Spring 2008

Spring 2008

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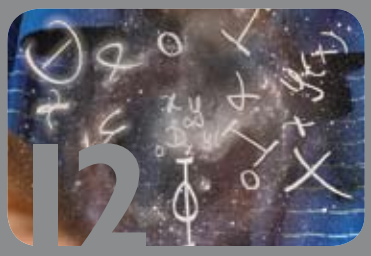

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perspectives

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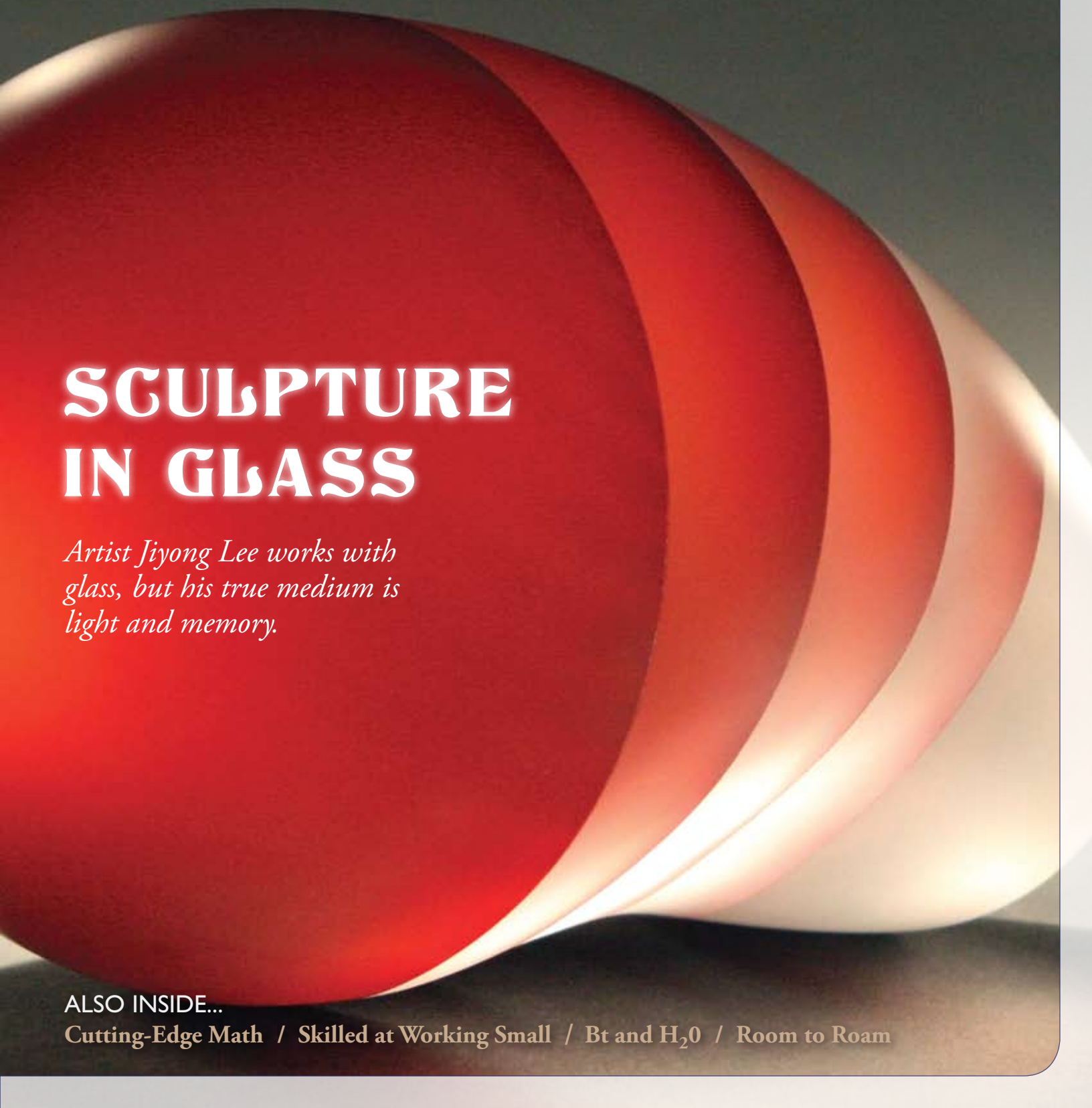
RESEARCH and CREATIVE ACTIVITIES



SCULPTURE IN GLASS

Artist Jiyong Lee works with glass, but his true medium is light and memory.

ALSO INSIDE...

Cutting-Edge Math / Skilled at Working Small / Bt and H_20 / Room to Roam

outlook

Every major research institution—and this university is no exception—has clusters of interdisciplinary research activity that draw attention and grant funding. The last issue of *Perspectives* focused on SIUC's research strength in the neurosciences.

Articles in this issue highlight SIUC's continuing research excellence in the fields of energy and the environment, materials science, and biotechnology. This issue also features another area of interdisciplinary activity—the new Center for Delta Studies that focuses on research and outreach to the people of the Delta Regional Authority. This federally designated area, which includes 16 Southern Illinois counties and extends to Louisiana, needs solutions for problems of health care access, nutrition, employment, and other areas. The center will draw together members of the Delta community with experts from all across the SIUC campus, and those from other universities in the Delta region, to address these issues.

But research and creative strengths at SIUC come in many flavors. There is also beauty in endeavors that enrich our lives in other than pragmatic ways. Thus our cover story features the work of Jiyong Lee, who runs the renowned glass program in our equally renowned School of Art and Design.

Lee creates his sculptural pieces with the thoughts of a poet and the precision of a scientist, and he is teaching students here and at prestigious summer seminars how to find their own means of expression.

Ultimately, he and his colleagues in the arts epitomize the creative forces that drive faculty all across our campus to benefit society by pushing the boundaries of their disciplines.

John A. Koropchak
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COVER: "Seed of Life," by Jiyong Lee. 2007. Hot-sculpted, cut, color-laminated, carved glass.

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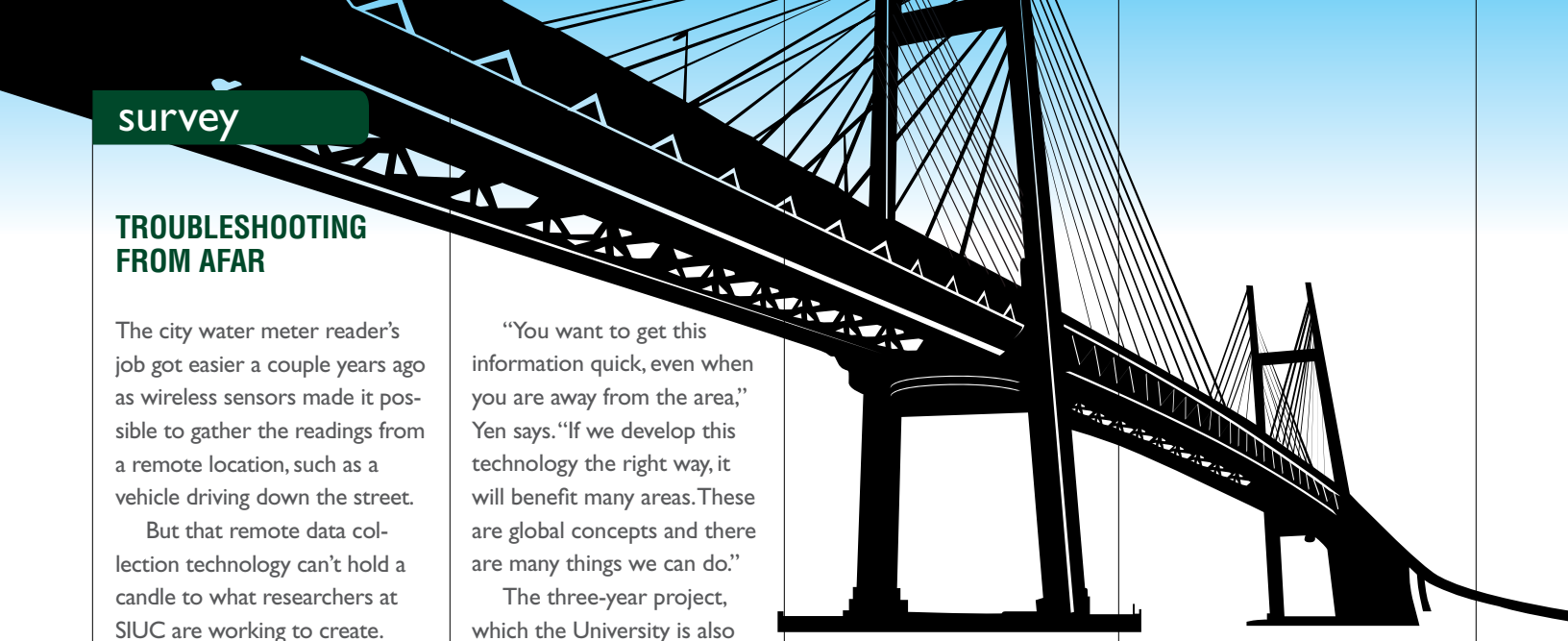


TROUBLESHOOTING FROM AFAR

The city water meter reader's job got easier a couple years ago as wireless sensors made it possible to gather the readings from a remote location, such as a vehicle driving down the street.

But that remote data collection technology can't hold a candle to what researchers at SIUC are working to create.

Engineers and scientists from several fields, working through SIUC's Materials Technology Center, recently received $1 million from the Federal Highway Administration's Intelligent Transportation Systems program to create a network of Internet-based wireless sensors and databases that can provide near real-time information about the structural soundness of transportation infrastructure, such as a bridge.

Shing-Chung "Max" Yen, the center's director, says the system will combine an integrated sensor network with wireless technology and powerful data analysis tools that potentially would improve transportation safety and efficiency. Engineers also could apply similar systems to other situations, such as security systems and environmental monitoring.

"You want to get this information quick, even when you are away from the area," Yen says. "If we develop this technology the right way, it will benefit many areas. These are global concepts and there are many things we can do."

The three-year project, which the University is also committing $1 million to in terms of faculty release time and other subsidies, will involve several faculty from various engineering and science-related departments, including civil and environmental engineering, chemistry and biochemistry, and electrical engineering. Undergraduate and graduate students also are playing a role in the research.

The team first will focus on creating and applying the system to a footbridge on campus to test ideas. Eventually they will work with the Illinois Department of Transportation to wire an actual vehicle bridge somewhere in Southern Illinois.

The idea involves placing different kinds of sensors that can detect variables such as stresses, elongation, deformation, and rotation, at key points on the structure. The researchers will connect the sensors to wireless transmitters, each set up as their own Internet address, which will then send data to a server off-site. The researchers will download that data to a Web site for analysis.

