in danger of colliding with another vehicle while attempting a lane change, or are at risk of colliding with the vehicle in front of them. The system employs a variety of sensors, including radar, image processing, and global positioning data, to determine the relationship between an equipped vehicle and the roadway environment.

In a soon-to-be-published UMTRI report from a similar program, the Road Departure Crash Warning Field Operational Test, there are significant new findings regarding the ability of one of these crash warning systems to reduce the frequency and amount of time drivers spend outside of their own lane. Analyses have shown that lane-departure warning systems have the potential to reduce the incidence of drifting out of



the lane by 50 percent. Such lane departures can lead to one of the most fatal crash types, single-vehicle road departures, where vehicles frequently collide with fixed objects such as trees. Along with a wide variety of efforts currently underway at UMTRI to help drivers avoid and survive crashes, this form of research builds upon UMTRI’s growing strength in the naturalistic measurement of driver behavior (including driver use and acceptance of new technologies) and leads toward an ultimate goal of a “science of driving.” **S&D**

New Resource for UM-China Research Collaborations

While China emerges as a global power of commerce and politics in the 21st century, the University of Michigan continues to strengthen its leadership position in research on China and with Chinese partners. In almost all disciplines and fields, U-M researchers are engaged in highly collaborative and groundbreaking projects with their Chinese counterparts.

Following President Mary Sue Coleman's trip to China in 2005, during which the U-M entered into a series of cooperative agreements with Chinese universities, Jen Zhu was named the University's first China Initiatives Coordinator. One of Zhu's key tasks is the creation and maintenance of a catalogue of China programs and activities at U-M. This frequently updated inventory helps U-M researchers share information and strategies regarding their existing and potential projects, and it serves to inform the entire University community of the breadth of these commitments. Additionally, Zhu is responsible for researching Chinese academia and identifying additional partnership opportunities for U-M and Chinese institutions.



A searchable database of China-related research projects will be posted on the web by mid 2007. To inquire about the inventory of UM-China activities or to contribute entries, please contact Jen Zhu at zzhu@umich.edu. [S&D](#)

A searchable database of China-related research projects will be posted on the web by mid 2007. To inquire about the inventory of UM-China activities or to contribute entries, please contact Jen Zhu at zzhu@umich.edu. [S&D](#)

Four Faculty Elected to Institute of Medicine

Four members of the University of Michigan faculty are among 65 new members elected to the Institute of Medicine (IOM) of the National Academies, a prestigious honor for researchers in medical sciences, health care, and public health.

The University's new members of the IOM are:



John D. Birkmeyer, M.D., is the George D. Zuidema Professor of Surgery at the University of Michigan Medical School, and director of the Michigan

Surgical Collaborative for Outcomes Research and Evaluation Center. Birkmeyer is a national leader in surgical outcomes research, quality, and health policy with a particular interest in strategies for measuring and improving surgical quality. With funding from the National Cancer Institute, his current research is exploring why some hospitals and surgeons have better outcomes than others, with the ultimate goal of improving care in all settings.



Michael Boehnke, Ph.D., is the Richard G. Cornell Collegiate Professor of Biostatistics and director of the University of Michigan Center for

Statistical Genetics and Genome Science Training Program. Boehnke's research focuses on problems of study design and statistical analysis of human genetic data, with a particular emphasis on the development and application of statistical methods for human gene mapping. He is active in studies of the genetics of type 2 diabetes, schizophrenia, bipolar disorder, glaucoma, and several other eye diseases.



Martha L. Ludwig, Ph.D., was a research biophysicist and the J. Lawrence Oncley Distinguished Professor in the Department of Biological Chemistry.

She passed away in November, 2006. Ludwig was a structural biologist, using x-ray crystallography to study enzyme specificity and catalysis, especially among proteins that require metals or vitamin-based co-factors to do their work. Many of the enzymes that she studied change shape during catalysis or alter their structures in the process of molecular recognition, making the analysis much more difficult.



