

THE MAGAZINE OF UNIVERSITY OF KENTUCKY RESEARCH AND GRADUATE STUDIES • FALL 1999

ODYSSEY



Igniting
Youthful Curiosity

RESEARCH

www.rgs.uky.edu

FALL 1999
VOLUME XVII, NO. 1

ODYSSEY

The University of Kentucky's publication
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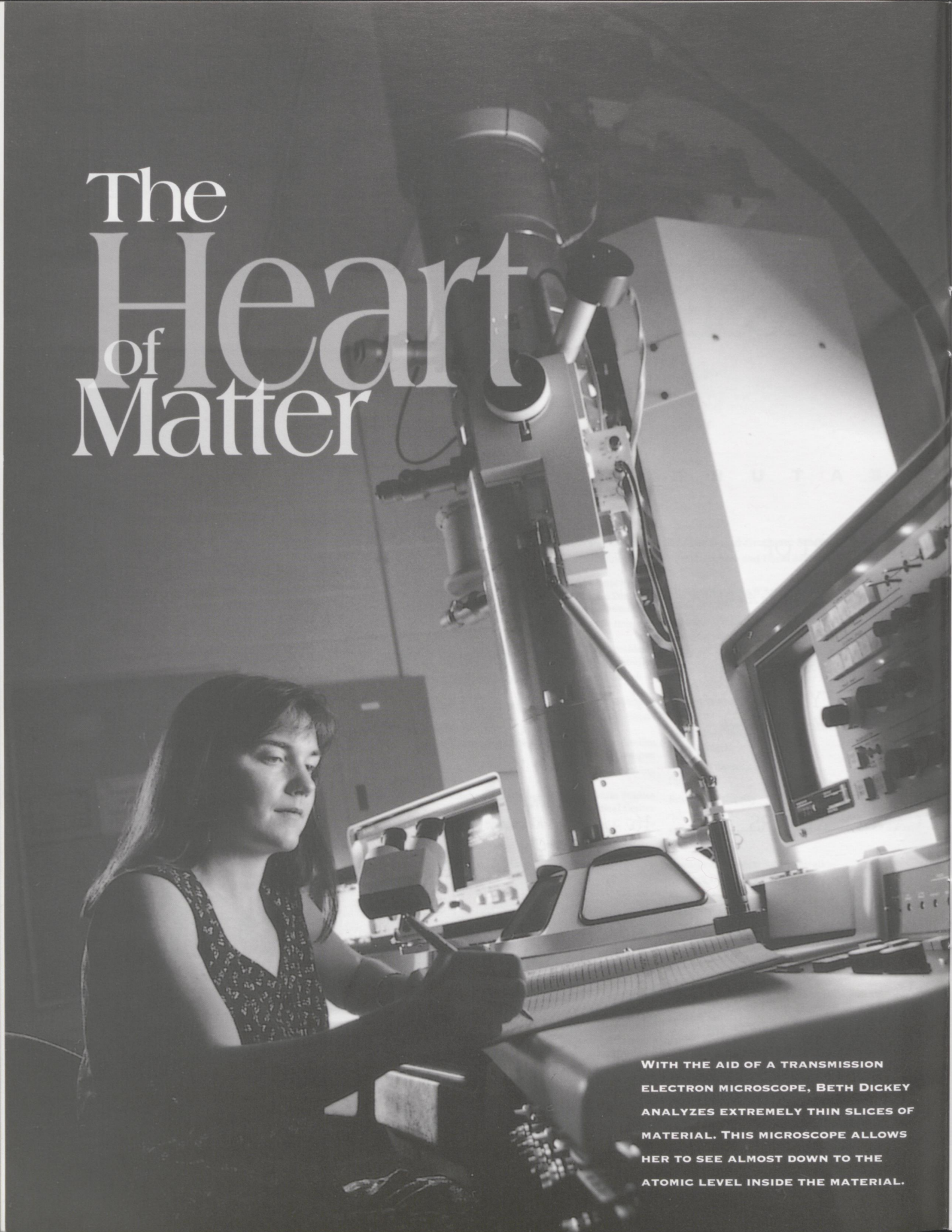
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University of Kentucky



The Heart of Matter

WITH THE AID OF A TRANSMISSION ELECTRON MICROSCOPE, BETH DICKEY ANALYZES EXTREMELY THIN SLICES OF MATERIAL. THIS MICROSCOPE ALLOWS HER TO SEE ALMOST DOWN TO THE ATOMIC LEVEL INSIDE THE MATERIAL.