The sensors must not only transmit data about how the structure is behaving, but must also crosscheck each other to ensure the data is reliable. For example, the sensors should show the effects of damage to a bridge at the point of damage, but sensors farther away might also validate those effects by signaling that the bridge's structure is compensating for that damage elsewhere.

Only then do the sensors become a true network and really begin telling the story of the structure's health, creating what Yen calls the structure's "signature."

Some of the sensors may use nanoelectronics to pick up minute signs of deterioration, allowing engineers to prevent a much bigger problem down the line.

One of the biggest challenges the researchers face, however, is fast, accurate analysis of what promises to be a huge amount of incoming data. Without that, the data is mostly useless.

A sizeable portion of the researchers' work, therefore, will go into compiling databases incorporating various parameters against which they can compare the new, incoming data from sensors. Because such databases are largely nonexistent, the researchers will build their own. They will use data they can apply from existing sets—such as corrosion data from the auto industry—along with their own predictions about how a particular bridge structure should react under different circumstances, based on past experience, actual examples, and computer models.

Such databases might include scenarios for how a bridge might react if it is damaged, if it receives faulty repairs that change its dynamics, or how those dynamics change as the bridge simply gets older.

"You have to be knowledgeable enough to know what your data means," Yen says. "You have to be able to tell what is reliable data and what is not. So you have to have a lot of databases.

"If an emergency comes up, we're looking for quick assessments. We don't have time to do computations. If you can do [quick assessments], there is still a chance to minimize the potential catastrophe."

Yen foresees a time when many bridges have their own performance record database on file that can be used, updated, and consulted as the structure ages and undergoes repairs and modifications. Depending on how successful the team is, Yen says the sensor network coupled with the powerful, layered databases will allow for much quicker diagnosis of structural problems with a bridge than civil engineers using traditional methods can perform. At the very least, the system would better indicate when a thorough, traditional evaluation is called for, making bridge inspections more efficient overall.

Eventually, such analysis may result in more efficient bridge design. Bridges are sometimes overbuilt to ensure safety over the estimated life of the structure. However, an overbuilt bridge may not be safer in the long run, says Yen. The SIUC research may indicate better ways to build safer, longer-lasting bridges.

Infrastructure is simply the selected proving ground for the new networked sensor system. It also could be applied to many other uses.

Security is an obvious possibility. Such a network could work in concert with ultra-sensitive sensors that "sniff" the air for chemicals emitted by methamphetamine labs or explosives, keeping the public and law enforcement out of harm's way. Ling Zang, associate professor of chemistry and biochemistry at SIUC, is working on such sensors and he will work on the transportation project as well, Yen says.

Such a system also could be installed in environmentally sensitive areas, such as in or around public water supplies, to give constant remote feedback and analysis and quickly pinpoint and warn of any contamination.

SIUC researchers have already developed several components of the planned system: a displacement sensor and a corrosion sensor, a data acquisition system to translate materials information (about deformation, for example) into digital format for transmission, and several radio-frequency–based communication systems.

Yen hopes the project also will help SIUC maintain an updated curriculum for engineering students, keeping them well prepared for the workplace after graduation.

"This project will allow us to exercise a real job situation and can help us influence the potential placement of our students," he says. "It will also help us with our curriculum. The engineering industry is changing and we also need to be changing."

—Tim Crosby

For more info: Dr. Max Yen, Materials Technology Center, myen@siu.edu.

Max Yen (center) with some of the students working on the wireless remote sensing project funded by the Federal Highway Administration. From left: Senior Adam Miller, doctoral student Oliver Yang, and junior Chris Williams. Faculty from several departments are contributing expertise to the project, which will be tested on a vehicle bridge in Southern Illinois.

MISSING VOICES

When an opinion poll and the actual results of a political primary vote don't coincide, SIUC sociology professor Darren Sherkat isn't surprised.

Sherkat's scholarship combines his interest in religion with his interest in quantitative methods and statistics. A recent article of his in the journal *Sociology of Religion* offers an explanation of why opinion polls don't accurately predict actual voting results.

"Religion and Survey Non-Response Bias: Toward Explaining the Moral Voter Gap Between Surveys and Voting" asserts that many popular opinion polls and surveys don't use scientific methods to ensure that their polls are representative of a given population. In addition, the constant demand for immediate, up-to-the-second information encourages the propagation of wrong information.

"We have lost our attention to high-quality data," Sherkat says.

One of the most slippery problems in obtaining accurate survey answers is accounting for biases created when particular groups of people refuse to participate in the study.

Sherkat's research indicates that religious affiliation and fundamentalist beliefs often play a role in political survey response—and non-response. In other words, religious factors not only affect an individual's political opinions, but also may affect that person's willingness to respond to a given political opinion survey.

In particular, Sherkat says, his study and others recently conducted by researchers at the Pew Research Center have found that political conservatives with a strong conservative religious orientation are more likely to refuse participation in political opinion surveys.

"A political opinion survey presented by a university, for example, can be seen by some religious conservatives as a liberal-biased survey because they perceive the university system as liberal-biased," he says. "As a result, they may not respond to the survey."

In turn, Sherkat notes, conservative boycotts of perceived liberal bias can cause those surveys actually to reflect a liberal bias, regardless of the survey-takers' intent. The result, as his research indicates, is that political conservatives in particular are often underrepresented in political opinion surveys.

"They feel embattled," he says. "Their response rates are far too low for accurate data in political opinion surveys….Political opinion surveys aren't a random sample of the population—they are at best a random sample of the population who cooperates with the survey."

—Andrea Hahn

For more info: Dr. Darren Sherkat, Dept. of Sociology, sherkat@siu.edu.

SOUPED-UP STYLE

You never know what the day's mail might bring.

For Carma Gorman, associate professor of art history and head of the academic area of the School of Art and Design, it was notification that the Organization of American Historians named her essay from *American Quarterly* one of the 10 best American history essays of the year.

The book, *The Best American History Essays 2008,* includes history articles published between the summers of 2006 and 2007 and provides an overview of the top work and important trends in the study of American history.

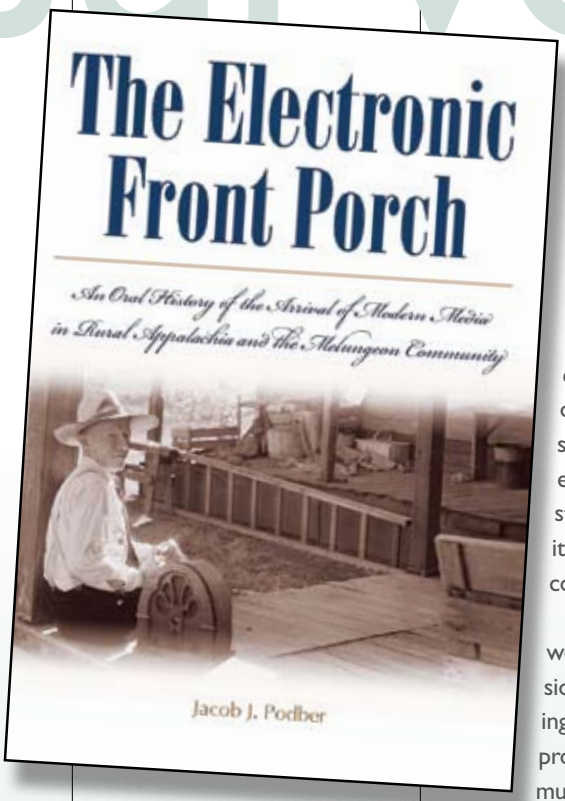
Gorman's essay—"Educating the Eye: Body Mechanics and Streamlining in the United States, 1925-1950"—seeks to explain why, after 1925, the products of "formerly artless industries," such as eyeglasses, typewriters, and automobiles, shifted from purely utilitarian to more streamlined and attractive models.

Gorman argues that consumers were not as passive in this process as most historical explanations suggest. She points to then-new trends in education, which, while they did not specifically address the appearance of utilitarian objects, emphasized "the personal and social importance of good form" and taught students to know it when they saw it.

One of these educational trends was, of all things, posture-training in gym class. Gorman points out that "body mechanics," a new component of the physical education curriculum beginning in the mid-1920s, trained students to appreciate a more streamlined form. She argues that middle- and upper-middle-class consumers were "primed by their schooling to expect bodies and products to conform to similar standards of beauty and efficiency."

—Andrea Hahn

For more info: Dr. Carla Gorman, School of Art & Design, cgorman@siu.edu.



RADIO DAYS

The best stories are sometimes near your doorstep.

While colleagues traveled to locales including Australia and Africa to conduct research, Jacob Podber chose a less-traveled route—roughly 30 minutes from his Ohio home—for a unique look at the arrival and impact of radio, television, and the Internet on rural Appalachia.

He traveled throughout Appalachia conducting interviews for his recent book *The Electronic Front Porch: An Oral History of the Arrival of Modern Media in Rural Appalachia and the Melungeon Community* (Mercer Univ. Press).

Podber, an associate professor in SIUC's Department of Radio-Television, hopes readers glean "the power of the media in creating community—in helping people feel a part of a community, with an identity and belonging."

And while there are theories that the media isolate communities and decrease social skills due to the amount of time that can be spent in front of the television or computer, the book also reflects the media's "great potential for bringing communities together," Podber says.

Podber began his work while a doctoral student in mass communication at the University of Ohio in Athens, which is in Appalachian Ohio. Podber said he realized he was living in a very underserved and underrepresented area of Appalachia. He decided to focus on how new media affected Appalachian communities over the years.

The book features 86 oral histories with recollections dating back to the introduction of battery-operated radios in the 1920s. Podber started by going to community centers and nursing homes, and found that a conversation with one person resulted in suggestions to talk with more people.

"Without their voices, this book would not have been possible," Podber says.

Many of the interviews deal with radio. Families were initially careful about when to use the radio because battery-operated sets required trips into town to recharge the battery. One story details how a wet-cell truck battery used to power a radio meant leaving the truck parked on a hill so it could be pushed in case the battery died.

Of course, listening habits changed dramatically once electricity became common. "Initially, they carefully planned what they would listen to because they knew the radio would only be running for a certain amount of time," Podber says. "But with electricity, they started leaving it on more as a companion."

The radio, as well as early television, reduced feelings of isolation and provided a community listening post for neighbors to gather and discuss the day's events. It fostered a greater sense of community identity, with people talking with pride about performers they knew who appeared on shows such as the "Grand Ole Opry." And it also offered a view to other parts of the country and world, and a realization of shared concerns and problems, Podber says.

Even with initial limited broadcast hours, early television had a similar impact on Appalachian communities. Gathering around a television with neighbors, family, and friends "became a major social event," Podber said.

