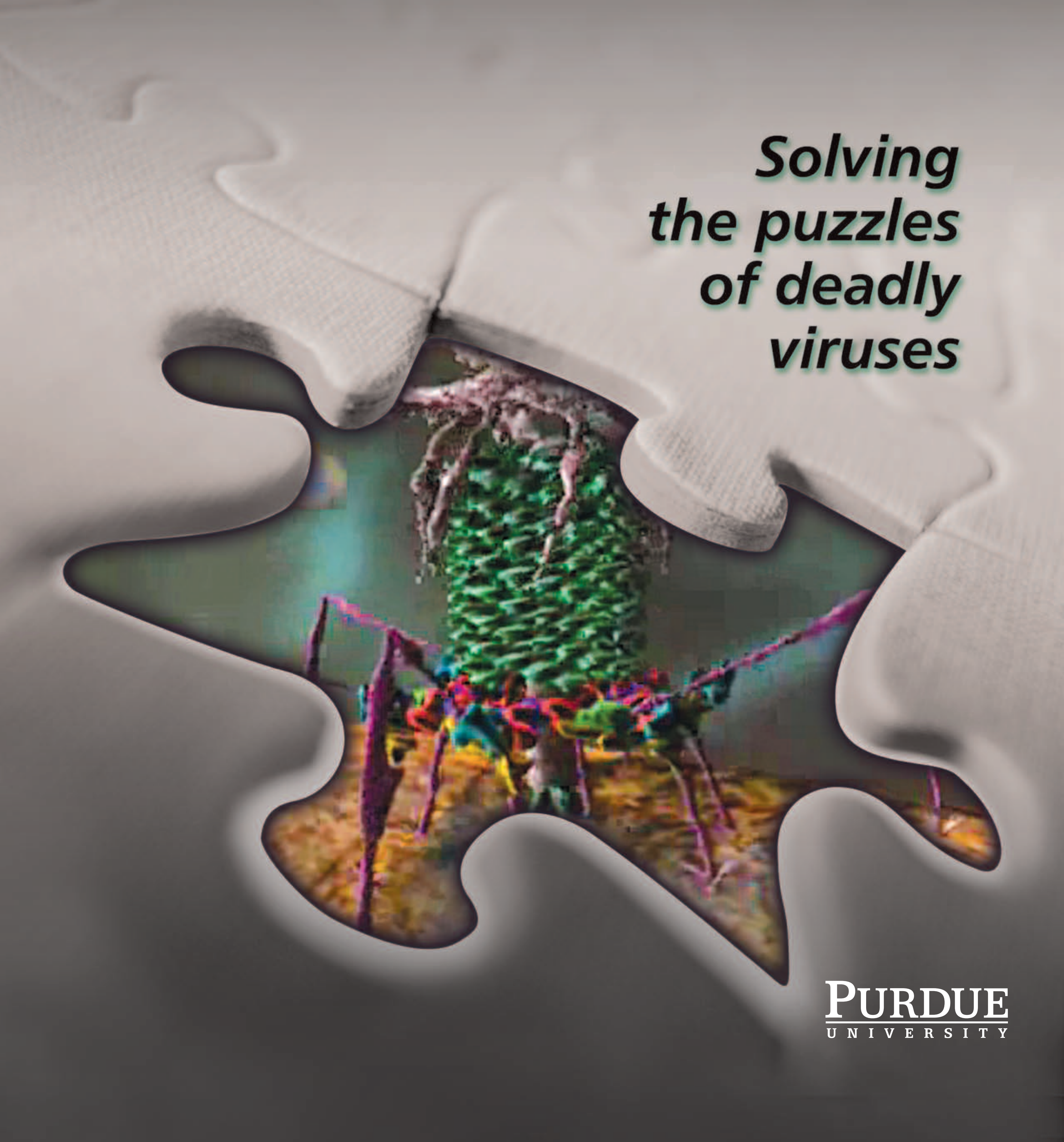
COLLEGE OF SCIENCE ■ SPRING/SUMMER 2005

INSIGHTS



Solving the puzzles of deadly viruses

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Dear Alumni and Friends,

Welcome to *Insights*, the new College of Science magazine! From curious child to science student, researcher, professor, or professional, all of us who are engaged in scientific inquiry know the excitement that comes with new insights and perspectives.

Our questions have changed over time, but the spirit of discovery and quest for insights into the world we live in remain very much the same. Many hundreds of years ago, we asked where the edge of the earth was. Today, powerful microscopes show us how tiny viruses are put together and the way in which living systems work.

The researchers in the Purdue Structural Biology Group, featured in this issue's cover story, have developed a world-renowned reputation for excellence in exploring some of life's most microscopic organisms. Their research presents a host of new opportunities to understand the structure of viruses, which can then lead to rational design of potential antivirals. The images of viruses are also quite humbling, as we become more aware of the beauty and intricacy of our world.

Noted author and biochemist Isaac Asimov said, "The most exciting phrase to hear in science, the one that heralds the most discoveries, is not 'Eureka!' but rather 'That's funny ...'." This is certainly true: the scientific process can provide us with many insights beyond what we would have gained only by looking at the result of the final experiment. As we bring you our latest discoveries twice a year in *Insights*, we hope that sharing our excitement about science with you will make you want to share yours with us.

Jeffrey S. Vitter
Frederick L. Hovde Dean of Science

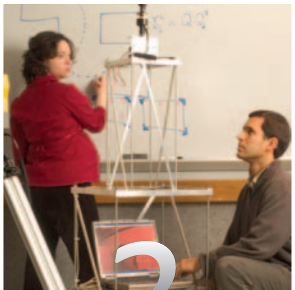
Letters

We'd love to hear what you think about *Insights*, and the stories in it. In fact, we'd like to include a "Letters" section in future issues. Do you recognize someone? Want to hear more about a topic? Send your thoughts to news@science.purdue.edu or *Insights* Magazine, College of Science, 150 N. University Street, West Lafayette, IN, 47907-2067.

Please include your name, graduation year, and major (if applicable). *Insights* reserves the right to edit letters for length or clarity. Depending on the number of letters received, we may not be able to publish all letters.

INSIGHTS

[COVER STORY]



2

Image is everything

Revolutionizing 3-D imaging could be automatic.

6

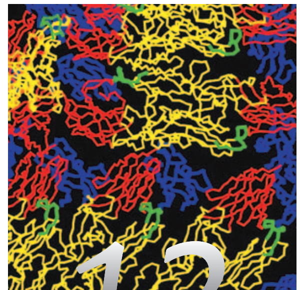
Virtual chemistry

A new approach to teaching chemistry to the video-gaming generation.

8

Size matters

The biggest question is how small can you make it?



12

Solving the puzzles

Structural biologists expose the secrets of deadly viruses.

20

100 years of physics

It started with one miraculous year.

[DEPARTMENTS]

MACROSCOPE 17

BREAKTHROUGHS . . .22

AWARDS & HONORS . .23

CLASS NOTES 26

INSIGHTS, Volume 1, Issue 1 (Spring/Summer 2005)

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CoS LOGO

Represented in each of the radiating arms of this logo are the seven departments of the college. The stability of the inner sphere symbolizes the knowledge and objectivity of science, while the implied movement of the outer configuration suggests the exploratory nature of the field.

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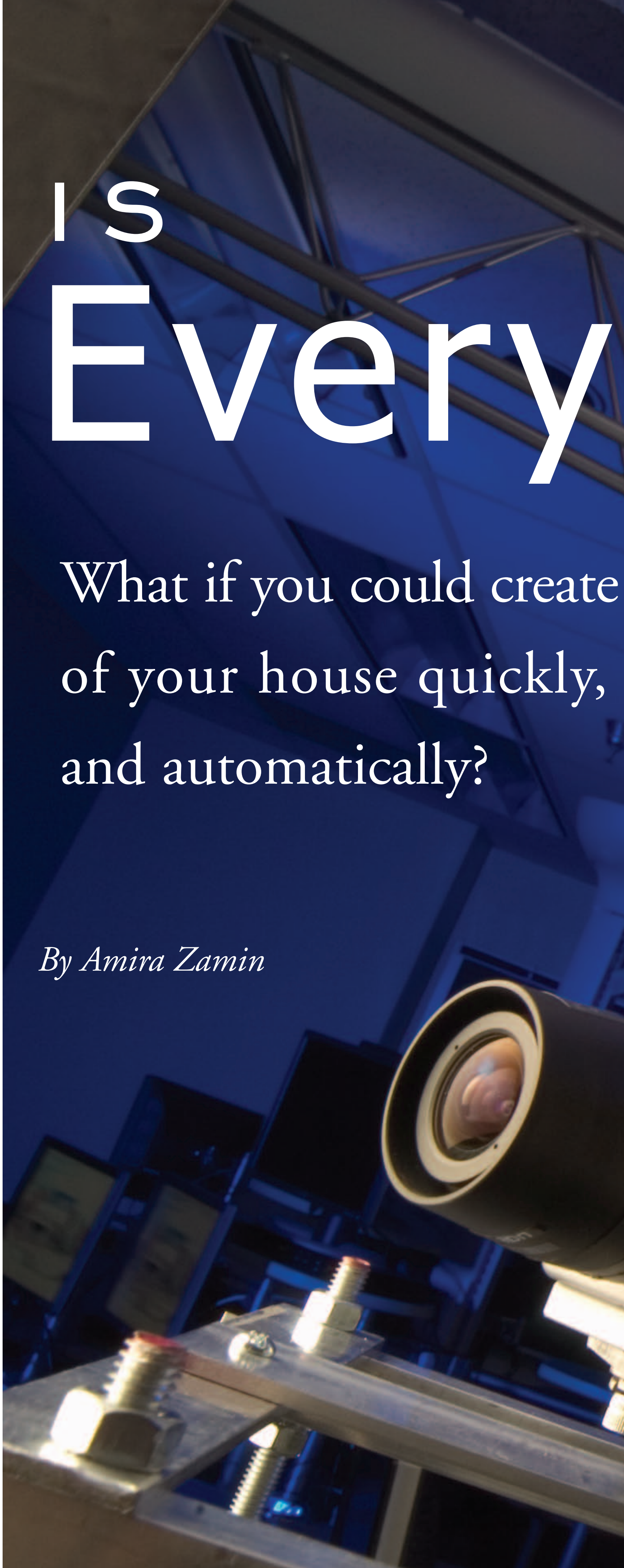
IMAGE IS Every

What if you could create of your house quickly, and automatically?

By Amira Zamin



Assistant Professor Daniel Aliaga jokes that his and Mimi Boutin's 3-D reconstructions research project uses "the braindead way" of managing data — like "data for dummies." Where most people creating 3-D reconstructions do it with the fewest number of pictures possible, Aliaga and Boutin are creating a process that would do it with literally millions of pictures.

In spite of the jokes, 10 minutes with any member of the research team makes it clear — there are no dummies here. The two primary investigators, Aliaga, an assistant professor of computer science, and Mireille "Mimi" Boutin, an assistant professor of electrical and computer engineering, with courtesy appointment in mathematics, have assembled a multidisciplinary team for a project that could revolutionize possibilities for Hollywood and museum curators alike.