DESIGNING MATERIALS AT THE ATOMIC LEVEL

4-H became a big part of Beth Dickey's life when she was a teenager in the Lexington area.

"I was in sewing for a while, but I was really bad," she says. "I also took public speaking, and I did a lot of leadership activities." In high school Dickey was the president of the Kentucky 4-H and helped create the fall leadership conference, which the organization still holds. "My favorite 4-H activity was showing horses," Dickey says. Since her father was a horse trainer and her mother a nurse, everyone assumed Beth was predestined to be a veterinarian.

"But I wanted to do something different," Dickey says. Not quite sure what that was, Dickey got involved as a Woodford County High School student in UK's Engineering Ahead program and got her first glimpse into the world of materials engineering. "I liked school, and I was good at math and physics, but I didn't have a clear picture of what I wanted to do until I started working in this UK College of Engineering program," Dickey says. "Materials engineering intrigued me because it bridged physics, chemistry and engineering. So I thought I'd give it a try, and if I didn't like it I could always switch to something else."

Hooked on materials

Dickey became sold on materials engineering during her summer internship at Oak Ridge National Laboratories after her freshman year at UK. Oak Ridge is the largest of the U.S. Department of Energy's five multi-program laboratories. Near Knoxville, Tennessee, Oak Ridge employs 5,000 staff and hosts more than 4,000 visiting researchers.

That summer Dickey began work in the ceramic processing group and made professional contacts with scientists she still collaborates with today. "I was hooked after that internship," Dickey says.

After her junior year, she went to the nation's capital for the Washington Internship for Students of Engineering. She worked with the Society of Automotive Engineers on a project to analyze the consequences of moving away from metal to plastic car components. "There was already a great system set up for handling scrap metal, but the question now was, when you put plastic and other materials in cars, what happens when they're scrapped? Do you just throw them in a landfill?" Dickey says the public-policy angle of this internship brought to life the

applications and problems associated with designing materials.

Dickey graduated with her bachelor's degree in materials engineering from UK in 1992 and enrolled in Northwestern University in Illinois, which has one of the best materials science programs in the nation. At Northwestern she was a National Science Foundation Graduate Research Fellow and a research assistant. Her training culminated in a Ph.D. in 1997. Dickey returned to UK in the spring of 1997 as an assistant professor of materials engineering.

"In 10 words or less, what I do is design materials at the atomic level to get certain properties," she says. The properties she's most interested in are mechanical, electrical and thermal. "I try to design the chemistry, the structure and the micro-structure of a material to optimize its properties."

Every property of a material is related to how its atoms are locked together. "A lot of what I do is look at the interfaces between two materials—what happens when you bring two dissimilar materials together," she says.

The microscopic behavior and the macroscopic behavior of a material are intimately related, Dickey says. "When we look at things at the atomic level, we ask, 'If we change how things are bonded, how atoms are arranged, how does that affect the macroscopic properties?'" All materials applications deal with the macroscopic. "For example," she says, "you want to know what's going to happen when you heat up the material or what happens when you pull on it."

"A lot of what I do is very basic science. I'm trying to understand the fundamental structure-property relationships, so I can start to predict what would happen if I alter the chemistry of a material," Dickey says.

Material rewards

There are three basic classes of materials: metals, polymers and ceramics. Ceramics are Dickey's bread and butter.

Her work on high-temperature ceramics won her national recognition last February. Dickey received the Presidential Early Career Award for Scientists and Engineers (PECASE), the U.S. government's highest honor for young engineers. The presidential

continued on page 4

award will fund Dickey's work with a five-year, \$500,000 research grant. She was one of only 60 recipients and is the first faculty member at UK to receive this prestigious award. The PECASE was established by President Clinton in 1996 to recognize the nation's best scientists and engineers who show potential for scientific leadership in the next century.