Unlike radio, where Appalachian residents could easily find performers with whom to identify, the same was not true with early television, according to Podber. When popular shows such as "The Beverly Hillbillies," "Green Acres," and "Hee Haw" did appear, they often generated a mixture of ambivalent and contradictory responses, he says.

"We would sometimes laugh at the characters and other times…we wondered if other people thought we were that bad, if other people thought we were that way," one lady told Podber. "If they did, we felt... that this was very stereotypical."

In spite of the stereotypes, some people felt a connection with characters such as the Clampetts—viewing the characters and their value systems as similar to their own neighbors rather than "superstars on TV," another woman said.

Podber also takes a look at how the Internet is playing a pivotal role for the tri-racial Melungeon communities in northeastern Tennessee and southwestern Virginia. The people in these communities, with European American, Native American, and African American heritage, were often shunned. Through the use of Web sites and listservs, the group has reconstructed its image and expanded into a virtual community where thousands of people are able to reconnect to their heritage, Podber says. The Internet also proved to be a catalyst for an annual reunion that attracts people from around the region.

While there are critics, the electronic media have been empowering for these groups and Appalachia in general, Podber says.

—Pete Rosenbery

For more info: Dr. Jacob Podber, Dept. of Radio-Television, jacob@siu.edu.

ONE STEP AHEAD

Even before the latest techno-gizmo hits the consumer mainstream, Joseph Schafer is trying to figure out how it could be used to break the law.

Schafer, an associate professor with the Center for the Study of Crime, Delinquency, and Corrections, is part of the Futures Working Group, a collaboration between the FBI and the Society of Police Futurists International.

Schafer recently edited two national reports prepared by the FWG—"Policing 2020: Exploring the Future of Crime, Communities, and Policing" and "Policing and Mass Casualty Events." The general goal of both reports, he says, is "lengthening the horizon."

"We take the long view," he says of the approximately 30-member FWG. "We're trying to get people to look a little further."

The FWG focuses on how to take steps now to deal with crime and justice issues that will probably develop in the future. The group researches predictable trends to prepare countermeasures to foreseeable problems.

This kind of foresight involves much more than just second-guessing the criminally minded. For example, it's not enough to know that online social networks such as MySpace and Facebook are a mainstay of today's teen-age and college-age populations, Schafer says. It's also important to understand how these networks affect the perception of community, and what that means in practical terms.

"We've got people who spend more time online and feel closer to people halfway across the country or even in other parts of the world than they do to their actual physical neighbors," Schafer says. "It is a community, and for some people, their cyber identity is an important part of who they are."

It's also important to study demographic trends to prepare for other potential problems or significant shifts in a community. How is a given area likely to be affected by immigration, by a rise or decline in minority populations, by a change in the male-to-female ratio, by changes in the median age of the population? Answering such questions and getting a sense of how a community defines itself is particularly important, Schafer says, in this era of community policing.

"Policing and Mass Casualty Events" focuses on "big events that influence a lot of people and interrupt government services," Schafer says—events like hurricanes and wildfires.

Putting it simply, the researchers found that "bureaucratic approaches don't work particularly well" in emergency situations. That may seem obvious, with the problems of Hurricane Katrina so widely publicized. However, Schafer says, it is true on the microcosmic level of a community as well. And the solution isn't as simple as it might seem.

"Police officers are pretty well-conditioned to wait for orders," Schafer says. There is good reason for that. Police officers, and the municipalities they represent, have liability and civil liberty issues to consider.

A governing body doesn't want to be saddled with a lawsuit because a police officer exercised improper judgment—even during an emergency. Hence, Schafer says, handling emergencies cannot be about loosening authority, but rather about teaching police officers how to use discretionary authority.

"Officers use judgment on a daily basis—just not the type of judgment often needed in these types of situations," Schafer says. "Officers need to be better prepared to use their judgment properly in more extreme and unusual circumstances."

Generally, Schafer says, both issues—preparing for mass casualty events and policing for the future—require inquisitiveness.

"We need to be more curious," he says. "We need to think about the future and what we want it to look like. Then we have to look for a path and find a way to get there."

"Policing and Mass Casualty Events" is available at http://tinyurl.com/2udp32. "Policing 2020" is available at http://tinyurl.com/36n4at.

—Andrea Hahn

For more info: Dr. Joseph Schafer, Center for the Study of Crime, Delinquency, and Corrections, jschafer@siu.edu.

HARD-DRIVIN' SOY

With a few molecular tweaks, U.S. soybeans could help reduce America's need for foreign fuel oil.

Work going on now at SIUC's Illinois Soybean Center aims to produce an oilier bean designed specifically for the biodiesel industry. Using new, high-tech equipment to analyze the beans developed here, University researchers have discovered two genetic regions that, along with three others previously found, contain genes controlling as much as 10 percent of the beans' oil content.

Using technology to pinpoint the genes so breeders can include them in new breeding lines could boost beans' total oil content from 20 percent up to 30 percent. David Lightfoot, a biotechnologist heading that effort, anticipates SIUC will release its first biodiesel lines to breeders sometime in 2008.

Graduate student Charles Yesudas is working to increase the energy content of soybeans for biodiesel fuel.

But there's much more to the research than that. Some types of oil carry a lot more chemical energy than others do. Two polyunsaturated oils that do—linoleic and linolenic acids—have been reduced over the past 40 years or so by breeders because they give food an "off flavor" in cooking and don't stand up well to frying.

"That's because they're packed full of energy and ready to burn," Lightfoot says. "Major companies have eliminated almost all of [that type of] oil from their seed."

But higher-energy oil is exactly what you want in diesel fuel, he says.

Meanwhile, SIUC chemist Yong Gao, Lightfoot's partner on the project, is working on ways to keep soy-based fuels from freezing at low temperatures—a critical characteristic for biodiesel. Typical soy oils start to "gel" at temperatures too high for transportation use.

While beans grown for fuel may add a new market for crops, those soy cultivars may differ in yield from those grown for human and animal use. A plant that stores more energy in its beans may not produce as many beans as conventional cultivars do. To be economically feasible, Lightfoot says, the high-oil cultivars "have to be very high yielding, so we can't just go back to the beans of 40 years ago."

Farmers could compensate for lower yields by growing beans intended for the biodiesel market on less productive land. But perhaps they won't have to make that trade-off.

The University's soybean breeding program generates some 100,000 "parents" with new genetic traits each year, including a number of "mutant" beans created through chemical changes induced by SIUC biotechnologist Khalid Meksem. (See www.siu.edu/~perspect/07_sp/tilling.html.) "We are talking now about using Dr. Meksem's mutant soybeans," Lightfoot says.

"Some are even higher in oil content than our best bean, but they are lower in yield. In the next phase of this project, we want to get his oil and our yield combined. With the right natural variations, the right mutations, and the right technology, we could even get to the point where we could specify oil content.

"Then we'd be growing beans for particular uses rather than growing them as commodities in bulk which have to be expensively modified post harvest."

—K. C. Jaehnig

For more info: Dr. David Lightfoot, Dept. of Plant, Soil, and Agricultural Systems, ga4082@siu.edu.

AIH comes to SIUC

Rolando Bravo, associate professor of civil and environmental engineering (see p. 9), is the new executive director of the American Institute of Hydrology (AIH), which is moving its headquarters from Georgia to SIUC.

The University has particular strengths in this area, with water-resources experts in several colleges. Bravo notes that having the AIH based here will help recruit students, especially graduate students, in the area of water resources, and may help faculty and students increase their grant funding because of their proximity to this resource.

The AIH has a stringent certification process. It is the only national organization that certifies qualified professionals in all fields of hydrology—surface water, groundwater, and water quality—and has only about 750 members worldwide. It also provides training and education, works with the government and the public on water-related issues, and sets ethical standards for the profession.

The AIH publishes a journal, holds conferences, and hosts an annual meeting, which Bravo will coordinate. He hopes to increase recruiting efforts abroad, building a larger base of qualified international hydrologists and ensuring the profession remains highly regarded throughout the world.

—Tim Crosby

For more info: Dr. Rolando Bravo, rbravo@siu.edu.

DECISIONS, DECISIONS

If you're looking to solve a problem, it helps to come at it with more than one decision-making style.

"When you get to brainstorming, the spontaneous can come up with eight million ideas, but execution is squat," says William Coscarelli, professor of curriculum and instruction.

"When it comes to evaluating the ideas, you want to shift to the systematic."

Coscarelli has spent 20 years researching how people seek, organize, and evaluate information when deciding what to do and has developed a system for categorizing their decision-making styles. He frequently makes presentations to industry managers, salespeople, teachers, and university students about how these styles work, the strengths and drawbacks of each, and how people can use this knowledge in their daily lives. "It's useful in a lot of settings," he says.

Spontaneous deciders see the big picture, leaping from vantage point to vantage point to do so. One thought leads to another, which leads to the next, which inspires a

Better Safe

SIUC is leading a $1.2 million, multi-county emergency preparedness effort funded by the federal government.

Geology professor Nicholas Pinter is directing the project, which will enable 17 Southern Illinois counties to assess their disaster risks and make plans for disaster mitigation. SIUC faculty will work with colleagues from Indiana University–Purdue University Indianapolis and with five Illinois regional planning commissions to assist local agencies with writing pre-disaster mitigation plans.

The Federal Emergency Management Agency is funding the work, which will continue through 2010, via the Illinois Emergency Management Agency.

"This grant from FEMA will help each of these counties identify the risks they have and make plans to deal with any of those potential disasters," Pinter says. "Southern Illinois has a history of major disaster losses—from the great flood of 1993 to the tri-state tornado to the New Madrid earthquake. It makes sense that these counties prepare for events such as these and others."

Once the assessments and plans are in place, local agencies can ask for additional funding from FEMA to reduce the dangers. Examples might include shoring up a river levee or building earthquake-resistant fire and police stations.

Pinter and Harvey Henson, a research project specialist in geology, will bring expertise in earthquake, flooding, and other geologic risks to the planning process. They and a number of SIUC graduate students also will gather and help analyze data and work with the planning commissions to help update databases, such as locations of schools, hospitals, and other critical infrastructure.

Researchers at The Polis Center at IUPUI will use computer software to model the effects of various disasters on certain geographic areas.

"The software can take a specific disaster, say an F5 tornado, and look at how it would impact an area," Pinter says. "It can look at the vulnerability and help us determine how we can mitigate that risk.

"Planning for disasters, rather than just reacting when they strike, is the best way to reduce damage and loss of life."

—Tim Crosby

For more info: Dr. Nicholas Pinter, Dept. of Geology, npinter@geo.siu.edu.

new thought, a process Coscarelli calls "chaining." They make quick decisions because they need to try on their choices to fully understand them. They often don't worry about making the wrong choice as they can easily switch to a new one if the first one doesn't work.