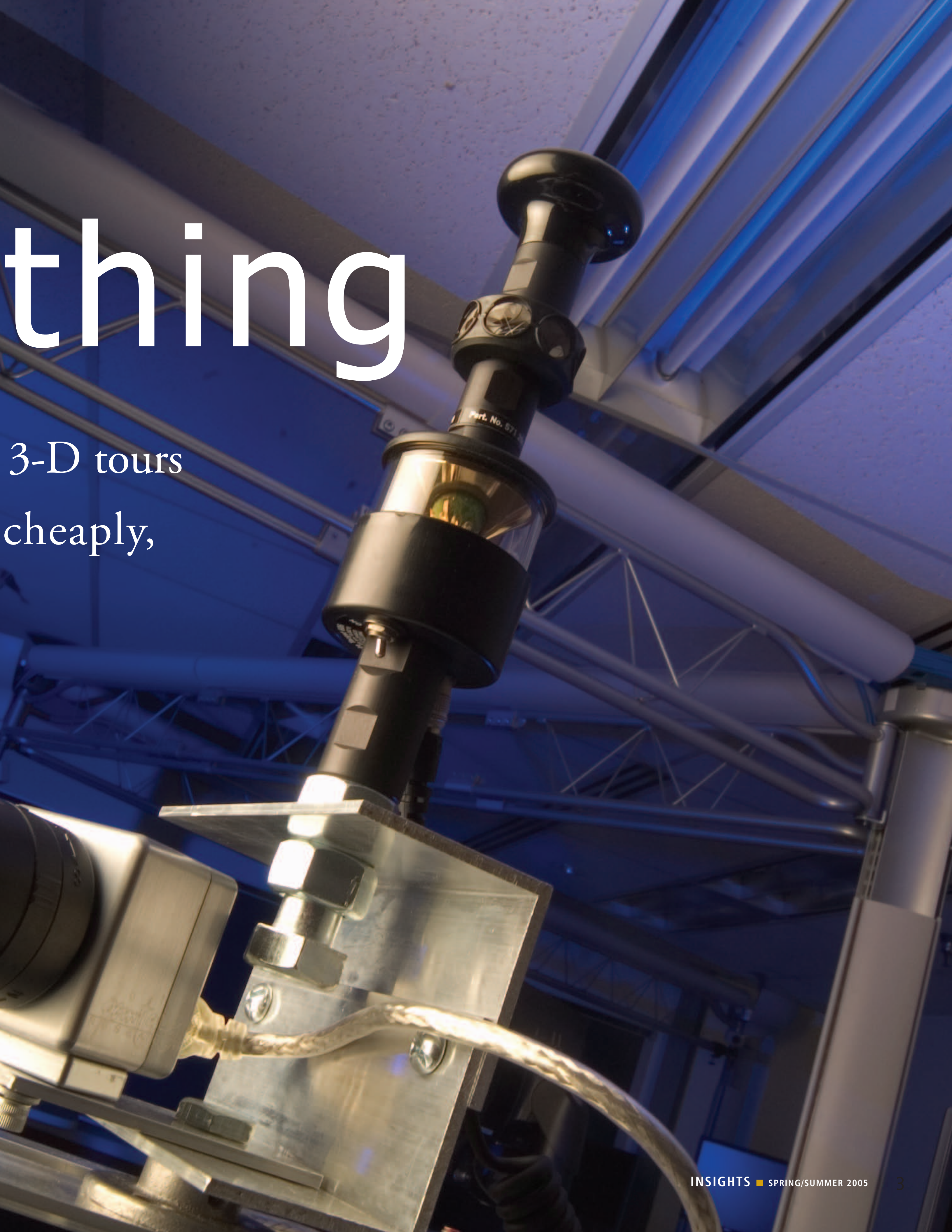
"Right now, nobody can capture a model of a large environment [automatically]. People think we can because of what they see on TV or in the movies. But that's all done manually," says Aliaga.

Their project seeks to create an automatic way of creating 3-D models and virtual tours. Using his educational background, curiosity, and love of robots, Aliaga constructed a robot for the project. Here's how it works: Outfitted with a massive one-terabyte hard drive, the robot meanders around a room, taking millions of pictures. Later, using sophisticated mathematical modeling, the computer selects the best picture of each location and merges them together to create a reconstruction.

thing

3-D tours

cheaply,



The geometric overlay of the chair (above right) shows every part of the chair, but doesn't differentiate color between the brown legs and the black chair. Geometric reconstructions tend to be far more precise than photometric ones, but they lose visual details such as these.

The team includes research assistants from mathematics and computer science. Abhinav Jain, a graduate student in computer science, works with the robot and its mobility; Jamie Gennis, a senior majoring in computer science, designs the path planning for the robot; Jeffrey Zhang, a graduate student in mathematics, handles the mathematical modeling; and Yi Xu, a computer science graduate student, works on the computer reconstructions.

> *"Doing this automatically doesn't exist yet," Aliaga says.*

"Doing this automatically doesn't exist yet," Aliaga says. But when he's done, it just might. With applications in heritage preservation, remote teaching, entertainment, architecture, archaeology, and commercial applications, the possibilities for the finished product seem endless.

Miles ahead of the competition

It's hard to imagine this isn't already automatic. The Web is full of virtual tours of well-known and not-so-well-known monuments, and online shoppers can make a shoe spin around for a better look with the click of a mouse. But making the shoe spin took an illustrator about three hours of manually pasting together pictures on the computer screen.

"A lot of [these reconstructions] sort of cheat," explains Gennis. "They don't figure out the geometry."

There are two ways to approach creating a 3-D image: geometric and photometric. Geometric reconstructions, as the name suggests, consider the environment as a set of geometric figures. Even people are geometric — a head is a circle and a torso is a rectangle. Because geometric modeling puts together individual pieces, those pieces can be moved and manipulated quite easily; however, geometric reconstructions tend to suffer in the visual details department. A laser — a common tool for geometric reconstructions — can't tell where a shoe's brown upper ends and its black sole begins because it can't distinguish color. Photometric reconstructions, using just photographs, are more detailed, but because the basic geometry is missing, the environment cannot be manipulated.

Aliaga and Boutin's project, when complete, will allow the user to keep the minute details as well as the geometry, making the image modifiable. As an automatic process, it will also significantly reduce the human time necessary to complete these reconstructions.

Other research has taken small steps in creating parts of the process, but this will be the first project to put them all together, capturing the necessary detail.

"For shopping, people want to see the details. If museums want to preserve sculptures, they want the detail. Some things have to be super precise," she says.

A Stanford team went to Italy to capture a detailed, three-dimensional picture of David. The project, called the Digital Michelangelo, took a team of 30 people nearly a year, cost millions of dollars, and required the creation of a custom scanning device the size and weight of a small car, says Aliaga.

Mathematics graduate student Jeffrey Zhang and Assistant Professor of Electrical and Computer Engineering Mimi Boutin check the mathematical formulas guiding the modeling. Creating the perfect formula is critical to ensure that the program does not distort the images as it assembles them into a reconstruction.

By comparison, Aliaga and Boutin's robot stands about 6 feet high and weighs less than 50 pounds, computer and motor included. The smaller size is far more practical, and with potential applications ranging from retail to historic preservation, the team says the final process must be practical.

"Theories [used in projects like this] are ideal," says Zhang. "They're not concerned with error, how time-consuming it is, or applicability."

Part of the challenge of the project is creating automatic imaging that is also practical. If it is cost-prohibitive to those who most need it, it isn't useful.

"It has to be cheap in the long run," says Boutin. "The ideal would be to have it cheap with no training."

Data for dummies

If he ever did want to send his robot around the inside of the Louvre, Aliaga does not foresee them letting him in more than once. "If you go into a real place, you can convince them to let you in once. If it doesn't work and you call back saying you want to come back and do it again, okay, maybe they let you in a second time. But if you call back and want to come in a third time? Forget it."

In other words, it has to be efficient and effective. For Boutin, a mathematician, the experience of working with applications that require such practicality points out drastic differences between that and the often abstract world of mathematics.

"In math, we usually look for the minimum number. In this case, what's the minimum number of frames we can have to reconstruct this environment? Maybe it's three. But in applications, the minimum isn't relevant," she says.

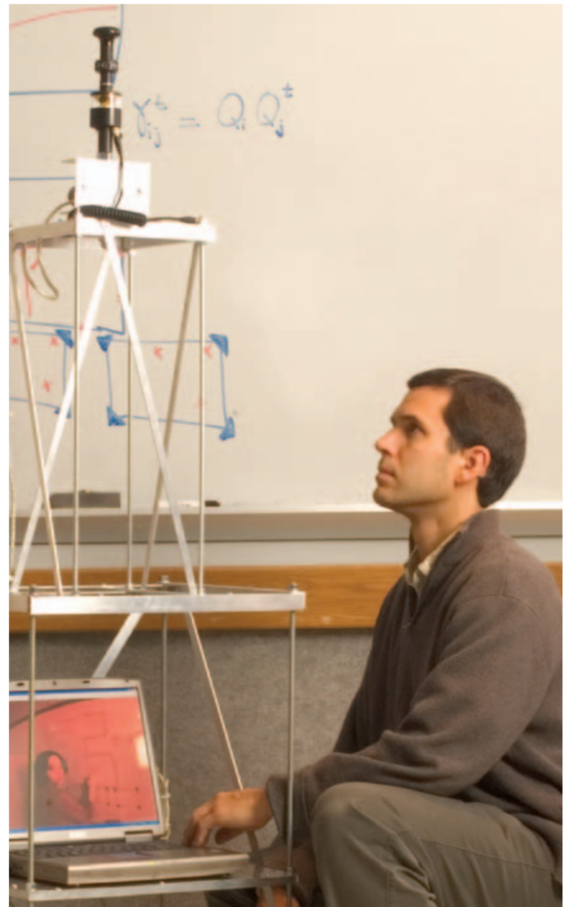
Although it could be done in three pictures, what if there's something wrong with any of those pictures? By taking such a multitude of pictures, the team can be sure the images necessary for a detailed reconstruction exist in the data bank. Then all they have to do is find them.

"It's kind of the 'stupid' way of doing it. Rather than having only a bit of information and trying to make it make sense, this way we know it's in there somewhere," says Aliaga.

With the information captured in the robot's one-terabyte storage disk, it became Boutin's problem to find mathematical processes that didn't distort the data.

"Traditional math processes don't scale properly," says Aliaga.

Several test runs exposed flaws in the standard processes, Boutin and Zhang, the team mathematicians, explained. The images were coming out distorted. With a new formula, the problem appears to be solved. Of course, they can't reveal their research secrets – not yet, anyway.



Assistant Professor of Computer Science Daniel Aliaga checks the robot before letting it go on a test run. The researchers outline a path around the room, and the robot follows it, snapping millions of photos along the way.

Two heads really are better

Although funding from the National Science Foundation sent the project on its way, getting it started had a lot to do with being in the right environment. The project wouldn't have survived if the multidisciplinary collaboration weren't encouraged the way it is at Purdue, say Aliaga and Boutin.

"Science is becoming more mixed. A lot of places talk about doing it, but the faculty have to enable this kind of interdisciplinary work," Aliaga says.

Collaborating with others is like businesses hiring consultants, he explains. For a given scenario, consultants know the most common ways to deal with it. A company could search for months to find out what a consultant can tell them in a day, simply because their fields of expertise are different.

Boutin agrees. "There are a lot of things I'd like to implement that I couldn't on my own."

To Sears and beyond

In the future, the applications of this technology could change more than online shopping. Although virtual tours of museums are the first example that springs to mind for most of the team, it's the less famous reconstructions that get Aliaga excited.

"Imagine if you wanted to buy living room furniture. If you had a reconstruction of your living room on your memory key," says Aliaga, "and you could take it to Sears and bring it up on their computer, you could see exactly how their furniture would look in your living room."

Virtual Chemistry

By Amira Zamin

Looking around the underground, secret government biochemical research facility, you can tell something happened. Dark corridors give way to equally dark and abandoned labs and locker rooms. But don't let the eerie silence bother you. Or the attack robots.

After all, despite the high-tech graphics, it's only a game.

Modeled after highly successful commercial multiplayer video games, The Chemistry Game (working title), an educational video game that reinforces chemistry concepts, will enter its educational testing phase this summer when students will play it for the first time. Associate Professor of Chemistry Gabriela Weaver and Assistant Professor of Computer Graphics Technology Carlos Morales created the multiplayer, first-person shooter game to be educational, yet still capture students' attention and excitement. That includes having excellent graphics.

Associate Professor of Chemistry Gabriela Weaver and Assistant Professor of Computer Graphics Technology Carlos Morales lead the team behind the game.

"Before we began, we did a study of other games," says Morales. "The games that people play for 20 hours a week have really good graphics. If you look at educational games, though, most don't."

The game is set in the distant future, in a secret government biochemical laboratory where experiments used to take place. There are four players to choose from: the chemist, the mechanic, the psychic, and the bruiser.