PECASE nominations come from eight federal agencies, including NSF, NASA, and the Department of Defense. "Winning this award was surprising and extremely exciting," Dickey says. Alex Pechenik, acting director of the Air Force Aerospace and Materials Sciences Directorate, nominated her for the award. "I met Alex at a few scientific meetings and knew he was interested in the work I was doing with some people at NASA. He took it upon himself to nominate me, which was wonderful."

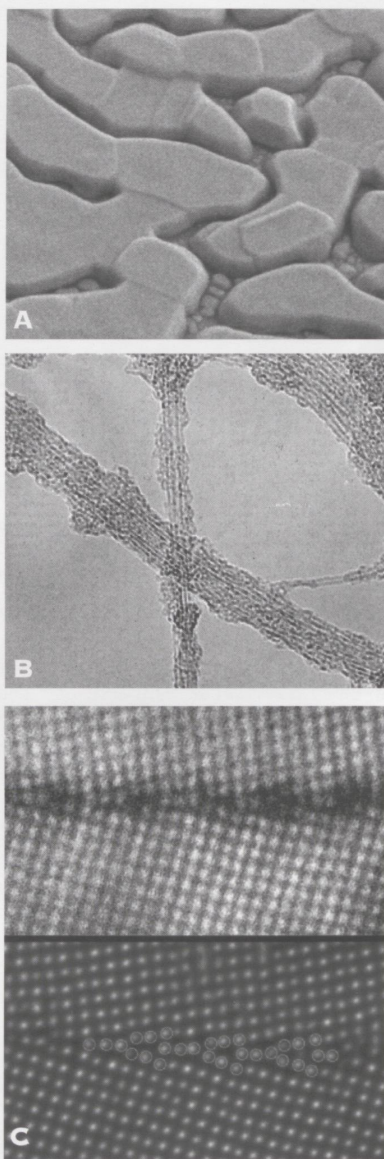
Pechenik's comments on her abilities are a resounding vote of confidence. "Professor Dickey has developed a number of techniques for characterizing interfaces in materials, particularly high-temperature ceramic materials. Her command of electron microscopy, X-ray diffraction, and neutron diffraction has brought some important insights into the structure of interfaces," he says.

"She has the potential of becoming one of the leading researchers in the field of high-temperature materials in the near future. Her collaboration with many researchers at the Air Force Research Laboratory, working on designing new, improved high-temperature materials for turbine and rocket engines, makes her work very valuable for the Air Force," Pechenik says.

Coffee cups and jet engines

These are not your grandma's ceramics. Ceramics have moved far beyond pottery, dinnerware, glass, and tile to a whole new world. Light bulbs, scissors, and watches; engine components, electronic sensors, catalytic converters and spark plugs; joint implants, bone and eye substitutes, and dental work are just a few new ceramic applications.

Ceramics are hard but lightweight, with good heat, wear and corrosion resistance. But there are a few problems. "If you drop your coffee cup on the floor you get an



BETH DICKEY USED ELECTRON MICROSCOPES AT UK AND OAK RIDGE NATIONAL LABORATORIES TO CAPTURE THESE IMAGES. A) IS AN SEM IMAGE OF NICKEL; B) IS A TEM IMAGE OF COLLEAGUE ROBERT HADDON'S CARBON NANOTUBES; AND C) IS A TEM IMAGE OF A ZIRCONIUM OXIDE (ZRO₂) GRAIN BOUNDARY, A SAMPLE OF THE WORK ON WHICH DICKEY IS COLLABORATING WITH SUSAN SINNOTT TO DISCOVER HOW ATOMS MOVE ALONG GRAIN BOUNDARIES.

object lesson on the main drawback of ceramics: they're brittle," Dickey says.

Alumina, a widely used ceramic, stays strong at temperatures that can melt steel. On its own, alumina will fracture under stress, but reinforced with microscopic fibers of silicon carbide, alumina is strong enough to cut steel.