This drives the systematic folks nuts. Logical and analytical, they see the big picture's individual components, weighing each one separately. Acutely aware of risk, they carefully take their time in deciding.

"A spontaneous person will go to the new restaurant in town and have the most outrageous thing on the menu," says Coscarelli, a self-described spontaneous. "The systematic doesn't like to go to a restaurant unless they've been there before, and then they will have the chicken.

"If a spontaneous makes a decision and it's wrong, it doesn't matter because the perceived risks are low—they'll just abandon it. A systematic who makes a bad choice will just keep working away at it."

Most people—80 percent of those who have filled out Coscarelli's copyrighted decision-making inventory—fall in the systematic category. But when it comes to how they make sense of the information they have gathered, they divide between what Coscarelli calls external and internal processing styles.

To explain these styles, Coscarelli likes to show a cartoon that demonstrates both. The cartoon shows two people facing each other. One wears a sign that says, "I NEVER KNOW WHAT YOU'RE THINKING!!" The other has a thought bubble that says, "I always know what you're thinking."

"The external needs to hear the words to analyze information; the internal prefers to analyze privately," he explains.

"These two dimensions of 'internality' and 'externality' are all too often overlooked and lead to tensions in group work as well as in personal relationships. In fact, these differences can be more troublesome than the conflicts that can arise between the spontaneous and systematic styles."

Becoming aware of your own style can help you communicate better. Coscarelli told of one faculty member who always got blasted on student evaluations for not answering questions. She came to him for help because she perceived herself as always answering questions. When he observed one of her classes, he spotted the problem immediately.

"She was 'chaining' all over the universe," he says. "She'd start to answer the question but one thought would remind her of something else and off she'd go. As far as the kids were concerned, she was talking but not answering.

"Once I explained the styles to her and asked her which she wanted to use for which setting, she turned that around amazingly fast. It was beautiful."

—K. C. Jaehnig

For more info: Dr. William Coscarelli, Dept. of Curriculum and Instruction, coscarel@siu.edu.

RIVER OF HARDSHIP

The water is disappearing in the Ica River Valley of Peru. Entire branches have dried up, and the agriculture-based economy is suffering.

Associate professor of civil and environmental engineering Rolando Bravo, who also is the new director of the American Institute of Hydrology (see p. 7), wants to know why. He's enlisted the help of the Peruvian government and the Universidad Alas Peruanas, a large private university in Lima, to find out.

"We want to understand what is going on with the ecological cycle there," says Bravo, a native of Peru.

The area lies near the city of Ica, about 200 miles south of Lima in a region known for its lush beet, asparagus, chickpea, and avocado fields. Ica is home to about 200,000 people.

The shortage is a mystery because other than a drought five years ago, things appear to be normal. Water for the area comes from rainfall and the melting of ice caps in the Andes Mountains, and runs into lakes scattered throughout the region. The lakes feed rivers, such as the Ica River.

"The lakes are full, so we don't know if maybe it is raining less or maybe it is raining heavier for shorter periods of time, which is not as productive," Bravo says.

He and the Peruvian researchers will gather existing data, such as rainfall totals, and create new data sets, such as an inventory of the estimated 2,500 wells in the area. The team will then analyze the data to try to determine why the rivers and groundwater are drying up.

Bravo hopes the team's baseline information will help Peru obtain development funds. Their goal is to make recommendations to local officials and engineers on how to mitigate the water shortage.

The yearlong project is supported by about $80,000 from Universidad Alas Peruanas.

—Tim Crosby

For more info: Dr. Rolando Bravo, Dept. of Civil and Environmental Engineering, rbravo@siu.edu.

Rolando Bravo (left) examines a dry riverbed in Peru with Carlos Blanco, academic coordinator with the Universidad Alas Peruanas.

Winners

The 2007 Outstanding Dissertation Award went to anthropology student David Goldstein, a paleoethnobotanist. Working with co-advisors Izumi Shimada and Lee Ann Newsom, Goldstein combined various lines of investigation, from forest ecology to metallurgy, to focus on the procurement and use of plant fuels for pottery firing and metalworking by pre-Inca peoples living along the northern coast of Peru. His work showed how local artisans worked together to establish resource management practices that did not adversely affect local forests.

In 2007 there were two winners of SIUC's annual Outstanding Graduate Student Research Award.

Chemistry doctoral student Kaushik Balakrishnan, who works with advisor Ling Zang, fabricates and studies the characteristics of nanowires and "nanobelts" made from organic semiconducting molecules. Such nano-assemblies, he explains, "have now emerged as unique building blocks in the miniaturization of optoelectronic devices." Balakrishnan won his department's teaching excellence award in 2003 and recently held an internship with Motorola.

The second winner, Abhijit Shukla, a doctoral student in biochemistry and molecular biology, works with advisor Sukesh Bhaumik to understand the mechanisms involved in gene regulation and how they can go awry. Shukla, who concentrates on mechanisms implicated in human diseases, holds a two-year, $52,000 fellowship from the American Heart Association.

The SIU Alumni Association's 2007 Outstanding Thesis Award went to zoology student Forrest Brem. Under the guidance of advisor Karen Lips, Brem studied a fungus that is wiping out frog populations in Central America. He was the first researcher able to study a population before, during, and after infection, which revealed valuable new information about why the fungus is so deadly and how it spreads.

Forrest Brem on site in Central America.

VIRTUAL TOURS

Your MP3 player could become a park ranger you can carry in your pocket, thanks to a Department of Forestry class at SIUC.

Students in Erin Seekamp's upper-level environmental interpretation course spent spring semester producing five podcasts for use at nearby Crab Orchard National Wildlife Refuge. A 44,000-acre mix of forest, pasture, lake, wetland, wilderness, and recreational areas, the refuge attracts roughly one million visitors each year.

The podcasts, which will be downloadable onto individual players from a freestanding kiosk in the visitors' center, will serve as tour guides to the different refuge areas, offering the kind of insider insight visitors would get from a one-on-one tour with a ranger.

Seekamp, an assistant professor, focuses her research on partnerships for natural resource management, including interpretive strategies for parks and historical sites. Wildlife refuge specialist John Magera, who enlisted Seekamp's help with the project, says it draws on technology to get people to "go outside and get their feet on the ground."

Many people, he says, "come to our visitors' center, look around, then get in their vehicles and go to dinner or go home. Even if we had the staff to give tours, you can only move as fast as the slowest member of the tour."

Seekamp's students researched, wrote, and produced the podcasts—two to replace existing, more traditional car-based tours, two new programs on the Rocky Bluff nature trail, and one for an annual open-refuge event. In addition to the audio portions, the podcasts include video components for those whose MP3 players can play them.

Once the download station is installed and the podcasts are up and running, Magera anticipates they'll get a lot of use.

"We have some fascinating stuff here, and this is one of the tools we're going to use to get the word out."

—K. C. Jaehnig

For more info: Dr. Erin Seekamp, Dept. of Forestry, eseekamp@siu.edu.

DELTA DAWN

A new research and community-service networking tool is in place with the establishment of the SIUC Center for Delta Studies.

The Delta refers to a federally designated area known as the Delta Regional Authority—240 counties and parishes in states bordering the lower Mississippi River and in Alabama. The region includes 16 Southern Illinois counties. There are geological, cultural, demographic, and historical similarities that encourage study of the large area as a unit.

John Koropchak, vice chancellor for research and dean of the graduate school, says that plans for such a center date back several years as the University sought to find a way to "marshal the resources of the research universities in the region to help to address (the region's) issues and circumstances."

The director of the new center is Jane Adams, a professor of anthropology and history who specializes in rural transformation in the Delta. "I've had something like this in the back of my mind for about 20 years—a center that would involve everyone on campus who is involved with that region," she says. The center's governing board includes faculty from eight different SIUC colleges.

The goal is to create new avenues of interdisciplinary scholarship and improve communication between academic fields for those whose expertise connects with the greater Mississippi River Delta area—not just experts in the SIU system but those at other universities as well.

Adams says she's seen that younger scholars, in particular, are eager to find others studying the same area they are, even if those other scholars are in different disciplines.

Another factor, she says, is the current trend for grant monies to flow toward interdisciplinary research efforts, which are needed to tackle complex social issues.

Activity at SIUC concerning the Delta region has ranged from archaeological work to community development partnerships with the citizens of Cairo, Ill., and New Orleans.

Much future work is expected to be service-oriented research involving Delta-area citizens and focusing on practical solutions to long-term problems, such as poverty and lack of jobs.

At present, the center is not a physical place, though work has begun on a Web site (www.siu.edu/~delta). But it has already hosted or co-hosted several symposia on various topics, including disaster planning in the context of Hurricane Katrina, possible effects of climate change on the Delta region, and health care.

—Andrea Hahn

For more info: Dr. Jane Adams, Dept. of Anthropology, jadams@siu.edu.

ECOLOGIST HONORED

Plant biology professor David Gibson was named the 2008 Outstanding Scholar at SIUC.

Gibson's research focuses on grassland ecology. His work on the Konza Prairie in Kansas, a key fieldwork site in this discipline, revealed the long-term effects on fire on grasslands and is widely cited by other researchers.

Gibson later showed his findings had ramifications for the overall management of tall-grass prairie, and in Illinois he has shown how the effects of fire are important for grasslands restoration and management.

The spring 2007 issue of *Perspectives* highlighted an ongoing project with Sara Baer, SIUC assistant professor of plant biology, and a team of students to study prairie restoration for what it can reveal about underlying ecological principles (see www.siu.edu/~perspect/07_sp/prairie.html).

Gibson also studies the interactions between plant species and other organisms. In his latest research, he has focused on the contrasting ecology of rare and invasive species.

During his 25 years as a researcher, Gibson has published a critically acclaimed book, *Methods in Comparative Plant Population,* and nearly 100 papers in peer-reviewed journals and books.

His articles have appeared in some of the most prestigious in the science community–*Ecology, Journal of Ecology, Journal of Applied Ecology,* and *Global Change Biology,* among others.

His work has been supported by more than $1.5 million in grants from local, state, and federal sources, including the National Science Foundation.

2008 Outstanding Scholar David Gibson.

Gibson earned his doctorate in 1985 at the University of Wales, Bangor, United Kingdom, where he studied with P. Greig-Smith, an international authority on ecological theory. He did postdoctoral work at the Division of Pinelands Research in 1985 at Rutgers University.

He was a research associate at Kansas State University in 1986 and staff scientist for the International Satellite Land Surface Climatology Project examining the Konza Prairie in 1987. He joined SIUC in 1992, becoming a full professor in 2000. Much of his work has involved international collaborations.