"If there's a chemical spill somewhere, the army sends in its people, but they also send in a chemist," says Morales. In other shooter games, you might be one of the soldiers. "The difference is, in this game you're the chemist," says Morales, adding, "But you still get a gun."

The educational objective of the game is to reinforce chemistry concepts, such as balancing chemical equations. The game does not teach chemistry, so without a good understanding of it, the player cannot pass from one level to the next.

"Too often, students do not understand that the material presented in different chapters of a general chemistry textbook are actually related to each other in important ways," says Weaver. She hopes the game will also help students assess what concepts they need to study more, and get them excited about it.

Clues guide the players through the game using their chemistry knowledge. In one room, a poster displays LeChatelier's Principle, stating that if a change in conditions is imposed on a system in equilibrium, the system will react to counteract the change and restore equilibrium. Later in the level, the players must use LeChatelier's Principle to modify a chemical reaction before they can move on to the next level.

"Watching my nieces and nephews play games, I realized that even very young kids can jump into an environment they have never seen before, with new rules and challenges, and they are instantly sucked in. They don't sit and read a manual about how to play that game, they just learn it by doing. This is a really powerful way to learn. I have always thought that learning chemistry should get students excited, so I wanted to find a way to capture that 'addictive' quality of video games and apply it to chemistry," says Weaver.

In a related study underway now, Weaver is looking for the elements of video games that are most important to learning, such as graphics, plot, etc. Once those are identified, the game will be built around these design elements by including chemistry concepts, like equilibrium and buffers.

"Fundamentally, this is an educational research project. What we really want to learn is *how* one would teach chemistry effectively in a game environment. When we have learned that, then maybe one of the game-developing giants will become interested in our research findings and apply it to a game. It would be great to see one of these games in every home, but that's not the immediate goal of the project." ■

Meet the four characters of "The Chemistry Game."

The Bruiser

The government's solution to the ultimate warrior, he is the only player who starts out in attack mode and can handle the heavier weaponry available at the later levels of the game. He can do the most damage to robots that attack the team.

The Mechanic

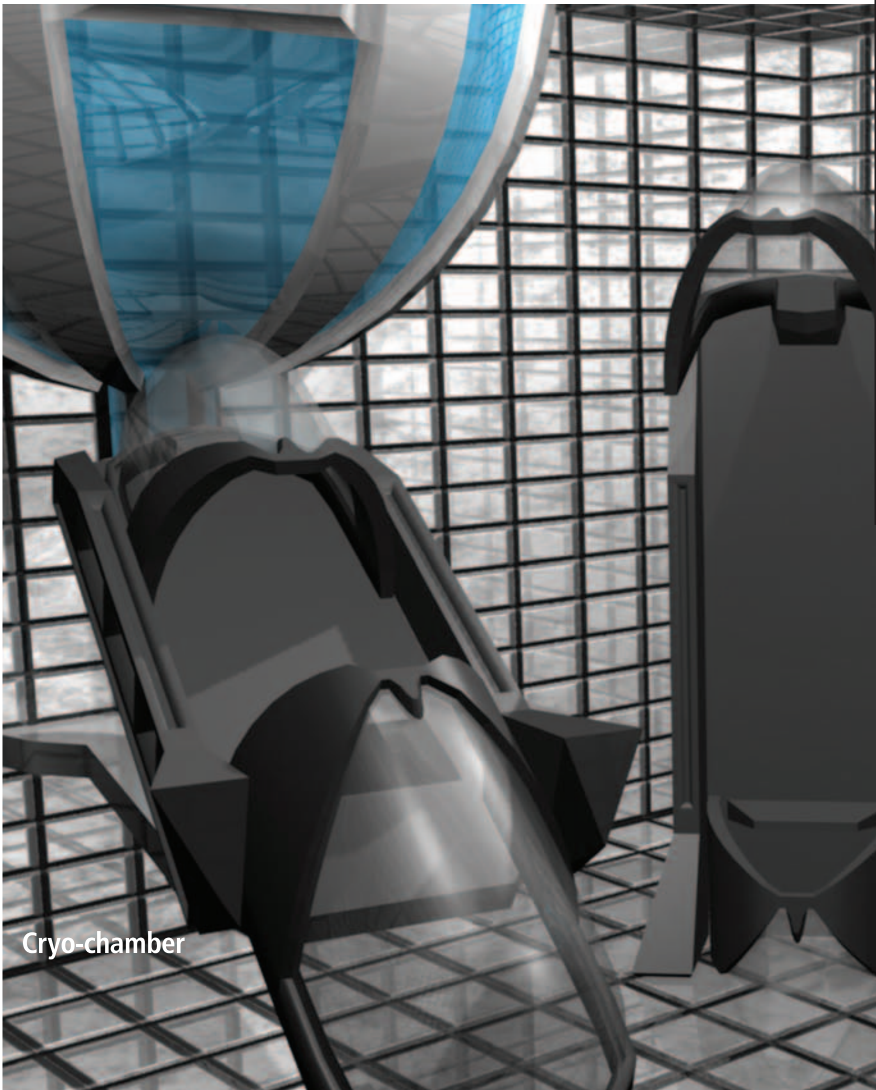
The mechanic, the only female character of the four, works well with computer terminals, locks, and the breaking or fixing of things. Throughout the game, she gets quicker and more skillful at repairing machinery and cracking schematic plans of enemy vehicles.

The Chemist

Equipped with a body suit that allows him to deal with almost any biochemical, biohazardous, or bionuclear situation, he is the scientist of the operation. He is skilled in the art of mixing chemical and biological weapons, defusing enemy weapons, and finding cures for other chemical or biological weapons.

The Psychic

He has the ability to see the past, and is also telekinetic. Due to his abilities, he is the only player able to see some of the clues in the game.



Cryo-chamber

SIZE MATTERS

Analytical chemistry research moves toward miniat

Two professors prove that the biggest ideas can come in the smallest packages.

By Eric Nelson

Ever since Q demonstrated his first high-tech spy gadget to James Bond, the world has been fascinated with tiny devices that can do incredible things. The trend continues in the many crime and medical dramas now on TV, where props might range from a handheld analyzer that detects deadly toxins to a portable disc that performs thousands of complex blood tests.

Most of these instruments are fictional — at least for now. But you can find prototypes in the laboratories and research facilities of Henry Bohn Haas Distinguished Professor of Chemistry R. Graham Cooks and John H. Law Distinguished Professor of Chemistry Fred E. Regnier, who continue to prove that the biggest ideas often come in small packages.

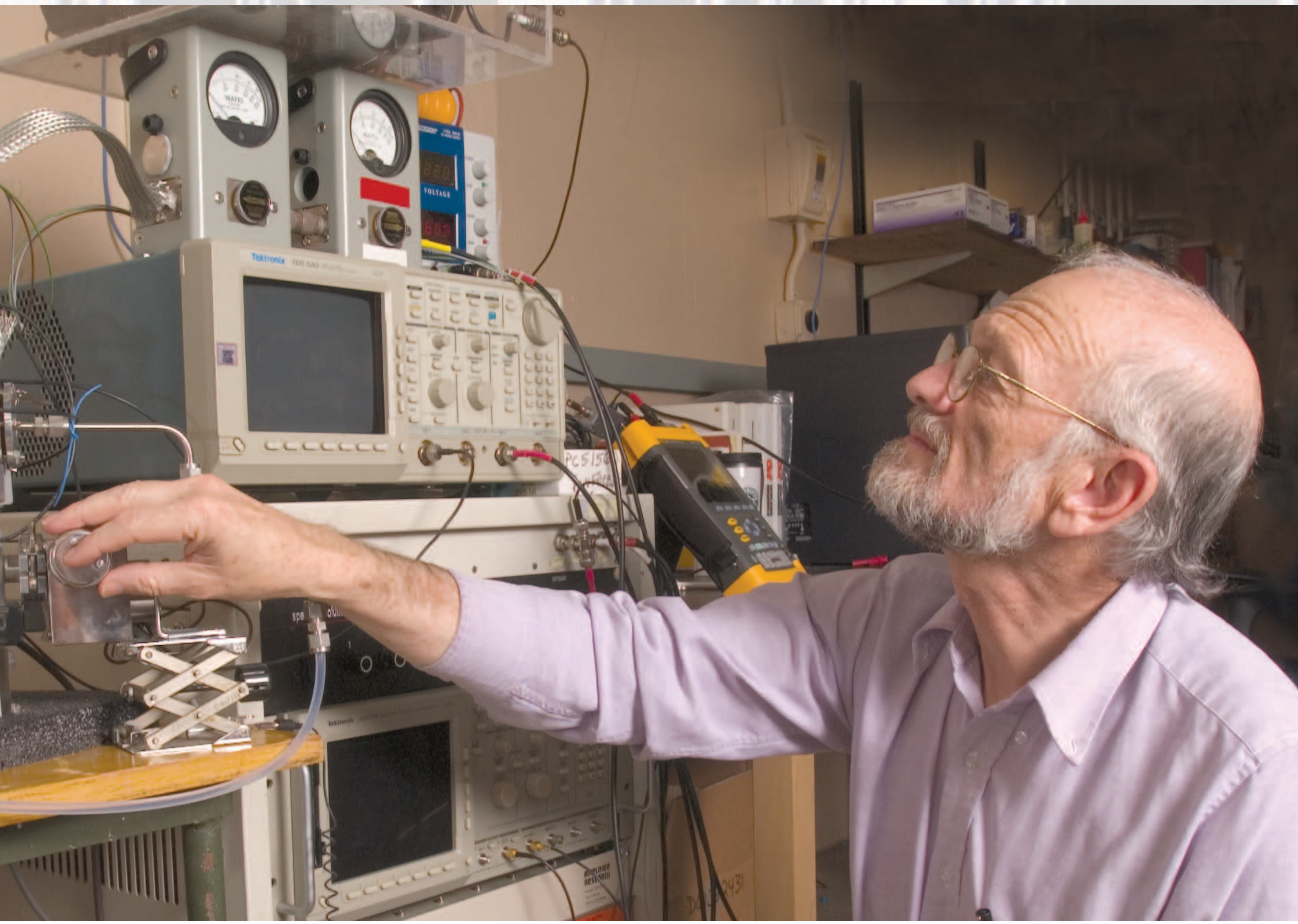
Fielding the lab

Many of the big ideas originate from Purdue's Aston Laboratories for Mass Spectrometry and an eclectic group of researchers tucked quietly away in the basement of the Wetherill Laboratory of Chemistry. Led by Cooks and his colleagues in the College of Science, the facility is widely recognized as one of the world's leading sources of innovation in the $2 billion-a-year mass-spectrometry industry.

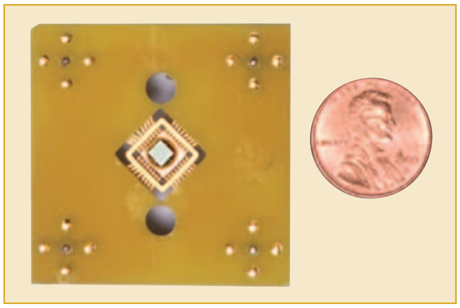
Mass spectrometers are one of the most vital pieces of equipment in a modern lab, Cooks says. They allow scientists to see the exact chemical makeup of a substance, displaying each compound's unique signature as a series of peaks and valleys on a chart.

URIZATION

After years of a "bigger is better" mentality, the trend in instrumentation has taken a 180° turn. Haas Distinguished Professor of Chemistry R. Graham Cooks' mini-mass spectrometer could easily fit in a backpack. Using diagnostic equipment in the lab, Cooks ensures that all features are working properly.



“The primary advantage of mass spectrometry is its applicability to any sample for testing, from the doping of racehorses, quality control in pharmaceuticals, and metallurgical analysis to natural products and new organic compounds that have been synthesized for the first time,” Cooks says. But mass spectrometers are complex, vacuum-based systems, with relatively slow, and delicate instruments. The industry trend has been towards ‘bigger is better.’ But large instruments are limited to lab use.