Catherine G. McLaughlin, Ph.D., is a professor in the Department of Health Management and Policy and director, Economic Research Institute

on the Uninsured, at the School of Public Health. McLaughlin's work concerns health care policy and access to health care. The Economic Research Initiative on the Uninsured, which she directs, seeks to initiate, commission, and disseminate original research to spark new discussions on health coverage issues. She is vice chair of the Citizens' Health Care Working Group, created to talk to citizens nationwide and submit recommendations to Congress and the President. And she is a member of the board of trustees for the American Hospital Association's Health Research and Educational Trust. [S&D](#)

OFFICE OF
THE VICE PRESIDENT
FOR RESEARCH

4080 Fleming Building
503 Thompson Street
Ann Arbor, MI 48109-1340



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CONTACTS

Stephen R. Forrest

Vice President for Research
734/764-1185, stevefor@umich.edu

James A. Shayman

Associate Vice President
734/936-2680, jshayman@umich.edu

Steven L. Ceccio

Associate Vice President
734/936-3933, ceccio@umich.edu

Marvin G. Parnes

*Associate Vice President and
Executive Director for Research
Administration*
734/936-3933, mgparnes@umich.edu

Judith A. Nowack

Associate Vice President
734/763-1289, jnowack@umich.edu

Sarah K. Walking

*Director of Federal Relations
for Research & Assistant Director,
U-M Washington Office*
734/764-1185; 202/554-0578,

Curt W. Smitka

Director, Budget & Administration
734/936-2681, cwsmitka@umich.edu

RESEARCH UNITS

Biophysics Research Division (BRD)
James E. Penner-Hahn, Director
734/764-5258, jeph@umich.edu

*Center for Human Growth
and Development (CHGD)*
Daniel P. Keating, Director
734/764-2443, keatingd@umich.edu

*Institute for Research
on Women and Gender (IRWG)*
Carol J. Boyd, Director
734/614-6468, caroboyd@umich.edu

*Magnetic Resonance
Imaging Facility (fMRI)*
John Jonides, Co-Director
734/764-0192, jjonides@umich.edu
Douglas C. Noll, Co-Director,
734/764-9194, dnoll@umich.edu

*Michigan Memorial Phoenix
Energy Institute (MMPEI)*
Gary S. Was, Director
734/763-4675, gsw@umich.edu

*U-M Transportation
Research Institute (UMTRI)*
Peter F. Sweatman, Director
734/764-6505, sweatman@umich.edu

ADMINISTRATIVE/ SERVICE UNITS

*Business and Industrial
Assistance Division (BIAD)*
Marian J. Krzyzowski, Director
734/998-6201, mjsk@umich.edu

*Center for Statistical Consultation
and Research (CSCAR)*
Edward D. Rothman, Director
734/763-2052, erothman@umich.edu

*Division of Research Development
and Administration (DRDA)*
Marvin G. Parnes, Executive Director
734/936-3933, mgparnes@umich.edu

*Institutional Review Boards (IRBs)—
Behav-Sci and Health*
James A. Shayman, Director
734/936-2680, jshayman@umich.edu
IRB office: 734/936-0933,
irbhsbs@umich.edu

*Office of Human Research
Compliance Review (OHRCR)*
Ronald F. Maio, Director
734/647-0489, ronmaio@umich.edu

Office of Technology Transfer (OTT)
Kenneth J. Nisbet, Executive Director
734/763-0614, knisbet@umich.edu

*Unit for Laboratory
Animal Medicine (ULAM)*
Howard G. Rush, Director
734/764-0277, hgrush@umich.edu

*Women in Science
and Engineering (WISE)*
Cinda-Sue Davis, Director
734/647-7012, 734/615-4455,
csdavis@umich.edu

INCUBATOR UNITS

*Core Technology Alliance (CTA)
of the Michigan Life Sciences Corridor*
George F. Vande Woude, Interim
Executive Director
734/615-5045, bkissel@umich.edu

Hydrogen Energy Technology Lab (HETL)
Levi Thompson, Director
734/936-2015, ltr@umich.edu

Imagining America
Julie Ellison, Director
734/615-8370,
imaginingamerica@umich.edu

*U-M Substance Abuse Research
Center (UMSARC)*
Margaret E. Gnegy, Director
734/998-6500, pgnegy@umich.edu