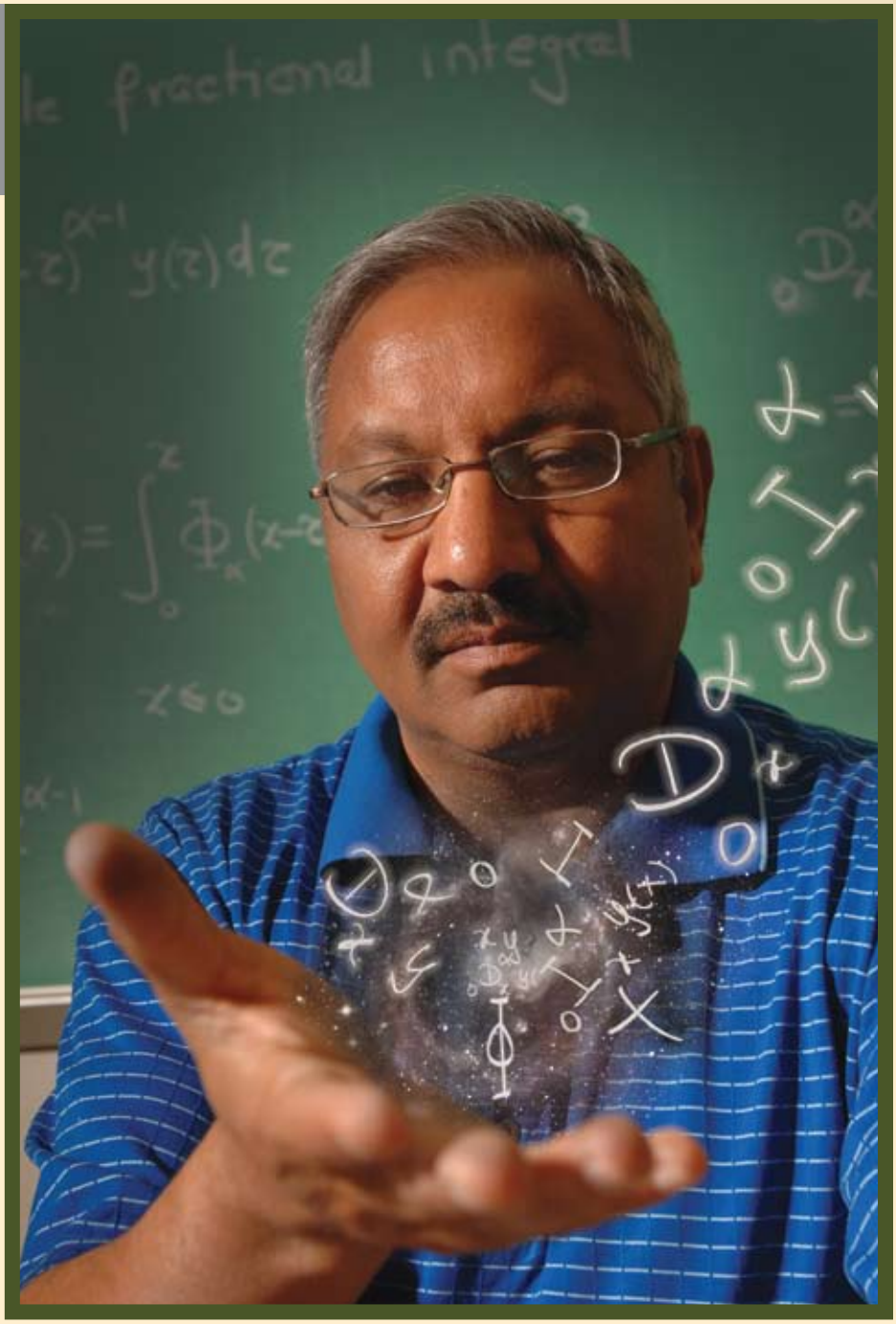
Gibson is also currently co-director of SIUC's Center for Ecology.

—Tim Crosby

CUTTING-EDGE MATH

A seldom-taught branch of calculus provides better tools for real-world challenges, says Om Agrawal

by Marilyn Davis



Mechanical engineer Om Agrawal doesn't consider himself a mathematician. He doesn't number himself among those who expand frontiers in the high realms of pure mathematics. But, working in the area of applied mathematics, he has gained attention as a leading exponent of an offshoot of calculus increasingly useful in engineering and science.

"Fractional calculus is the calculus of the future," says Agrawal, who has co-organized several international symposia on this branch of math and its applications. "With it, we can solve problems we couldn't have solved before."

Fractional calculus often better describes the behavior of complex systems and materials than traditional calculus does, he says. With tools from fractional calculus, researchers are developing new mathematical models in fields from bioengineering to economics.

French researchers have designed improved shock absorbers using fractional calculus. A colleague of Agrawal's at the University of Illinois at Chicago has demonstrated that fractional calculus gives more accurate interpretations of nuclear magnetic resonance data in imaging the brain. Colleagues at the University of Akron and NASA have found that fractional calculus models better describe the movement and structure of hurricanes and galaxies.

Agrawal himself was the first researcher to use fractional calculus to develop theories and numerical schemes for optimal controllers for mechanical systems.

The idea of fractional calculus was raised by the mathematicians who first developed traditional calculus. But not until about 30 or so years ago, when certain mathematical issues had been worked out, did engineers and scientists begin using it to tackle real-world problems. It has since found many applications—yet it is greatly underused and underappreciated, Agrawal says.

Fractional calculus involves derivatives and integrals of so-called fractional order. Derivatives are what tell you the rate of change in a system. Take the case of a moving car. Velocity tells you how distance is changing with time; acceleration tells you how velocity is changing with time. Velocity is the first-order derivative of

distance with respect to time; acceleration is the second-order derivative of distance with respect to time.

"Currently most of the engineering problems we solve are formulated in terms of integer-order derivatives: first, second, and so forth," Agrawal says. "And these are local derivatives, meaning that you only need local values.

"For example, if you want to know your [car's] acceleration at approximately 10 seconds after you start driving, you only need to know your velocity at around 10 seconds, not what it was at 2 seconds or 5 seconds." Solving such problems doesn't depend on the *history* of the system.

But many natural and manmade systems—from body tissues to climate effects to viscoelastic materials such as polymers and gels—"react not only based on their current state, but also on the previous states they have gone through," Agrawal notes. Because integer-order derivatives are local values, using them to predict such systems' behavior requires elaborate models and often employs an averaging approach to try to handle irregularities and discontinuities.

Fractional derivatives provide a better way, Agrawal says. The simplest lay explanation is that fractional derivatives capture intermediate states; mathematically, they incorporate the history of the system or material. Although models based on fractional derivatives require much more data—information about previous states—the model itself can be much simpler.

Agrawal tries to "hypothesize and predict" fractional calculus approaches that could be used by colleagues to solve engineering problems. They in turn have the hard data about systems that he needs to verify his mathematical formulas.

One area where Agrawal has used fractional derivatives is in thermal analysis of disc brakes, crucial to developing longer-lasting brake materials. In the past, predicting the surface temperature distribution of a disc involved a very complicated model. However, Agrawal says, "Under certain assumptions the surface temperature can be predicted very easily using fractional derivatives." (Engineers working on a system "have a good idea what assumptions will hold up," he says, though testing is needed to confirm them.)

Fractional derivatives are a "cutting-edge tool" for the design and analysis of materials, Agrawal says. Many of the materials suited to fractional calculus models have not been fully characterized, he adds: "Many of their behaviors are not fully known."

Using fractional calculus, researchers are developing improved mathematical models in fields from bioengineering to economics.

Agrawal's work on optimal controllers has applications to mechanical, electrical, and other systems, including robotics. He pioneered equations for optimal control of systems whose behavior fits fractional-order models and also is subject to random inputs.

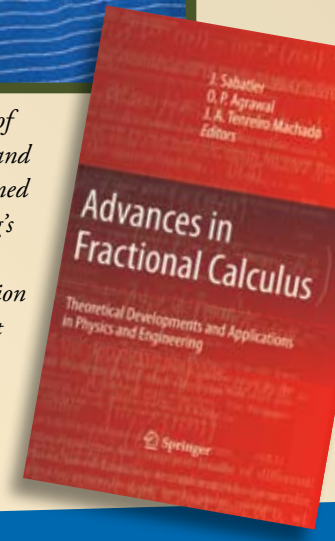
In addition, he was one of the first researchers to incorporate fractional derivatives in what's called variational calculus, developed for problems that involve nature's tendency to minimize potential energy in systems. "My idea was that if a system requires fractional derivatives to define its behavior, there must be an energy-minimizing law in the system coming into the picture," he says.

"Fractional variational calculus" remains highly theoretical, he says: "The future will tell where the applications are." But other researchers have been using it to address abstract problems in mechanics and have dubbed one of his formulations "Agrawal's Principle."

Agrawal has many U.S. and international collaborators, in disciplines as diverse as physics and engineering. In 2004 he led a seven-member interdisciplinary U.S. team to Bordeaux on a National Science Foundation–sponsored effort to work with a similar French team. The goal: to see how their expertise in fractional calculus could be combined to solve problems in various areas.

Also in 2004, French colleague Jocelyn Sabatier, Portuguese colleague J. A. Tenreiro Machado, and Agrawal co-edited a special issue of the journal *Nonlinear Physics.* In 2007, they worked together again on a book called *Advances in Fractional Calculus: Theoretical Developments and Applications in Physics and Engineering* (Springer).

In 2006 Agrawal was recognized for his career contributions at an international conference on mathematical methods in engineering at Ankara, Turkey, where he gave a keynote speech and other presentations. He will speak at the 2008 meeting this fall, as well as at other venues—as always, advocating for fractional calculus as a valuable tool to understand our complex world.