This chip, manufactured by Sandia National Laboratories, is the key piece in the mini-mass spectrometer. Researchers from Sandia have come to Purdue to work alongside Cooks and ensure that their contribution is doing its job.

“To use mass spectrometers in the field, you have to make them smaller,” Cooks says. “Instead of taking the sample to the mass spectrometer, we began to take the mass spectrometer to the sample.”

One of the most promising areas of research is the development of a method that allows sampling to be done in ambient conditions rather than in a vacuum, he says. In addition to making mass spectrometers smaller and more portable, such technology would improve the instruments’ performance and stability.

“As an end point in fieldable (sic) instruments, we are attempting to produce a handheld mass spectrometer,” Cooks says. “Where we are at this point is more of a backpack mass spectrometer, but those are still very capable devices.”

Building on tradition

“Our major advantage in the chemistry department is a tradition and infrastructure in instrumentation that is without question the best in the country,” Cooks says. That reputation helps Purdue’s Jonathan Amy Facility for Chemical Instrumentation attract the best and brightest researchers in instrument design and development, not only from chemistry, but also engineering, physics, and other areas.

Work with miniature mass spectrometers was particularly appealing to Zheng Ouyang (PhD ’02) because of its possible applications in his native China. He and Cooks are currently collaborating with several Chinese universities to investigate the technology’s potential for pesticide testing, which is a critical issue to the country’s agricultural industry.

“There are few places doing instrumentation research that combine chemistry and engineering, but Purdue is well known for it,” Ouyang says. “That’s why I chose to come here.”

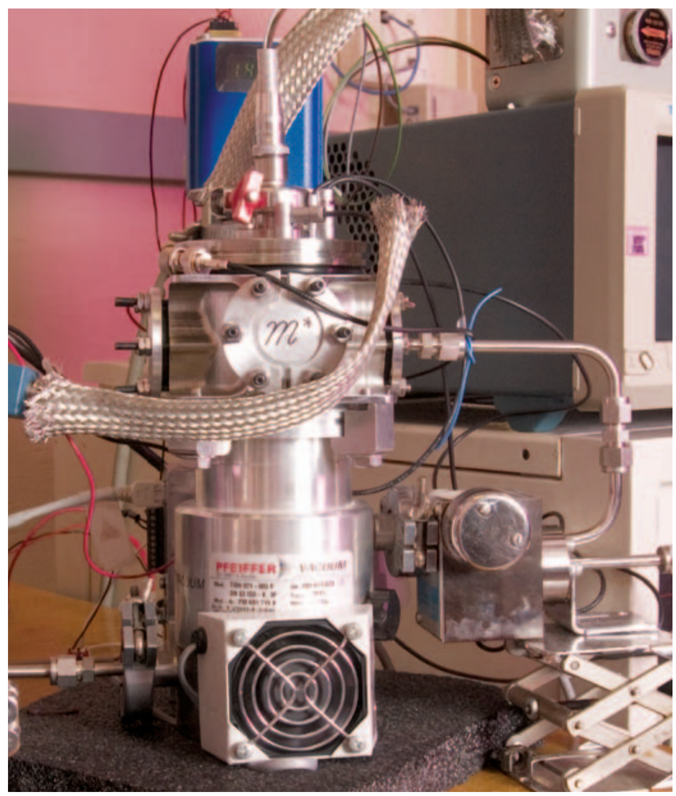
Even as the research and its applications become more international, Cooks is mindful of its positive impact closer to home. Recently honored by Purdue’s Office of Engagement with the Outstanding Commercialization Award, Cooks is committed to advancing both science and commerce. “We want to make sure there are economic advantages to Indiana and at the same time continue to build our worldwide reputation in instrumentation,” he says.

Shifting the paradigm

Next door in Brown Hall, Prof. Fred E. Regnier is part of an interdisciplinary team using miniaturization to develop technology that could revolutionize the clinical medicine industry.

“While at the macro scale you might do one thing, at the micro scale you can quite easily do thousands,” says Regnier.

Building on their earlier research in miniaturization, Regnier and Physics Professor David Nolte have pioneered a method of creating analog CDs that can function as inexpensive diagnostic tools for protein detection. Because the concentration of certain proteins



Cooks’ mini-mass spectrometer maintains all the functions of a traditional mass spectrometer, but its size opens the door to many field applications, from medicine to airport security.

in the bloodstream can indicate the onset of many diseases, such a tool would be a welcome addition to any doctor's office.

With current technology, says Regnier, blood samples are sent to outside laboratories for analysis — a procedure that screens for only a few of the thousands of proteins in the blood and also is costly and time-consuming. "If we could do thousands of these tests at a time — quickly and using a single drop of blood — it would enormously extend our ability to diagnose disease," he says.

Such a device would also allow physicians to monitor the health and disease indicators of a person throughout his or her lifetime.

"It will no longer be necessary to compare an individual against the population," Regnier explains. "Instead, we can compare someone against himself or herself. We can see if an individual's results are changing at a normal rate that is consistent with the aging process."

Currently, the medical diagnostics industry is dominated by a few large clinical laboratories. "The diagnostics market is relatively stable," says Regnier. But these products will force a change, he says.

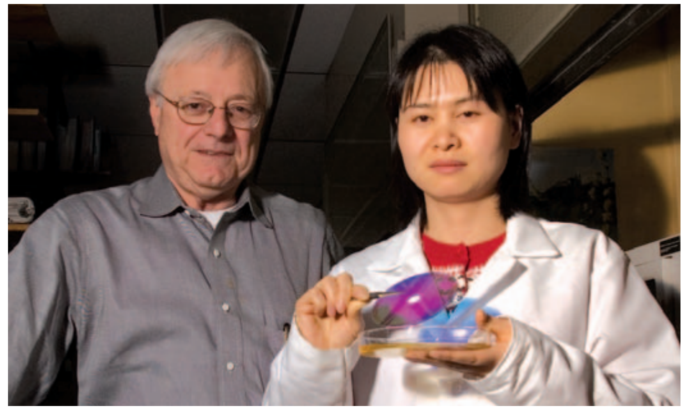
"It's been called a disruptive or paradigm-shift technology," Regnier says. "We're talking about moving diagnostics out of the clinical laboratories and to the site of need — the doctor's office. If we and the other small companies who are introducing these products are right, the big companies will move in this direction to keep from losing market share. This means they must either invent something themselves, or acquire the small innovators."

> *"Our major advantage in the chemistry department is a tradition and infrastructure in instrumentation that is without question the best in the country."*

According to plan

The shift may occur sooner than some predict. Regnier and Nolte have already patented the concept of a 'BioCD' that would function much like a traditional compact disc, which stores digital information such as computer data as billions of microscopic "pits" in its surface. These tiny pits, representing binary ones or zeroes, are etched in concentric tracks from the inner to the outer edge of a CD.

Instead of pits, the BioCD uses "posts" like upside-down miniature test tubes. Each post can be stamped with a trace chemical quantity that reacts to a certain protein found in blood. Blood contains



Law Distinguished Professor of Chemistry Fred Regnier and graduate research assistant Wonryeon Cho display the BioCD. The BioCD is slightly smaller than a standard compact disc, but one disc could be programmed to test blood for up to 10,000 different proteins.

thousands of proteins that physicians would like to monitor, and up to 10,000 tracks on a CD could be paired up with a different protein.

"Once the surface has been exposed to a blood serum sample — which would not need to be larger than a single drop — you could read the disc with laser technology similar to what is found in conventional CD players," Nolte explains. "Instead of seeing digital data, the laser reader would see how concentrated a given protein had become on each track."

While it could take years before they become standard equipment in doctors' offices, efforts to commercialize the BioCDs and related products have begun. The concept is being marketed by QuadraSpec, a West Lafayette-based startup company that has licensed the Purdue researchers' technology. In addition to diagnostics, QuadraSpec is leveraging it for uses in veterinary medicine, homeland security, and food and water testing. "There are many, many applications for these little devices," Regnier says.

The market's response has so far been promising. During the 2004-05 academic year, QuadraSpec took the top prize in three separate business plan competitions. The technology is also beginning to attract investors, adds Regnier.

"Not many academic patents are commercially successful," he notes. But Purdue's researchers now have a better chance at success because of a culture change that's occurred at the University, Regnier says. Entrepreneurship, once discouraged among faculty, is now supported and encouraged. "Purdue played a big role in helping us start QuadraSpec," he says.

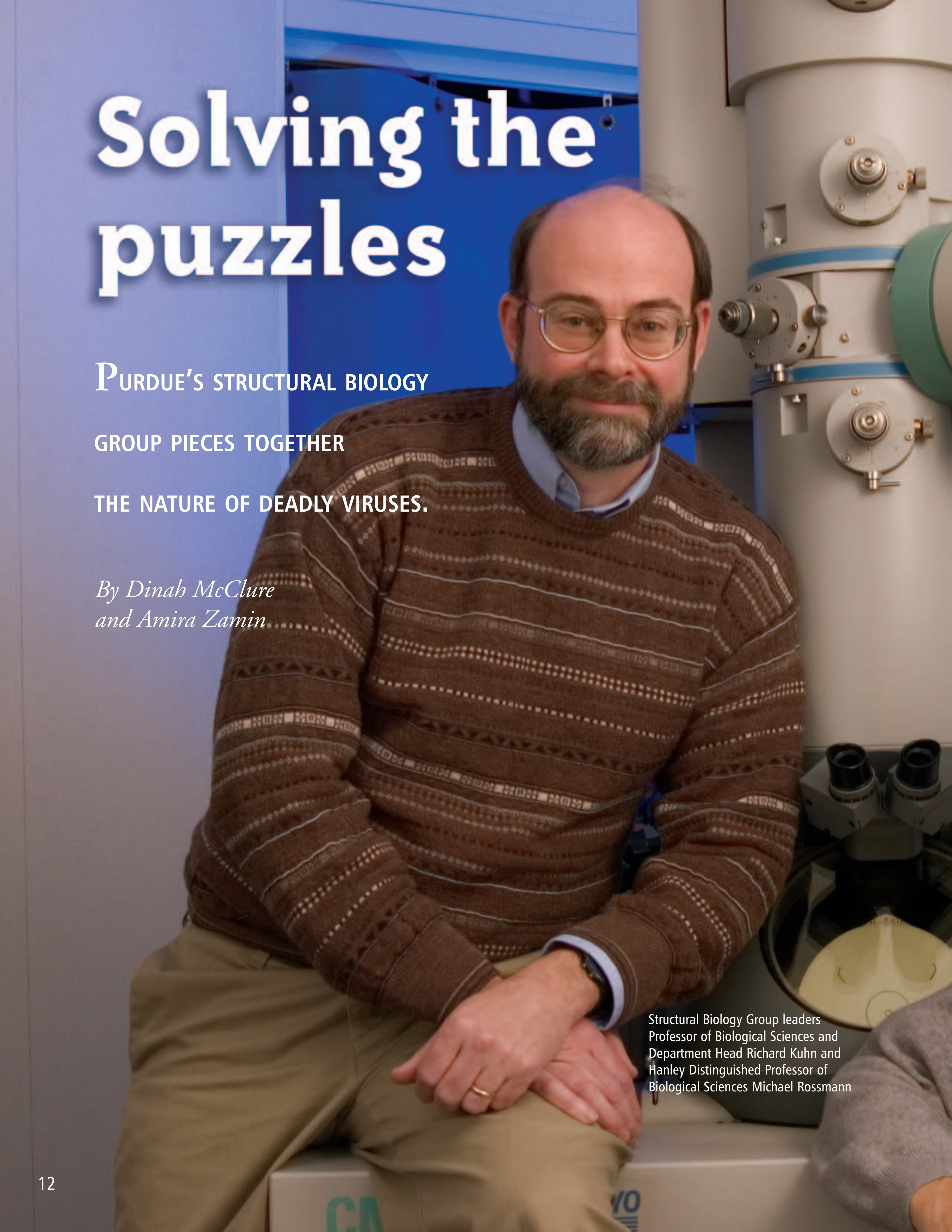
Purdue's interdisciplinary approach has further fueled the spirit of innovation. "Our people are our greatest strength," Regnier says. "We work in an atmosphere both within the college and across campus that is conducive to interaction and collaboration."