"The work I'm doing for the Air Force, funded by the presidential award, is focusing on how to make ceramics less brittle for applications in jet engines," she says. "If something flies into your engine, you don't want a catastrophic failure." Dickey is designing the micro-structure of the interface of the two materials to absorb energy. "If a crack forms it won't propagate throughout the material, and you'll have some prior notice that the component is going to fail."

"Today's jet engines are made from super alloys, metallic materials that have wonderful properties but at 1200 degrees Celsius they start to change chemically and even melt. What I'm looking at for the Air Force is using oxide ceramic composites to try to increase the temperature to 1400 degrees Celsius," says Dickey, "Even though this may seem like a small change in operating temperature, it has a huge impact on overall engine efficiency."

Dickey says developing high-temperature materials could have a wide range of applications. "In ground-based planes, there are applications in turbine engines. In space there is a whole range of applications because of the extreme heat during reentry," she says. The tiles that cover the current space shuttle are ceramic-based. While these ceramics differ from the ones she's working on, Dickey says the results of her work will be applicable to a variety of extreme-temperature and extreme-corrosion uses.

A lot of the materials developed in the aerospace industry end up in our homes and on our sidewalks. "What is at first an exotic material for specific applications eventually filters down into common household materials," Dickey points out. Many of today's household materials were born in NASA labs. "In the past 10 or 15 years, one material a lot of people are aware of is carbon fiber-reinforced composites, which started in aerospace and have been worked into the sports market," Dickey says. "When they were first developed, they were very expensive, but as

they've become cheaper to produce they've been worked into bikes and tennis rackets."

Tool time

Dickey uses a variety of tools to design the atomic makeup of materials, and the most vital and versatile is the electron microscope. She manages the Electron Microscopy Facility, housed in the Advanced Science and Technology Commercialization Center (ASTeCC) on campus, which makes available a variety of modern analytical equipment to researchers engaged in materials science and engineering at UK and in industry. UK currently has 13 electron microscopes across campus.

Dickey uses two kinds of electron microscopes. The first, a scanning electron microscope (SEM), utilizes a focused probe of electrons that scans across the material. Electrons are collected and measured by a detector that sits next to the microscope. An SEM gives information about the surface of a material. "UK's scanning electron microscope provides micron (millionth of a meter) information," Dickey says. "A hair looks pretty big under an SEM. One hair is about 100 microns in diameter."

atomic resolution transmission electron microscope thanks to a grant from NSF through the Experimental Program to Stimulate Competitive Research (EPSCoR) and matching state funds. "This microscope will be a resource for the whole state," Dickey says.

"A really nice feature of this microscope is the field emission gun, which gives you a much higher intensity beam and allows you to get chemical information at the atomic level," she says. "You can get structural information from the images and then focus the probe to sit on a column of atoms and get chemical information. You can correlate structure and chemistry."

"With the addition of this microscope, UK will have one of the best electron microscopy facilities in the country," Dickey says.

Point break

This electron microscope will contribute to an innovative new project funded by NSF. Dickey co-wrote the grant for this project with Susan Sinnott, also an assistant professor in materials science engineering. Their work will focus on parallel atomic-scale experimental and theoretical studies.

where these crystallites come together is called the grain boundary. Grain boundaries are defects in the material and foreign atoms tend to go there.

"In a lot of ceramic materials, if you break the material the fracture won't go straight through. It will split around the different grain boundaries," she says. "So if you change the strength of the grain boundaries, you can change the mechanical behavior of the material."

Fracture toughness deals with the amount of energy a material can absorb as it fails, and is the primary mechanical property of interest to Dickey and Sinnott.

Another property is called creep. "Creep doesn't involve cracks. It involves pulling on the material at high temperatures, which makes it deform—it flows like plastic," Dickey explains. "What is happening is the grain boundaries are sliding, moving past each other under the weight of the load. This is related to diffusion (the intermingling of molecules) at the grain boundaries." By preventing diffusion at the grain boundaries, Dickey says researchers could prevent things from moving around and keep the material from deforming.