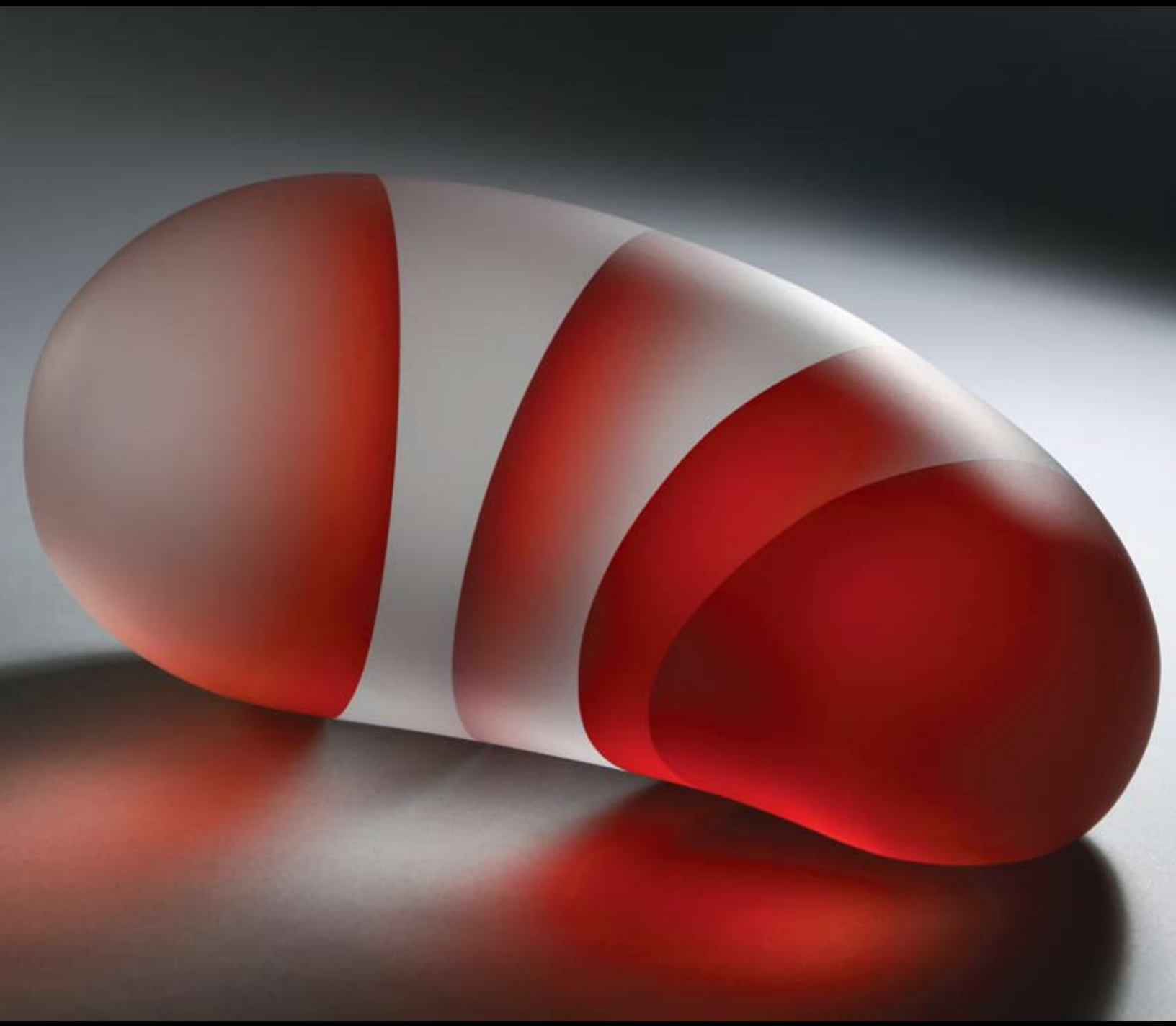


Dr. Om Agrawal, Dept. of Mechanical Engineering and Energy Processes, was named the College of Engineering's Outstanding Scholar in 2007. For more information about his research, contact him at om@engr.siu.edu or see http://meep.engr.siu.edu/faculty/agrawal/index.htm.

SCULPTURE IN GLASS

Jiyong Lee works with glass, but his true medium is light and memory.

by Marilyn Davis; all photos courtesy Jiyong Lee



On a table in Jiyong Lee's studio sits a larva-shaped artwork, more than a foot long, made of five glass segments joined together. Run your palm over it: The piece is so finely ground, so smooth, that the joints can't be felt. The segments are beautifully colored, a gradient of tints running from a deep dark red in one end segment, through rosy orange hues, to near-white in the other end segment. But when Lee turns the piece around, everything reverses: the white and dark ends seem to have traded places and the gradient of tints is running the other way.

When you get up and stand directly over the piece, you see that the glass itself is clear, from end to end. The only color is in the epoxy resin that glues the glass segments in place. Different segments reflect different depths of color depending solely on the angle of the light coming through the joints.

Memory can be like that too, illuminating things differently at different times. And memory, Lee says, is what his work as an artist is all about.

Many of his pieces draw upon the sights he remembers from his physician father's office, which was part of the house where Lee grew up. "He had all these medical books, he did compounding of drugs," Lee explains. "I got sick quite often when I was a kid and my dad had to compound all the medication for me because I couldn't swallow tablets. Syrup wasn't widely used for children's medicine in Korea at the time, so I carried folded parchment papers with me with the powdered medicine to mix with water."

Those packets became a kind of metaphor representing his childhood and his father's love for him. Last fall Lee exhibited a two-piece work based on that experience at the Cheongju International Craft Biennale in Korea.

Left: "Red Embryo Segmentation 2," 2008. Hot-sculpted, cut, color-laminated glass.

One piece consists of a glass mortar and pestle sitting next to rows of partially folded paper packets, each with a bit of fused glass powder in the middle to simulate medicine. The other piece takes the form of a monumental "days-of-the-week" pill holder, each compartment stuffed with packets. Flecks and slashes of black paint on the box's surface make this modern object appear old and fragile, like a relic of an ancient culture.

"The pillbox is something very convenient, very American," Lee says. "I enjoy going around giant grocery stores and Walgreens, seeing things I didn't see in Korea." Thus this piece, called "Take Every Day As You Need," fuses elements of his home culture and his adopted culture. Together, the two pieces are called "Memory."

Jiyong Lee grinding glass parts on a flat silicon carbide grinder.

Lee also creates a lot of segmented pieces in various shapes. These are often geometric, but recently they have also taken on biological shapes reminiscent of cells and embryos. "I like the way cells start to segment and it becomes a life," Lee says. "I started being interested in this cell segmentation series when my son was born."

"Glass can give you transparency, translucency, opaqueness. Metal, clay, stone can't give you that."

Lee has come a long way for someone who's worked with glass for only about 10 years. In high school, he was interested in product design, and he earned his bachelor of fine arts degree in ceramic product design from Korea's Hong-ik University. He then got a job working in a ceramics studio run by two well-established Korean artists. One of them was doing more sculptural, artistic work, and Lee too began to feel drawn to the idea of creating his own sculptural work—original pieces, not functional wares.

At the same time he was becoming intrigued by the idea of using glass as a

Top: "Take Every Day as You Need," 2007. Cut, engraved glass; paper; paint. Bottom: "Mortar and Pestle," 2007. Blown, solid-sculpted, fused glass; paper. The two pieces were conceived together as a work called "Memory."

medium. His employers encouraged him to go to graduate school abroad; at the time, there were no glass programs in Korea. Although Lee still likes ceramics, he prefers the hardness and "precision" of glass. Above all, he says, "Glass can hold the light. Glass can give you transparency, translucency, or opaqueness. Metal, clay, stone can't give you that."

Lee was accepted into the master of fine arts glass program at the Rochester Institute of Technology, where he began playing catch-up to his fellow students. "The first year at RIT I definitely struggled to learn [glass techniques]," he says. "I was in the studio all the time. My professor, Michael Taylor, was also a ceramicist who had turned to glass, and we did a lot of experimenting with technique."

After graduating in 2000 with his M.F.A., Lee worked in Taylor's studio for five years and also taught at RIT. By

attending workshops at such places as the Pilchuck Glass School in Washington State and the Studio of the Corning Museum of Glass in New York, he also learned a great deal from Eastern European artists using glassworking techniques not very common in the United States. In 2005 Lee joined SIUC, where he is an assistant professor and heads the School of Art and Design's glass program.

Americans who know a little about glass art are most likely to be familiar with the huge, fluted, brilliantly colored bowls and other work from the Seattle studio of Dale Chihuly, one of the founders of the modern art glass movement. Most of Chihuly's work involves glassblowing. In contrast, Lee most often uses two other techniques to create the basic shapes of his pieces: hot sculpting and kiln casting.

With hot sculpting, Lee begins just like a glassblower begins, by gathering molten glass on the end of a punty (a solid metal tube) or a blowpipe. Like a glassblower, he must spin the punty or pipe so that the glass won't drip off. ("It's like gathering honey out of the jar—you have to keep turning," Lee explains.)

Unlike a glassblower, he doesn't blow a bubble to begin creating a shape. Instead, he repeats the gathering and turning process until he has the amount of glass he wants. Then, wearing Kevlar sleeves to protect his arms from the heat, he uses cork paddles, metal tools, and even folded, soaked newspaper to start sculpting the glass into the shape he wants.

When he's satisfied, the glass piece goes into the furnace—not to be heated, but to be cooled down at a slow, carefully controlled rate. This annealing process, which takes an average of three weeks for Lee's works, gives the glass its ability to resist breakage. When the piece reaches a crucial temperature called the annealing point—where it starts to lose stress and begins to solidify, usually about 900 degrees Fahrenheit—it is held there, sometimes as long as 48 hours. Then it is allowed to continue cooling to room temperature.

Each type of glass has a different annealing point, and each type of object requires a different annealing time, Lee explains. Glass suppliers provide the annealing point for the type of glass and some other general guidelines. Beyond that, annealing is a matter of experience.

For other pieces, Lee uses what's called kiln casting. He creates a form out of clay, builds a mold of plaster and silica around it, removes the form, and puts glass billets—rectangular pieces of glass bought pre-made—into the hollow space. He uses a water displacement technique to calculate the volume of glass he needs to put in. Then he puts the mold in the kiln to melt the glass, gradually cools it to room temperature, and removes the glass from the mold.

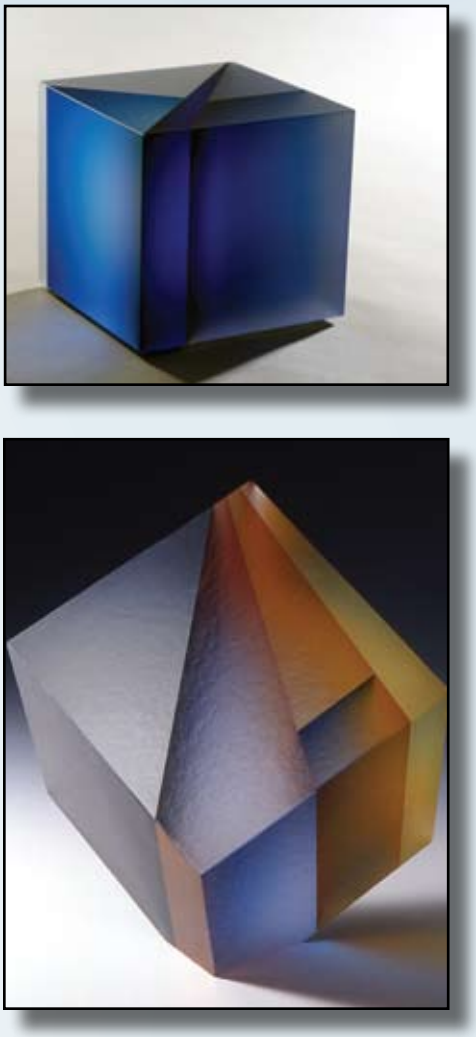
In either case—hot sculpting or kiln casting—that's just the beginning of the fun. Lee finishes his pieces by carving, grinding, polishing, and sometimes engraving them. Such procedures are called "cold working." He often uses a strong epoxy resin to join glass segments, frequently adding dye to the resin to give color to the artwork.