Chad Boutin of Purdue News Service contributed to this story.

Solving the puzzles

Purdue's structural biology group pieces together the nature of deadly viruses.

By Dinah McClure and Amira Zamin



Structural Biology Group leaders Professor of Biological Sciences and Department Head Richard Kuhn and Hanley Distinguished Professor of Biological Sciences Michael Rossmann

The T4 virus (below), long known to infect E. Coli bacteria, changes its shape during an infection. High-resolution snapshots of the virus attacking its host (which culminated in a movie of the process) could reveal secrets of viral infection and improve gene therapy techniques.

Imagine a thousand-piece jigsaw puzzle. It looks like the image in a kaleidoscope with symmetrical colored patterns.

Now imagine that completing the puzzle could add to knowledge that may cure disease and ultimately save lives.

For a structural biologist, the puzzle is a molecule, and the challenge is to define its architecture, atom by atom, like putting together a thousand-piece puzzle without knowing exactly what the final picture should look like.

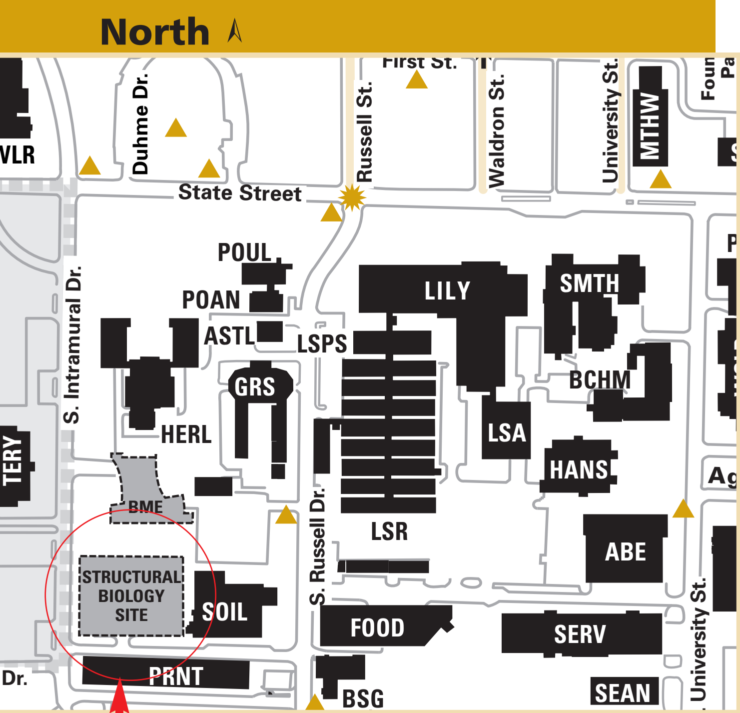
Using methods from biochemistry, biophysics, and molecular biology, a talented and growing team of Purdue structural biologists has already earned worldwide recognition in solving some of nature's most complex puzzles.

In 2002, the Purdue group, including Wei Zhang, Ying Zhang, Tuli Mukhopadhyay, Paul Chipman, and others, led by Michael Rossmann and Richard Kuhn, in collaboration with Tim Baker, mapped the structure of the mature dengue virus, a mosquito-borne pathogen that causes fever, muscle aches, headache, rash, and hemorrhagic complications. The virus kills more than 24,000 people worldwide each year.

The next year, the team produced high-quality images of the immature dengue virus still forming in its cellular host, a finding that shed more light on how this kind of virus reproduces.

"With that work, we had begun to dissect the individual steps in a virus's life cycle," says Rossmann.

Two short years later, Rossmann, founder of structural biology at Purdue, and Kuhn, whose research interests focus on lipid-enveloped viruses — like rubella, Ross River, and Venezuelan equine encephalitis viruses — and flaviviruses, which include yellow fever, dengue, West Nile, and hepatitis C viruses, announced they had solved some of the structural puzzles of West Nile virus.



Proposed site for the Structural Biology building is located east of Discovery Park on South Intramural Drive.

A home at last

Top priority for the College of Science this year is the construction of a new building for the Structural Biology program. The team has garnered international recognition for its work with the human rhinovirus, the dengue virus, and the West Nile virus, among other discoveries.

The new building will bring together researchers from around the campus in a customized facility designed to further discovery and enable the interaction it requires. The building will include the latest in equipment, including specialized laboratory suites, isolated electron microscopy suites, shared instrumentation pods for x-ray diffraction, and space for the newest helium-cooled cryomicroscopes.

"We have a constant need to improve and upgrade the technological procedures," said Structural Biology Group leader Michael Rossmann.

The College of Science welcomes inquiries about and donations to this valuable addition to the Structural Biology program. For more information, please contact Mary Jo Bartolacci, Director of Advancement, at (765) 496-3525 or mbartolacci@purdue.edu.

Gathering the pieces

Though mapping the West Nile virus is the latest in a string of high profile discoveries made by the group, the momentum has been building for years. Rossmann is internationally known for his contributions to the field of structural biology, although his humble personality never gives that away.

"There are two reasons people get into research: one is the personal enjoyment of discovery. The other is wanting to feel they've contributed something to humanity and human knowledge," Rossmann says. He cites both reasons for getting him into crystallography, his area of specialization, as well as a fortuitous opportunity to get to know crystallographer Kathleen Lonsdale while he was in high school.

"For me at the time, crystallography was a game, a jigsaw puzzle. The biggest puzzle seemed to be proteins," he says. Along the way, he learned about computers and other new technologies that came along.

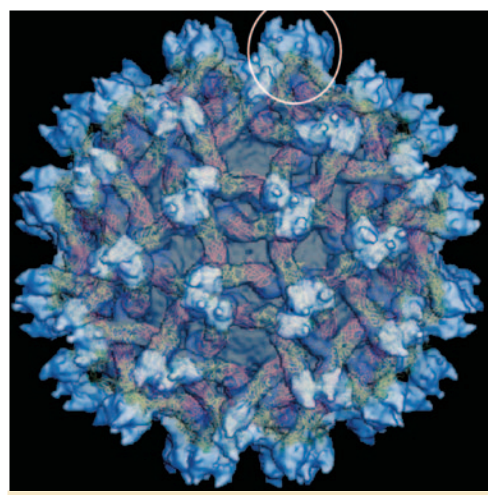
When the National Institutes of Health (NIH) redirected him toward animals rather than plants, Rossmann began looking at various viruses. Many viruses tend to be symmetrical, making mapping their structure easier than that of other organisms.

One of his crowning achievements came in 1985 when his team, including Eddy Arnold, Gert Vriend, and John Erickson, was the first group of scientists to build a model of human rhinovirus-14 (HRV-14), one of about 100 known common cold virus strains. The work opened the gates to new discoveries that have led to the development of antiviral drugs.

In 1999, the NIH awarded the group a $6 million, five-year grant to study togaviruses and flaviviruses.

"Very little is known structurally about these viruses," Kuhn said at the time of the award. "What we can determine about one can be extrapolated to help us understand the structure of other viruses in the family."

The similarities between viruses in the same family helped the group in their research into both dengue and West Nile viruses. Their success with these viruses



When the team uncovered the structure of the dengue virus, they were also able to capture images of the virus maturing. (seen above). Knowledge of the maturation process of viruses may allow other researchers to develop methods to prevent or interfere with this change.

led to an additional NIH program grant of $15 million to further expand research into these viruses.

"What we already know from studying other flaviviruses gives us a leg up in understanding West Nile's behavior," Kuhn says. "Dengue, for example, has a very similar structure to West Nile, but its surface features are sufficiently different. Comparisons could help shed light on how West Nile operates."

Before computer modeling, Michael Rossmann, Hanley Distinguished Professor of Biological Sciences, built his models by hand, as seen here in a picture from 1971. Although the process was very time intensive, he says he became much more familiar with the intricacies of the structure by the end of the project.

From marshmallows to microscopes

The technique high school chemistry students use to model atomic structures with marshmallows and toothpicks is similar to Rossmann's for building his first models.

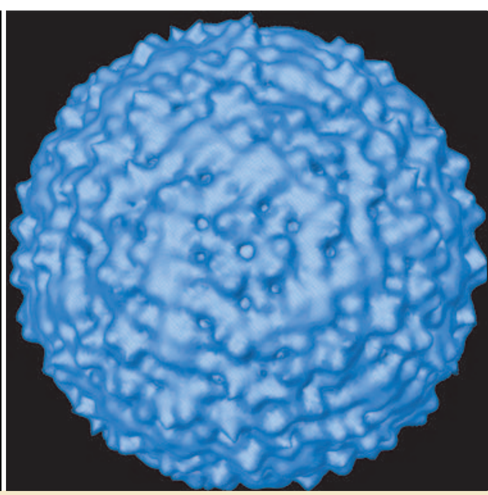
"In the days when we did it by hand, it took an awfully long time to do just the basic work of displaying maps. But you learned a lot because you became very familiar with it as you were building it. To build these things now by computer takes a day or two, and it used to take a month or two," he says.

Developments in microscopy and computer imaging have streamlined many stages of the discovery process. Researchers now use cryo-electron microscopy and X-ray crystallography. Cryo-electron microscopy traps and freezes virus particles in an ethane solution. Viruses frozen in their natural state — not squished, stained, or dried out — can be viewed with a powerful electron microscope. X-ray crystallography also uses powerful computing equipment. The proteins in the virus are hit with an X-ray beam and the crystals diffract, producing tens of thousands of little spots on a detector-like film. A computer helps the researcher put together the spots into a picture of the virus.

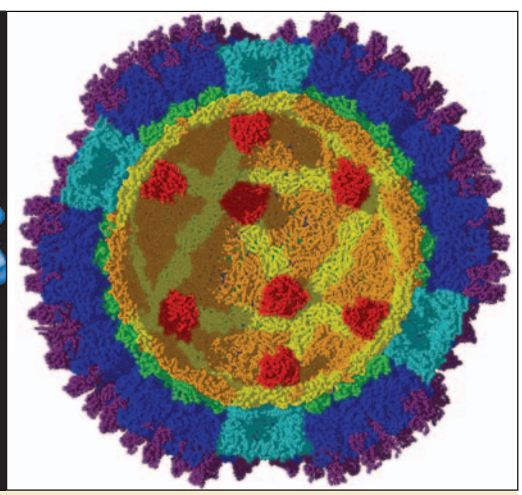
"Dr. Rossmann's pioneering research demonstrates the power of combining two biophysical methods — cryoelectron microscopy and X-ray crystallography — and how this approach can provide new insights that may not be obtained from a single methodology," says Kamal Shukla, program director for molecular biophysics at the National Science Foundation. The combination of the two technologies enabled researchers to capture pictures of the dengue virus as it was maturing.

With the dengue discovery tucked under their belts, members of the group turned their attention to the West Nile virus and the major surface proteins of the virus particle.

"Proteins are in charge of doing all the essential running of life," says Miriam Hasson, associate professor of biology. "It is as if we are watching a play about life — we are watching not only the actors (proteins that get out in the news), but also those dealing with the lights and riggings (i.e. metabolic proteins)."



A Purdue team's 2003 mapping of the structure of the West Nile virus determined the orientation of the major surface proteins of the virus. These proteins are instrumental in allowing the virus to bind to and invade a host cell.



This cross section of a reovirus, from research done by Prof. Tim Baker and his team, reveals the inner features of the viral particle. Visible for the first time within the virus are several tiny "factories," shown here in red, which convert raw materials from a victim cell's interior into RNA messages instructing the cell to begin manufacturing more viruses.

Proteins are the driving force behind a virus's structure, says Kuhn, and they form the outer shell of the virus. Antibodies work against surface proteins, so learning about those proteins is essential to developing vaccines and antivirals.

"We can now clearly understand how these proteins interact with one another," says Kuhn. "We can't cure West Nile yet, but we can start thinking about how to interfere with these interactions, and that could be a key to stopping the infection's progress."

The Lewis and Clark of vaccines

In the same way that Lewis and Clark had to map the west before settlers could imagine venturing forth into it, structural biology must define the architecture of a virus before pathologists and biologists can begin searching for antivirals.

"Structural biology allows us to ask two questions: One, how does this thing put itself together, and two, how can we interfere with that process?" says Kuhn.

Assistant professor and group member Jue Chen points out that although establishing the structure doesn't always mean an antiviral is right around the corner, the possibilities for such compounds are always present in the research.

"If we can determine the atomic structure of a virus protein in complex with the cell surface receptor, we will know the details of how the virus attaches a target cell. These details will enable people to design compounds that will block such attachment. Such compounds are potential antivirals," she says.

Last year, the Purdue Structural Biology Group made national news by using cryto-electron microscope images to create a brief animated movie of a bacterial virus attacking its host. An international team headed by Rossmann, and including Purdue's Petr Leiman, Victor Kostyuchenko, Shuji Kanamaru, and Chipman, as well as Vadim Mesyanzhinov in Moscow and Fumio Arisaka in Tokyo, obtained clearer pictures of the T4 virus, long known to infect E. coli bacteria, altering its shape as it prepared to pierce its host's cell membrane. The images showed the operation of the virus's baseplate, which sits at the bottom of the head of the virus and acts as a communication center, telling the virus what to do next.

"Instead of a still photo of the baseplate, we now have a movie of it opening," says Rossmann. "A better understanding of the infection process is a step forward for fundamental science, but it also could allow scientists to alter the virus so that it could target cells other than E. coli. T4 might then be used to deliver beneficial genes to damaged or infected human tissue."

Lookin' bright

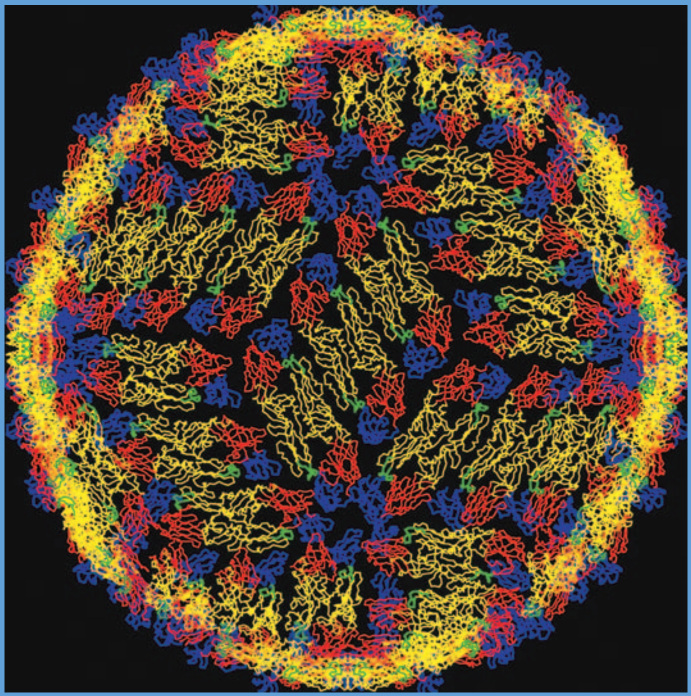
With so much experience and enthusiasm to their credit and a new, state-of-the-art building in the works, the structural biology group has a lot to look forward to.

Recently, they were awarded a $1 million grant to look at how antibodies bind to dengue virus. Building on their successes with symmetrical viruses like West Nile and dengue, the group is also looking at more complex viruses, like measles, or the Hantaan virus that appeared in the southwestern United States in the early 1990s. Other major projects on the horizon include structural studies of membrane proteins and large complexes of proteins.

"We're doing great science now, but we will expect a lot better with new facilities," Kuhn says.

The new building will include microscopy suites within a containment facility, making it easier for the group to study high-containment viruses like West Nile, which require special handling and equipment when moved from one lab to another. With the new facilities, they won't have to be moved.

"The modern facilities are simply a facilitator of better science," says Kuhn. "With them we'll be able to do our science more efficiently."



What's going on here?

There's more here than meets the eye. This image of the dengue virus shows the surface proteins of the virus. Protein strings, called polypeptides, don't lie straight – they fold up, with each section folding in a different, distinct way. Dengue's three different folds, called domains, are color-coded.

Red represents domain 1.

Yellow and green represent domain 2. The green section is involved in the fusion that brings the virus cell together.

Blue represents domain 3. This area is usually involved in adhesion, and is probably where the antibodies bind to the virus. On the edge of the image, the blue section sticks out a little farther than the others.

"[When I see this] I see the beauty and simplicity of symmetry; I see how nature perfectly packs proteins together to create a structure that is so simple and stable. If I stare at it even longer, I'll start to imagine how this structure changes shape during an infection," says Assistant Professor Jue Chen.

The air up there

The Shepson Research Group prepares to launch the 45-foot-long research balloon that collects air samples. The helium-filled balloon is made of a polymer-coated nylon and requires 10 people to manage is when it's on the ground. The balloon is powered and controlled through a cable and tether system that holds up 1,000 pounds of torque. This is connected to a winch developed specifically for this balloon by the Jonathan Amy Facility for Chemical Instrumentation.

"At the moment, most of the Arctic Ocean is covered in this sheet of ice, and in 50 years, it's likely to be mostly gone," Paul Shepson, a professor in chemistry and in earth and atmospheric sciences, explains.

In a joint project with the University of Fairbanks and Environment Canada, members of the Shepson Research Group spent the spring semester in northern Alaska collecting samples that would allow them to begin to assess the impact losing the Arctic ice could have on climate worldwide.

"[People] are contributing to an enormous change in the Arctic," explains Shepson. As atmospheric temperatures rise worldwide, the ice caps, home to polar bears and seals, among others, are melting. "Within our lifetime, the habitat for these animals will be gone."

In Barrow, Alaska, 340 miles north of the Arctic Circle, the team collected air samples at various altitudes over snowpacks and ice cracks, known as leads, to develop a profile of the release of a chemical called acetaldehyde.

"[Acetaldehyde] is a precursor to a molecule called PAN, which is carcinogenic and related to production of ozone, a human respiratory irritant," says Shepson. Acetaldehyde is emitted by cars, some production facilities, and is also contained in tobacco smoke. It is in the same family of chemicals as formaldehyde, a chemical commonly used in embalming and another environmental contaminant.

The ice sheets provide a mechanism for temporarily locking up some of these chemicals, since they get absorbed into these frozen masses. But when sunlight hits, they are released.

"There are chemical compounds that help clean the atmosphere that are emitted from sunlit snow packs. And there are chemicals that are removed from the atmosphere that then re-enter the snowpacks, some of which are toxic," says Shepson. The same is true of cracks in the ice.

This emission into the atmosphere and re-entry into the snow and ice sets up the two research foci of the trip: first, to understand how gases like acetaldehyde get trapped in snow and ice to begin with to achieve a better understanding of ice cores and how they record past atmospheres in their frozen layers; second, to learn how these chemicals can be photochemically produced in snow and ice and then released into the atmosphere, where they affect air quality. This understanding is important, since the amount of sea ice and snowcover is decreasing in the Arctic. The profile the team is establishing through its research will help answer how substantial the impact of this change could be.

Shepson's study lays the groundwork for a broader 2007 study. 2007-08 has been designated "International Polar Year," and environmental agencies worldwide have committed to funding Arctic and Antarctic projects that year. One such project, called OASIS (Ocean, Atmosphere, Sea Ice, and Snow pack), will study the interaction of chemical species among those four areas. — *Amira Zamin*

More grants for Endocyte's cancer treatment drugs

Endocyte, Inc., a Purdue Research Park life science company, has garnered more than $3.5 million in federal and state grants to make cancer treatment drugs more potent while also easier for patients' bodies to tolerate. The grants — $1.63 million from the National Cancer Institute and $1.95 million from the Indiana 21st Century Research and Technology Fund — will enable Endocyte to complete preclinical research on tumor-targeted chemotherapeutics. Endocyte is founded on folate targeting research conducted by Phil Low, Ralph C. Corley Distinguished Professor of Chemistry (pictured at right).

Phil Low

Miller chairs provide much-needed faculty support

Three endowed faculty chairs in nanoscience, bioscience, and cyberscience will be funded by Purdue alumni William F. and Pat Miller. The Miller professorships all will be associated with the College of Science and each will be named a Miller Family Chair. The Millers' donation will be matched by funds from the Lilly Endowment's Faculty Endowment Challenge. William Miller is a former provost at Stanford University and earned his undergraduate degree in physics in 1949, a master's degree in 1951, and doctorate in 1956, all from Purdue. The University also awarded him an honorary doctorate in 1972. Pat Miller earned her undergraduate degree in 1953 in American and English literature.

Science Advancement Team welcomes two new faces

Dana Neary

Lisa Robertson

Alumni and friends can look for two new faces at College of Science events from now on. This year, Dana Neary joined the team as director of alumni relations and special events, and Lisa Robertson came on as director of corporate relations.

Though a southern gal at heart, Neary has developed a great fondness for Purdue and its alumni in the 12 years she's been here.

"Purdue alumni are a lot of fun. They really take pride in their alma mater," says Neary. Prior to working with the College of Science, Neary worked with alumni in the College of Engineering and the College of Agriculture. In her position, Neary will lead alumni board meetings and coordinate events such as Distinguished Science Alumni and Homecoming festivities.

Lisa Robertson accepted the new position of director of corporate relations. Over the coming months, Robertson will be developing a college-wide Corporate Partners Program and strengthening existing corporate relationships. According to Robertson, "The brainpower available in the College of Science is a tremendous resource for companies."

All alumni and friends are invited to contact Nearly (nearyd@purdue.edu) or Robertson (robertsl@purdue.edu) with questions about their respective areas. Look for more information about the Corporate Partners Program in the Fall/Winter issue of *Insights*.

Introducing the Lawson Computer Science Building

The new computer science building will be named the Richard and Patricia Lawson Computer Science Building, in honor of alumni and lead donors Richard and Patricia Lawson. During Homecoming week, the University held a naming ceremony in which President Martin C. Jischke presented the Lawsons with the Pinnacle Award in recognition of their gift. The Lawsons' gift of $4.7 million forms the largest single private contribution to the $20 million facility. The building is slated to open in time for classes in the fall of 2006.

Undergrad biology is H.O.T.

Beginning in the 2004-05 academic year, the Department of Biology introduced H.O.T. Biology, a new approach to teaching undergraduate biology courses. Focused on the practical skills that biologists use, the courses have been nicknamed Hands On Training in Biology or H.O.T. Biology. While the students use microscopes like other courses do, they also take them apart and learn about the optics of the microscope to establish a better understanding of the apparatus (seen to the right).

Matthew Huber

Huber hits the top 100

Earth and Atmospheric Sciences Assistant Professor Matthew Huber's research on the last days of the dinosaurs and the millennia that followed was listed in *Discover* magazine as one of the top 100 scientific discoveries of 2004. Huber's research indicates that the cooling that contributed to the end of the dinosaurs lasted for thousands of years, explaining the existence of cold-water-loving organisms in places like modern-day Tunisia.

Barbara Clark

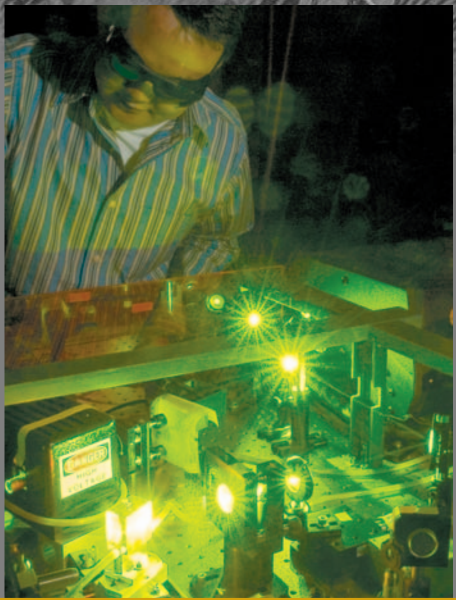
WISP celebrates 10 years

Seventy graduate students and guests gathered at a special program on January 26, 2005, to mark the 10th anniversary of Women In Science Programs. WISP Director Barbara Clark introduced the featured speakers: Martha Chiscon, professor and associate dean emerita, who was a Purdue pioneer in programs for women in science, and Lynn Bryan, a WISP alumna who is on the faculty at the University of Georgia.