"When the glass comes out of the mold, it's like the raw diamond," Lee says. "When I grind and carve it, it's like finding the shape and making it valuable."

Lee also has used steel to laminate pieces; entrapped copper wire inside pieces; sand-blasted images onto the joints of glass segments; and even created one segmented piece, called "Seed of Life," in which each joint bears his own thumbprint.

Lee now teaches cold-working techniques at the various well-known glass schools and workshops where he once was a student. His work has been chosen for international exhibits in the United States, Korea, China, and Australia.

In 2003 he was among a handful of artists invited to be included in the Corning Museum of Glass's *New Glass Review 24,* the most prestigious juried publication in this medium. And in 2005 the Glass Art Society gave him their Emerging Artist Award.



Top: "Blue Segmentation," 2008, cut, color-laminated, carved glass. Bottom: "Segmentation 2," 2003. Cut, color-laminated, engraved glass.

Does he ever lose pieces in the kiln? "Sometimes something goes wrong, and I'm disappointed when it does," he laughs.

Nonetheless, glass suits his personality, he says. "The style of the work I do involves a lot of measuring, a lot of planning.

"I enjoy doing something precise."

For more information: Jiyong Lee, School of Art and Design, jiyong@siu.edu.

Skilled at Working Small

by Tim Crosby

Understanding the mechanics by which molecules bind to tiny nanotube bundles could have big ramifications for energy storage, air purification, environmental remediation, and other challenges.

One of SIUC's latest faculty to win a coveted National Science Foundation CAREER award is using nanotechnology to make advances in areas related to energy storage and other applications.

María de las Mercedes Calbi, assistant professor of physics, received a five-year, $400,000 grant to develop theoretical models and methods aimed at understanding how molecules and atoms gain access and bind to carbon nanotube bundles.

CAREER awards, which are highly competitive, aim to establish promising junior researchers by providing long-term funding for their work. The grants also integrate student outreach and education.

Calbi's work has great potential for areas such as gas separation, purification, and storage. Although atom and molecule adsorption has been used for some time in areas such as gas separation, Calbi's work moves the concept forward by focusing on how carbon nanotube bundles behave in this arena.

The bundles are extremely tiny collections (a nanometer is one billionth of a meter) of long, hollow tubes that form spontaneously under given conditions. Because of their shapes and porous nature, the structures provide several different types of surfaces as bonding points for atoms and molecules, and thus a high amount of total bonding area.

The atoms and molecules can attach themselves inside a nanotube or along the valley-like areas that run along the outside

of the tubes, for instance. The structures also contain interstitial pores between the tubes, which provide additional potential bonding points.

Such nanotube structures are promising materials for separation and membrane applications. When they're fully understood, one possible use might involve efficient hydrogen storage methods, which could open a variety of environmentally sound technologies. Other possible applications include air purification systems and environmental remediation.

Among other things, Calbi wants to know how to ensure the strongest possible bond between the gas and the nanotube bundles. She also wants to study how quickly certain atoms and molecules can gain access to and bond with a surface, a topic known as adsorption kinetics.

Part of Calbi's project will look at the relationship between the size of a pore in relation to the size of an atom or molecule and how that affects bonding strength. Generally, the closer the size match, the stronger the bond—but this also makes access more restrictive. Calbi will examine how this trait plays into the overall question of adsorption.

Using different atoms and molecules under various conditions, she and her students also will look for efficient combinations that balance the time it takes for adsorption against the energy required to do so.

Although she'll focus on nanotube bundles to extract this knowledge, Calbi's goal is to discover the basic principles that could be used to understand such processes in other nanomaterials, or even to design nanostructures with specific applications.

Because of its nanoscale nature, Calbi's work will delve into the world of quantum mechanics, which operates under an entirely different set of laws than classical physics.

"Much of it is really unknown," Calbi says. "When you have diffusion of molecules in restricted spaces, such as inside a nanotube, the molecules can behave in a very different way."

Calbi's work will be done mostly with theoretical models and computer simulations. However, she'll also work closely with Aldo Migone, professor and chair of the physics department. He'll test various concepts in his laboratory, confirming or disproving the various theories and models Calbi's team advances.

Three graduate students and one undergraduate are working with Calbi on the project. Junior Jared Burde recently won third place at SIUC's Undergraduate Research Forum for a poster describing his part of the work. Calbi also plans a new physics course on surface science at the nanoscale, which will emphasize using computers to model processes that occur in such a small realm.

"It will teach students how to use a computer as a tool for doing physics research," she says.

For more information: Dr. Mercedes Calbi, Dept. of Physics, mcalbi@physics.siu.edu. Assistant professor of chemistry Punit Kohli, whose work in nanotechnology was featured in our fall 2006 issue, also received a CAREER award recently; *see p. 24.*

Left: Mercedes Calbi gives a rough demonstration of binding sites for gas molecules on nanotube bundles. Right, top: Master's student Seyoum Tsige and Calbi go over some calculations. Right, bottom: Material about a particular adsorption model.

Bt and H_2O

by Tim Crosby

Could transgenic corn have uninte

The genetically modified corn grown by many U.S. farmers might harm life in the streams where parts of the plants end up each year, an SIUC scientist says.

Matt Whiles, associate professor of zoology, is part of a team of stream ecologists from four universities studying the effects of Bt corn on the waterways near agriculture fields. The group's first paper on the subject garnered international attention when it appeared in the *Proceedings of the National Academy of Sciences* last fall.

Bt corn is engineered to incorporate a bacterial gene that produces a toxin poisonous to the European corn borer and other pests. This transgenic corn is popular with farmers because they are able to grow healthier crops using less insecticide. In recent years, however, the potential for ecological side effects from transgenic crops has come under greater scrutiny.

The scientists examined whether material from Bt corn plants—everything from pollen to husks and cobs—might have unintended impacts on the stream food chain as aquatic insects use the material for food.

"We all got interested in this because there weren't many people looking at possible effects of transgenic crops on aquatic systems," says Whiles. He joined researchers from Indiana University, the University of Notre Dame, and Loyola Chicago University in doing the four-year study, which wraps up this year. The National Science Foundation funded the project with a $580,000 grant.

The research focused on caddisflies, small insects closely related to pests targeted by Bt corn toxin. Caddisfly larvae are aquatic; they break down the coarse biomaterial deposited into streams, making nutrients available to other creatures.

Whiles and graduate student Catherine Chambers found caddisfly larvae have slower growth rates when feeding on Bt corn crop debris than when feeding on the non-modified variety. Because smaller insects tend to have fewer eggs, it's possible their numbers could decline over time, which might have an overall negative effect on stream food webs.

"We're beginning to speculate some at that point—all we're showing now is slower growth," Whiles says. "But it could have a negative effect because caddisflies…[are] an

nded consequences downstream?

important link in the food chain, and they are in turn a very important food source for fishes, amphibians, and other life forms."

One of the challenges the researchers faced is the fact that agricultural streams are already highly impacted by other substances, such as nutrients, pesticides, and sediments. To try to separate out the relative impacts of Bt corn debris, the researchers strove to record real-life conditions in the field.

Working on 12 streams in northwest Indiana, the researchers suspended adhesive microscope slides over the streams they studied, to capture pollen grains and estimate exactly how much pollen was entering the waterways. They used nets to measure how much coarse material entered the streams and in some cases measured how far it traveled.

"We built various structures and traps along the streams," Whiles says. "We'd also walk the streams, pull material out, and weigh it."

In the lab, the researchers fed caddisfly larvae modified and non-modified corn plant crop debris from the fields surrounding the streams they were studying, and then measured the growth and survival of the insects.

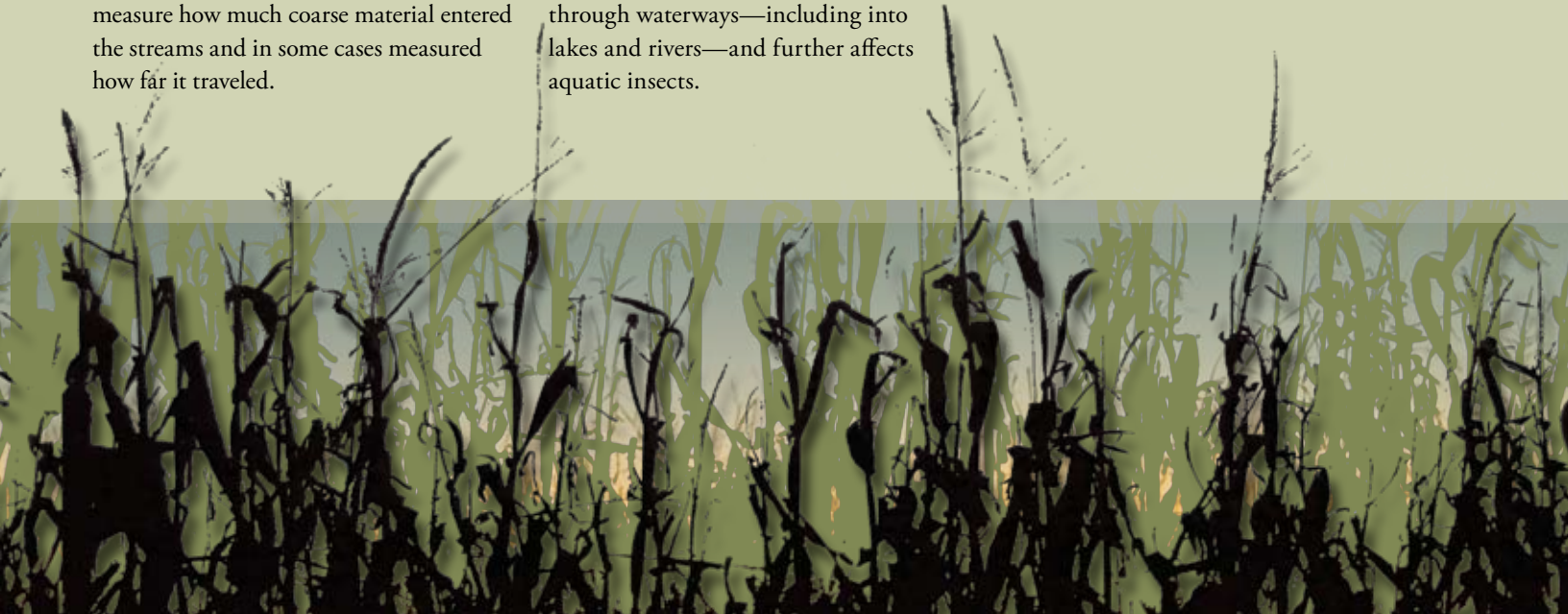
It's too early to say whether Bt corn is having any significant effects on the aquatic environment. But the study shows that the potential exists for unintended consequences. The group wants next to examine how Bt corn debris moves through waterways—including into lakes and rivers—and further affects aquatic insects.