Macroscope

World Year of Physics

Photo courtesy Lucent Technologies



1904—The Department of Physics at Purdue University is created as a separate department.

1905—Albert Einstein first publishes his theory of relativity, solving the problem of the connection between electromagnetic theory and ordinary motion with the "principle of relativity." In the same year, he also publishes papers on light and Brownian motion.

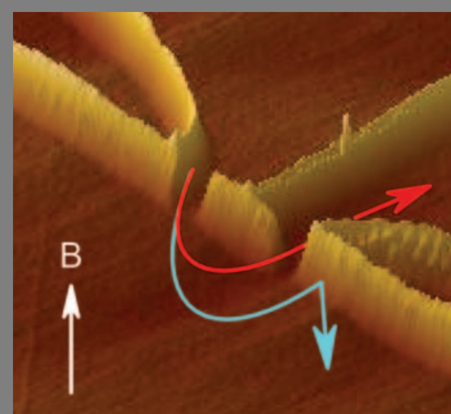
1947—A group of scientists at Bell Labs (now Lucent Technologies) have been working on developing the first transistor. They start to get nervous when they suspect that physicists at Purdue might scoop them on the discovery. The Bell Labs team had come up with a transistor that almost worked, but the piece of germanium they used wasn't high enough quality. A better quality piece, grown at Purdue in the Physics Building, is added in 1947, and the first working transistor is created.

1960—Theodore Maiman develops the first laser.

1970s—Purdue graduate Aram Mooradian makes significant contributions to a category of lasers known as YAG lasers. His contributions are a direct outgrowth of his PhD work at Purdue, "Radiative recombination in III-V compounds." Above, current Purdue graduate student Nara Dashdorj works with a YAG laser setup.

In 1905, Albert Einstein published three papers that each influenced the field of physics. Only a year earlier, in 1904, Purdue University officially established its Department of Physics, separating physics from the School of Engineering. A century later, we celebrate Einstein's accomplishments with the World Year of Physics, and the 100th birthday of the Department of Physics at Purdue University.

YEARS



1975-76—Two Purdue physicists, Albert W. Overhauser and Roberto Colella, attract international attention with the announcement of an experiment that links gravity and quantum mechanics. The device used in the experiment incorporated very modern techniques, connecting two areas not previously connected.

1980s—Mesoscopic physics — now called nanoscience — is gaining in popularity. Nick Giordano, a faculty member at Purdue, is one of few researchers in the growing field. He is taking measurements with mesoscopic wires. The wires are so small that physicists have to find new ways of explaining their behavior, since the old rules don't seem to apply. Above, graduate students Dan Lawrence and Todd Jacobs work in Giordano's lab.

2004—Leonid Rokhinson, a young physicist at Purdue working in spintronics, develops a way to separate electrons based on their spin, up or down. The discovery could pave the way for quantum computing.

Breakthroughs

In their research, scientists at Purdue tackle diverse questions, from the far reaches of the universe, to the tiny corners of nanoscience. Centers and research teams are established to further encourage the collaboration necessary for discovery. Each issue, Breakthroughs will highlight some of the latest progress and contributions Purdue researchers are making.

Light kills — really

A team of scientists including **Harry Morrison**, professor of chemistry, has developed a group of rhodium-based compounds that, when exposed to light, can kill tumor cells and deactivate a virus closely related to the West Nile and yellow fever viruses. Unlike standard substances used in chemotherapy, the Purdue team's compounds are not harmful to the body. While therapies based on this discovery are years away, its potential applications include anti-cancer agents and blood sterilization.

E. coli in the spotlight

Structural biologists including **Michael G. Rossmann**, Hanley Distinguished Professor of Biological Sciences, have obtained clearer pictures of how the T4 virus prepares to pierce its host membrane's cell. The virus has long been associated with E. coli. Rossmann and his team have used the images to create a short movie that demonstrates the virus' action.

Big grants for nanoscience

The National Science Foundation and the Environmental Protection Agency have awarded grants totaling nearly $2 million to the Purdue Nanoscale Interdisciplinary Research Team and a colleague from the University of Minnesota. The team is looking into the environmental impact of manufactured nano-sized materials. The tiny structures are becoming more common in industry, but their effect on and interaction with the environment remains unknown.

A team of researchers including **Leonid P. Rokhinson**, assistant professor of physics, working in the area of nanotechnology, has created a device that will separate a stream of electrons according to their spin, up or down. The development is a crucial step towards the possibility of quantum computers.

Testing the living

Analytical chemist **R. Graham Cooks**, Haas Distinguished Professor of Chemistry, and a team of researchers have developed a method for mass spectrometer analysis of living materials. The in vivo mass spectrometer sampling uses a wand, added to a traditional gas chromatograph mass spectrometer, to deliver a high-velocity spray of fluid, and then takes in and analyzes the particles kicked up in the high-velocity storm. The research was published in the October 12, 2004 issue of *Science*.

Inside the model plant

A Purdue University team of researchers from the Statistical Bioinformatics Center became one of few groups worldwide to use sophisticated statistical models to analyze microarray genetics data from the Arabidopsis plant. The team includes center head Rebecca W. Doerge, professor of statistics. Their research was published in the June 2004 issue of *Nature*.

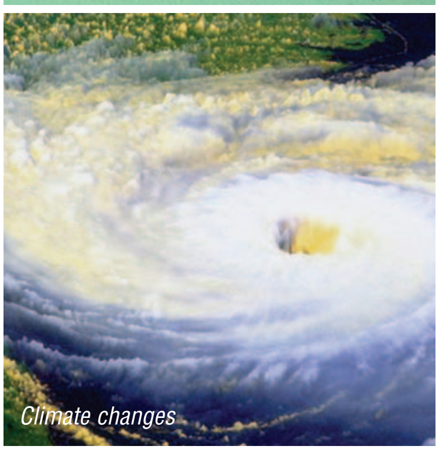
In vivo mass spectrometer samples a rose.

Arabidopsis

A cold way to go

A Purdue University research group including **Matthew Huber**, assistant professor of earth and atmospheric sciences, has provided further confirmation that the catastrophe that ended the reign of the dinosaurs ended in an icy darkness. Their conclusion stems from fossil analysis from a Tunisian site, and showed cold-loving dinoflagellates and benthic formanifera appearing suddenly in the strata in a place that used to be a warm-water sea. The sudden cooling may have taken up to a millennium to abate.

Dinoflagellates



Climate changes

Climate changes

The National Science Foundation has designated four priority areas for the coming years. Among them is climatic research, focusing on climate change and its impact. Purdue has established the Purdue Climate Change Research Center, where researchers from various disciplines both inside and outside the sciences will collaborate to investigate the impact of climate change on dozens of areas of life. **Paul B. Shepson**, professor of chemistry and of earth and atmospheric sciences, heads the PCCRC.

Purdue's Nobel Laureate passes away

Herbert Charles Brown, R.B. Wetherill Research Professor Emeritus, died on December 19, 2004, at the age of 92. A Nobel Laureate, Brown taught in the Department of Chemistry from 1947 until his retirement in 1978.

Brown was born in London in 1912, but his father moved the family to Chicago two years later. An advanced student from an early age, Brown was advanced several times throughout his schooling. At Englewood High School, Brown joined the newspaper staff.

"I ran the humor column of the school paper and won a national prize," he wrote. "I never recovered."

Brown said he liked studying more than any job he could have gotten, so he decided to go to college. In the chemistry lab of Dr. Nicholas Cheronis, Brown gained experience in chemistry, and fell in love with a fellow student, Sarah Baylen.

"Sarah had been the brightest student in chemistry…prior to my arrival. But since she could not beat me, she later decided to join me, to my everlasting delight," Brown wrote in his autobiography. In his yearbook in 1935, Sarah predicted he would be a Nobel Laureate.

As a graduation gift, Sarah presented Brown with Alfred Stock's book, *The Hydrides of Boron and Silicon.* It happened that reading this book spurred Brown's interest in boron — the research area that would lead to his Nobel Prize.

Brown began his academic career as a post doctorate at the University of Chicago in 1938, and moved to Wayne State University a few years later. In 1947, Henry B. Hass, then head of the Department of Chemistry, invited Brown to join Purdue's faculty. He became a distinguished professor in 1959, and an emeritus professor in 1978, although he continued to work with post doctorates for years after that.

Brown's interests spanned organic, inorganic, and physical chemistry, but he is best known for his work exploring the role of boron in organic chemistry. This work made organoboranes, part of the toolkit for synthesizing drugs and other chemicals, readily available. He was awarded the Nobel Prize in 1979 for this work.

The H.C. Brown Laboratory of Chemistry was dedicated in Brown's honor in 1983.

Sarah Brown passed away on May 29, 2005, at the age of 89.

Awards & Honors


Mikhail Atallah


Daniela Bortoletto

Mikhail Atallah, Distinguished Professor of Computer Science, and **Stephen Konieczny**, professor of biological sciences, are the latest science faculty members to be named to the Purdue University Teaching Academy. … **Daniela Bortoletto**, professor of physics, was elected a Fellow of the American Physical Society. … Purdue presented an Honorary Doctorate of Science at the commencement ceremony on December 19, 2004, to **Herman Cain**, former corporate executive and current national radio and TV host, who earned his master's degree in computer science from Purdue in 1971. … **Julie Conlon**, outreach coordinator in the Department of Physics, and **Yuni Xia**, a computer science graduate student, received 2004 Leading Light Awards from Women & Hi Tech, an non-profit organization established in 2000 to address the specific needs of women in high tech industries in Central Indiana and to encourage more women to consider careers in technology. … **Graham Cooks,** Haas Distinguished Professor of Chemistry, received the 2004-05 Outstanding Commercialization Award for Purdue University Faculty for his work on commercialization of analytical


Herman Cain


Yuni Xia


Graham Cooks

First place for Quadraspec

Quadraspec, a Purdue Research Park company focused on commercializing protein-diagnostic technology, took home three number one prizes during the 2004-05 academic year. The company won the Opportunity for Indiana Business Plan Competition in November, the Burton D. Morgan Entrepreneurial Competition in February, and the Purdue Life Sciences Business Plan Competition in April.

President and CEO of Quadraspec, Chad Bardin, says he couldn't be happier with the result of the competitions. "We're just blown away. It's a great win for us," he said after winning the April competition.

The company's technology was invented by Purdue Physics Professor David Nolte and Law Distinguished Professor of Chemistry Fred Regnier. By measuring protein interactions on the BioCD, the technology can scan biological samples and quickly and inexpensively test and diagnose disease. It has potential applications in medical diagnostics, research, and biodefense, among others.

Above, Chad Bardin and Brian Weichel, both of Quadraspec, and competition judge Joe DeGroff from Ice Miller (L to R) pose with their checks in hand after the Burton D. Morgan Entrepreneurial Competition. That first place finish garnered the company $30,000, plus office space at the Purdue Research Park for one year.

instruments, in particular mass spectrometers. ... **John Cushman** was appointed as University Distinguished Professor of Earth and Atmospheric Sciences in April. … Computer science PhD candidate **Tomasz (Tomek) Czajka** brought home the top prize from the TopCoder Open for the second year in a row. …

Tomasz Czajka

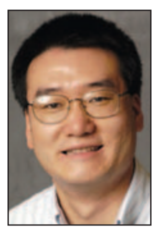
John Deely

John Deely is the first recipient of the David S. Moore Teaching Award from the Department of Statistics. … The Purdue University Board of Trustees appointed **Alexandre Eremenko** as Purdue Distinguished Professor of Mathematics. ...**William Cleveland**, was named the Shanti S. Gupta Distinguished Professor of Statistics. … At its August 2004 meeting in Providence, Rhode Island, the Mathematical Association of America (MAA) announced that **Greg Frederickson,** professor of computer science, had won its annual George Po'lya Award. Presented to authors of articles of expository excellence that appear in the *College Mathematics Journal*, the award recognized Frederickson's article, "A New Wrinkle on an Old Folding Problem," which appeared in the September 2003 issue. … **Nicholas Giordano** was named a Distinguished Professor of Physics by the Purdue Board of Trustees. … **Albena Ivanisevic**, assistant professor of biomedical engineering and chemistry, was included in a list of "100 top young innovators" by *Technology Review*, a magazine published by the Massachusetts Institute of Technology. … **Laszlo Lempert** was elected a foreign member of the Hungarian Academy of Sciences at its 173rd General Assembly in May 2004. Lempert was also named a Distinguished Professor of Mathematics. … **Jorge Rodriguez**, Department of Physics; **Leonid Rokhinson**, Department of Physics; and **Ninghui Li**, Department of Computer Sciences, received prestigious National Science foundation CAREER awards in 2004 and 2005. The CAREER program is a foundation-wide activity that offers the foundation's most prestigious awards for junior faculty members. … **Ian Shipsey**, professor of physics, was appointed vice chair of the American Physical Society Panofsky Prize Committee for the 2005 Panofsky Prize and chair of the Prize Committee for the 2006 prize. The Panofsky Prize is the highest prize for experimental elementary particle physics awarded by the American Physical Society.

Alexandre Eremenko

William Cleveland

Laszlo Lempert



Ninghui Li

Ian Shipsey

Giordano named top prof.

Nicholas Giordano, Distinguished Professor of Physics, was selected as the 2004 Carnegie Foundation for the Advancement of Teaching Indiana Professor of the Year. The Carnegie Foundation's Professors of the Year Award Program recognizes extraordinary dedication to undergraduate teaching as evidenced by impact on and involvement with undergraduates, contributions to undergraduate education in the institution, community, and profession, and support from colleagues and current and former students.

"I chose an academic career for a couple of reasons," says Giordano, seen (above) working with two students. "I thought there would be more variety; there are always new courses to teach and lots of opportunities to learn new things. But the most important thing was I just really enjoy interacting with students."

Class Notes

1970s

Moira Gunn (MS '72, Computer Science) is one of five experts named to the Trusted Computing Group's newly formed advisory council. The Trusted Computing Group is an open industry standards organization whose specifications help vendors build products that let users protect critical data and information.

Jo Wimmenauer Meyer (BS '73, Mathematics) has been promoted to director of business analysis and planning at Roche Diagnostics in Indianapolis, Indiana. Jo joined Roche in '90 as a senior programmer analyst.

Louise C. Speitel (MS '75, Chemistry), received the Outstanding Achievement in Aviation Research award from the American Institute of Aeronautics and Astronautics.

Camille Meyer Wainwright (MS '77, Biology), received the 2004 Distinguished Service Award "Oregon Science Educator of the Year," from the Oregon Science Teachers Association.

1980s

Brian J. Carlson (BS '88, Science) and Sarah Carlson, welcomed a son on December 3, 2004.

Neil Hentschel (BS '85, Computer Science) and his wife, Kristin, welcomed William Evan Hentschel into the world on September 9, 2004. William joins 9-year-old Larissa and 8-year-old twins, Elysia and Stephen.

Joyce Meredith (BS '81, Biological Sciences and Agronomy; MS '83, Agronomy; PhD '93, Ohio State University) is special assistant to the president at Denison University in Granville, Ohio. She resides in Granville with her husband, Jeff Gill (BA '84, Political Science and Anthropology), and their 6-year-old son, Chris.

Robyn Stephens (BS '81, Chemistry) has been appointed to the position of internal auditor for BP operations around the world. BP is of one of the world's largest energy companies.

1990s

Catherine Anthony (BS '97, Biological Sciences) and her husband, Bill, welcomed Abigail Grace into the world on November 18, 2004. Catherine and Bill live in Broken Arrow, Oklahoma.

David W. Bedwell (BS '96, Biology) and Laura Bedwell welcomed their daughter into the world on January 11, 2005.

Kristen Krajewski Gladysz (MS '97, Chemistry) is a research scientist at Lyotropic Therapeutics in Ashland, Virginia. Kristen and her husband, Bill, who is an analytical chemist at Wyeth Consumer Healthcare, have a son, 3-year-old Shane Thomas Gladysz, and they share their house with three cats.

Erik M. Keldahl (BS '95, Biology) and Jennifer L. Baluch (BA '96, Elementary Education) welcomed their baby girl on December 6, 2004.

Salvatore Lepore (PhD '97, Chemistry) is an assistant professor of organic chemistry at Florida Atlantic University in Boca Raton, Florida. He and his wife, Susan (MS '96, Civil Engineering) recently founded Custom Synthesis Inc., specializing in custom chemical compounds.

Cheraman Vamadevan (MS '97, Mathematics) and Caroline welcomed their daughter on June 17, 2004.

Shelly Witham (BS '99, Earth & Atmospheric Sciences; MS '01, Education) teaches earth and space science and archeology at High Tech High School in North Bergen, New Jersey. She was the winner of the 2004 New Jersey Center for Science and Technology Education Teacher of the Year Award. The center, based at Kean University, honors teachers who demonstrate excellence in their fields as part of an initiative to enhance the education of science and technology professionals.

Haiying Xu (BS '02, Computer Science, MS '03, Computer Science) and Yuan Zheng (MSME '99, Mechanical Engineering, PhD '03, Mechanical Engineering) welcomed a son on December 20, 2004.

2000s

Michael J. Brelage (BS '04, Mathematics) and Gloria Moster were married on July 31, 2004.

Zachary D. Brennan (BS '02, Science) and Stephanie L. Goble (BA '03, Education) were married on June 12, 2004.

Ji-Won Byun (BS '04, Computer Science) and Jen-Jen Chen welcomed a daughter on November 27, 2004.

Gayla R. Hobbs (MS '04, Statistics) and Theodore J. Olbricht were married on July 12, 2004.

William G. Meredith, II (BS '00, Mathematics) and Heather Marie Morgan (BS '00, Mathematics), welcomed a daughter, Oct. 7.

Elisabeth Solchik (BS '04, Biological Sciences) and Michael Barton were married on October 16, 2004. Elisabeth is pursuing a master's degree in journalism and environmental science at Indiana University.

Brooke Rogers Waickman (BS '00, Earth & Atmospheric Sciences) and her husband, Rick, welcomed their daughter, Reese, into the world on October 1, 2004. She is their first child. Brooke is manager of prospect information for the Lutheran Church-Missouri Synod Foundation in St. Louis, Missouri.

Dawn M. Wall (BS ’02, Biology) and Kevin Parsell welcomed a son on January 20, 2005.

In memoriam

Darwin F. Aldrich (MS ’44, Medicinal Chemistry), Fort Worth, TX, November 5, 2004.

Grant W. Balkema, Jr. (BS ’74, Biology, PhD ’79, Biology), Waban, MA, November 25, 2004.

John R. Delbauve (MS ’74, Pre-1980 Programs), Indianapolis, IN, January 19, 2005.

Donald C. DeLong (MS ’56, Biochemistry, PhD ’58, Biochemistry), Indianapolis, IN, November 17, 2004.

Barbara Ann Jones Donecker (BS ’68, Biology), Sebastopol, CA, November 18, 2004.

Brian M. Duwe (BS ’64, Chemistry), Paducah, KY, October 15, 2004.

Rose Gannon Santomieri (BS ’48), Folsom, CA, November 23, 2004.

Karen M. Hays-Ogle (BS ’80, Biology), Muncie, IN, November 8, 2004.

Anita V. Hill (MS ’66, Biology; PhD ’73, Biology), Grambling, LA, November 29, 2004.

Richard W. Hughes (MS ’58, Pre-1980 Programs; PhD ’60, Pre-1980 Programs), Bloomfield, IN, December 29, 2004.

Alexander Miller (BS ’48, Science), Glen Rock, NJ, January 2, 2005.

Frederick S. Murphy (BS ’40, Science), Granada Hills, CA, December 4, 2004.

Albert Ernest Purcell (MS ’49, PhD ’51), Layton, UT, November 3, 2004.

Martha J. Sims (BS ’43, Science), Lafayette, IN, December 4, 2004.

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Confessions of a STORM CHASER


Kim Klockow

Kim Klockow's idea of a good time is going to a party with friends to make fun of weather-related movies like *The Day After Tomorrow*. Klockow double majors in economics and synoptic meteorology, and she and her friends know so much about weather that they spot inaccuracies in Hollywood movies that they find hilarious — like charts showing ocean currents going the wrong way.

"When we go to the theater to see these movies, we laugh hysterically," she says. "I feel sorry for the other people in the theater."

Klockow is a Phi Beta Kappa senior from Granger, Indiana, who last summer became the first Purdue student to do an internship at the National Severe Storms Laboratory in Norman, Oklahoma. She was one of 10 students chosen from approximately 150 applications.

Her fascination with weather dates back to her childhood in Naperville, Illinois, when a tornado chased her and her family home from signing up for French lessons. Klockow was only seven at the time.

"Mom got us in the basement and then went upstairs to watch the storm, and I sneaked upstairs to watch with her," she says. "The sky was green, and stuff was flying through the air. In that moment, I changed from being petrified by tornadoes to being awed by them. I kind of wanted to chase them back."

Since then, Klockow has gotten a good deal of storm chasing under her belt. She says that storm chasing involves hours of travel time, picking a particular aspect of the storm you want to focus on, and then staying in communication with someone called a nowcaster, who is at a base telling you exactly where to drive. When you get close to the storm, she says, you can start following it visually.

"Generally storm chasers see a tornado one out of nine times they chase," says Klockow. "But during my internship, we would see seven tornadoes each time we went out."

Klockow admits that storm chasing can be dangerous, but she notes that the danger usually is not from the tornadoes themselves, which have textbook weather patterns west of the Mississippi River. Rather, lightning is the most dangerous part. Klockow says the best thing storm chasers can do is stay inside their automobile, away from fences, and out from under trees.

While at Purdue, Klockow has learned how to combine both her majors so she doesn't have to choose between them. During her internship, she worked on a project linking economics and meteorology.

"I first learned about economic meteorology at a conference," she says. "It's a new area. Many industries are affected by weather — such as the construction, energy, and transportation industries — and they're looking for people who can advise them about upcoming weather."

She adds that economic meteorology also can aid disaster recovery efforts.

"The government spends billions of dollars a year on disaster recovery," Klockow says. "But it's not allotted, and if we study what happens in recovery efforts, it will result in more efficient allocation."

Klockow hasn't yet decided what she's doing after graduation in May 2006.

"The dream of all meteorologists is to get into the University of Oklahoma for grad school," she says. "But there are a lot of other graduate programs that are developing. And I would be happy just getting a job in business."

But that decision is a whole school year away. Meanwhile, Klockow will continue serving as president of the Purdue University Meteorological Association, teaching PHYS 152, and periodically presenting conference papers on the economic impacts of tornadoes. And watching weather-related movies with her friends.

— *Emily Hunteman*

"That's funny..."

In Australia's Great Barrier Reef, diver and Associate Professor of Chemistry Jon Wilker's explorations bring him face-to-face with a giant clam. Wilker's love for diving has brought him closer to his research interests — the natural, waterproof adhesive produced by organisms like mussels and barnacles — and allowed him to explore other undersea environments while there.

***Homecoming 2005* — Join your College of Science classmates, friends, colleagues, and professors for Homecoming events beginning on October 15, 2005. On Saturday morning, visit the College of Science tent for a look at new research, and great hands-on family activities. Questions, please contact Dana Neary (nearyd@purdue.edu) or visit www.purdue.edu/homecoming.**

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