"What we have is some evidence of unforeseen impacts," Whiles says.

"What it means is that there is more to examine here than has been considered yet."

For more information: Dr. Matt Whiles, Dept. of Zoology, mwhiles@zoology.siu.edu.

Top, left: A small creek borders fields of Bt corn. Top, middle: Master's student Catherine Chambers measures discharge in one of the study streams. Top, right: A pollen-collecting device. Photos courtesy Matt Whiles.



by Tim Crosby

Room to Roam

Don't try to sell Clay Nielsen on the idea that a breeding population of cougars has taken up residence in Southern Illinois. Despite the occasional reported sighting, the science just doesn't back it up, and science is where Nielsen puts his faith.

But some recent research by Nielsen and former SIUC graduate student Michelle LaRue does show the cougar might continue moving back toward the Midwest, where only about a century ago it thrived in the tall grass of the undisturbed prairie and thick cover of the forest.

Nielsen and LaRue's two-year study looked at potential cougar habitat in nine Midwestern states: Oklahoma, Arkansas, Missouri, Kansas, Nebraska, Iowa, South Dakota, North Dakota, and Minnesota. Since 1990, researchers with the nonprofit Cougar Network have confirmed more than 150 cougar presences throughout this region, says Nielsen, an associate scientist with SIUC's Cooperative Wildlife Research Laboratory and director of scientific research for the network.

Nielsen and LaRue didn't include Illinois or any other state east of the Mississippi River in their study because cougar confirmations there are almost nonexistent, Nielsen says. Illinois has had only two confirmations—one in 2000 in Randolph County and one in 2004 in Mercer County—and he was involved in investigating both.

"Sightings don't count," explains Nielsen, who previously did a study (reported three years ago in *Perspectives*) that looked at cougar confirmations in the Midwest. What's required for scientific research is "real proof, like a cougar carcass, DNA, or a photo where you can make a positive identification."

Nielsen and LaRue's study reveals that several large areas in the Midwest offer ideal habitat for the tan, carnivorous cats, which typically weigh in between 100 and 150 pounds and can grow as large as 200 pounds. It turns out that Arkansas, Missouri, and Minnesota have substantial areas that could attract and support cougars. About 19 percent of Arkansas, for instance, is highly suitable, as well as 16 percent of Missouri and 11 percent of Minnesota.

The Shared Earth Foundation, along with the Summerlee Foundation and the wildlife laboratory, funded the research, which Nielsen and LaRue published earlier this year in the science journal *Ecological Modelling*.

"One of the first questions we have about cougars in the Midwest is where is the potential habitat," Nielsen says. "Cougars, like bobcats and wolves, are very adaptable, and juvenile males are capable of dispersing from western populations to the Midwest."

Where the wild things might be, someday:

If cougars continue what seems to be a slow migration back toward the Midwest, what places are they likely to head?

Clay Nielsen, a scientist with SIUC's Cooperative Wildlife Research Laboratory, holds the skull of a cougar killed by a hunter in 2004 in Mercer County, Ill.

LaRue and Nielsen conducted the study in a somewhat unusual way for a wildlife research project. Instead of heading out into the wilderness, they asked cougar experts to rank how important various criteria are in making good cougar habitat. Then they used computers to overlay satellite imagery and databases cataloging those factors: land cover, road density, human population density, distance to water, and topography. By combining this existing geographic information with the experts' rankings, they identified areas with the most potential habitat in units of 90 square meters.

"Ideally, if there were lots of cougars around, we'd put radio collars on them, determine their locations on the landscape, and the cougars themselves would be informing us about critical habitat," Nielsen says. "However, there aren't many cougars present in the Midwest. So when the animals can't inform us as to what's important, the experts will.

"We also overlaid the model with cougar confirmation locations—where their presence was determined by carcass or photographic evidence—to see if our model made sense, and it did. We observed that cougar confirmations existed in areas of good habitat as predicted by our model. Most cougar confirmations occurred in forested areas with low human influence and rugged topography." Cougars, he explains, "like secretive areas and require some cover year-round."

While the study points to the potential for cougars to live in certain regions of the Midwest, Nielsen says it's important to note that the existence of ideal habitat does not mean those areas are currently playing host to breeding cougar populations.

"This is a first look only," he says. "This is the first large-scale model of potential habitat for cougars in the Midwest. It is not current cougar distribution in the region."

Overall, Nielsen says, about 8 percent of the Midwest offers highly favorable habitat for cougars, which generally means dense forest cover and rugged terrain. Areas with high human influence, row-crop agriculture, and lots of roads are inhospitable.

The study identified six large, contiguous areas of highly favorable habitat that are equal to or greater than 2,500 square kilometers in size. Those areas include northeastern Minnesota; Mark Twain National Forest in Missouri; Ozark National Forest in Arkansas; and Ouachita National Forest in Arkansas and Oklahoma. They also include the Badlands in North Dakota, and the Black Hills of South Dakota, where there are already known breeding populations of cougars.

The study also identified much smaller areas of highly suitable land scattered throughout the nine-state region. Such oases, Nielsen says, might act as "stepping stones" for animals dispersing from west to east. These areas tend to run along major rivers, and Nielsen says it is well known that cougars use river corridors to travel.

Although parts of Southern Illinois have some characteristics favorable to cougars, Nielsen says there are also important differences. The Shawnee National Forest, while large by some standards, may not be large enough to support a cougar population. "Compared to the Ozarks or the Black Hills, the Shawnee is a drop in the bucket—considerably smaller and not nearly as contiguous," he says. "It is pretty wild, but not nearly [as much] as some of the places we assessed in our habitat model."

The Shawnee, he adds, also is a long way from the next nearest population of cougars, in west Texas. And despite some confirmed sightings there, there's no guarantee a breeding population of cougars will even make it as far as the Ozarks.

Nielsen hopes the study will enable other researchers to further study cougar distribution and dispersal trends.

"Someday we may have cougars in these potential habitats, but it's going to take a lot of movement west to east for that to happen," he says. "Most dispersers are juvenile males, and it will require more females to travel into the Midwest for any breeding populations to eventually occur."

For more information: Dr. Clay Nielsen, Cooperative Wildlife Research Laboratory, kezo92@siu.edu.

kudos

Mathematics professor Salah Mohammed did research in residence at the prestigious Mittag-Leffler Institute in Stockholm during fall semester 2007. In addition, the **Mathematical Association of America** has named him as the David Blackwell Lecturer for the group's 2008 meeting.

An invention previously described in *Perspectives* won first place in the medical division of the **international Create the Future Contest** sponsored by NASA Tech Briefs, SolidWorks Corp., and others. Mechanical engineering professor Ajay Mahajan and co-inventor Dr. Sumeer Lal, a neurosurgeon, won for a highly accurate 3-D ultrasonic navigation system they developed for image-guided brain surgery.

Fulbright Awards recently went to radio-TV faculty Lisa Brooten and Leo Gher for work in Thailand and the Philippines, and in Azerbaijan, respectively, while journalist-in-residence William Recktenwald received a **Fulbright Senior Specialists Award** to teach in Uganda.

Creative writing professor Pinckney Benedict won a **2008 Pushcart Prize**—his third such award—for "Mercy," a story published in the *Ontario Review*. Pushcart Prizes honor the best literary works that appear in small-press publications. Benedict also received a $7,000 Illinois Arts Council **Artist Fellowship,** as did theater professor David Rush.

Geology professor Jack Crelling received the Reinhardt Thiessen Medal from the International Committee for Coals and Organic Petrology. Crelling, an international expert in coal characterization, is one of only a handful of Americans to receive this award, **a top honor in the study of fossil fuels,** during its 50-year history.

Architecture professor Robert Swenson received the **Lifetime Achievement Award** from the Illinois State Historical Society in April for his work in historical and archaeological preservation and fostering community/student partnerships.

Assistant professor of piano Junghwa Lee will make her debut at **Carnegie Hall** in a solo performance in June. And in March the SIUC Wind Ensemble played there to good reviews as part of the 2008 New York Band and Orchestra Festival. The group was **one of only two showcase ensembles** selected by competitive audition to give an exhibition performance at the conclusion of the festival; the other was from England.

Geography professor Leslie Duram has been elected to the **National Council of the Association of American Geographers,** and Coal Research Center director John Mead is serving on the **National Coal Board,** advisory to the secretary of energy.

Marketing professor Gordon C. Bruner II has been named **one of the "Most Cited Internet Advertising Authors"** by the *Journal of Advertising,* and two papers by Wallace "Dave" Davidson, Henry J. Rehn Professor of Finance, are **among the most downloaded articles** on the Social Science Research Network.

Chemistry professor Punit Kohli (at right, with graduate student Xuelian Li), whose nanotechnology research was featured in our fall 2006 issue, has received a five-year, $568,000 National Science Foundation CAREER award to develop "**nano-pen" arrays** to control deposition and patterning of molecules on surfaces at the submicron level. He also has received a two-year, $216,000 grant from the National Institutes of Health to engineer **artificial antibodies** that can bind with and indicate the presence of deadly microbes.

Root Issues

The flowers of these horseradish plants look the same, but the leaves tell a different story. S. Alan Walters, who heads the horseradish breeding program at SIUC, hopes that cross-pollination of the flowers will produce seeds for hybrid plants that will yield high-quality roots and a lot of them (a trait in the plant with the big leaves), while resisting diseases that cause root discoloration (a trait in the plant with the small leaves).

The development of new horseradish cultivars is a high-stakes race for the crop's top producers, clustered in the Metro East/Collinsville (Ill.) area across from St. Louis. "A lot of the horseradish cultivars they have now are starting to lose yield and quality characteristics," says Walters, an associate professor of plant, soil, and agricultural systems.

The breeding cycle for improved cultivars is at least a four-year process, carried out in cooperation with producers and growers, that can start with as many as 3,500 different lab-grown seedlings, winnowed down over the years to three or four eventually chosen for commercial production.

—K. C. Jaehnig