These are not your grandma's ceramics. Ceramics have moved far beyond pottery, dinnerware, glass, and tile to a whole new world. Light bulbs, scissors, and watches; engine components, electronic sensors, catalytic converters and spark plugs; joint implants, bone and eye substitutes, and dental work are just a few new ceramic applications.

The second microscope, a transmission electron microscope, analyzes a very thin slice of material. "The electrons penetrate all the way through, and it measures the electrons scattered by the sample," Dickey says. "Electrons scatter inside the material, and based on how they scatter you see contrast. You can see almost down to the atomic level inside the material."

"I've been doing all of my atomic-scale work at Oak Ridge because we haven't had the instruments to see atomic-level information," she says. "After I began work at the university, I realized there is quite a large demand on campus for this type of data, and I decided it was in our best interest to get our own instrument." Next February UK will install a \$1.8 million

"I can get only so much information experimentally about where atoms are in an interface," Dickey says. "But Susan can take my data, create a model and further refine the structure to identify things like the energy and strength of the interface, things that are difficult to measure experimentally."

The subject of their joint project is interface segregation, which specifically focuses on two mechanical properties of materials: fracture toughness and creep.

"Interface segregation means you've got foreign atoms (atoms which aren't inherent to the basic crystal structure of the material) that are moving to defects in the material," Dickey says. "Many materials are crystalline, but few are perfect single crystals. Most materials have clusters of crystallites, and

"Nobody really understands this process, which is why Susan and I are doing these fundamental studies to get experimental data and theoretical calculations to find out what these atoms are doing, and how they are affecting diffusion at the atomic level."

"Having complementary experiment and theory is a very powerful approach to understanding materials," Dickey says.

Materials 101

Dickey teaches three materials classes at the University of Kentucky: a one-hour freshman introductory class, a four-hour ceramic engineering class and a four-hour materials characterization class. Ceramic engineering, a required course for undergraduates in the materials program, has

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weekly labs where students measure ceramic properties and participate in industrial tours to places like the Corning plant in Harrodsburg, Kentucky, where glass flat-panel displays are manufactured.

"The quality of the undergraduate program is very high and students get good experience," says Dickey, who also serves as faculty advisor for Alpha Sigma Mu, the materials honor society. "In my ceramics engineering class this spring, every single person was doing an internship in industry, at a national lab or at UK."

The materials characterization class,



BETH DICKEY'S WORK ON HIGH-TEMPERATURE CERAMICS WAS RECOGNIZED EARLIER THIS YEAR BY A PRESIDENTIAL EARLY CAREER AWARD FOR SCIENTISTS AND ENGINEERS—A FIVE-YEAR, \$500,000 GRANT.

Japan together last fall. We were both invited to give short courses at Aoyama Gakuin University in Tokyo," Dickey says.

"We do end up talking about work at home. We're both very into it and we care about what's going on," she says. "I'm

not sure that I could do what I do without him being a professor too. If we need to come back to campus at night or on the weekends, it's not so lonely. We drive to work together and eat lunch together every day. Maybe it's because we're newlyweds and we're not tired of being together yet," she laughs, "but I don't think things will

Next February UK will install a \$1.8 million atomic resolution transmission electron microscope thanks to a grant from NSF through the Experimental Program to Stimulate Competitive Research (EPSCoR) and matching state funds.

which focuses on X-ray diffraction and electron microscopy techniques, is taking on a new dimension this fall. "We've cross-listed this class with the University of Louisville," she says. "We'll teach it over videoconferencing. Students will do some of the lab components in Louisville and others at UK." Graduate students, upper-level undergrads, Lexmark employees and other industrial workers take this class.

The College of Engineering recognized Dickey's teaching skills with the outstanding teacher award in materials engineering for 1999. "I enjoy teaching, but it's extremely time-consuming to do a good job," says Dickey. "I think my teaching ends up benefiting my research, and the students benefit by seeing current examples. You can

give it relevance by being able to tell them what you're doing in the lab."

Shop talk

How do engineers spend their free time? "Painting, mowing and picking cherries right now," Dickey says. She and husband Craig Grimes, a professor of electrical engineering at UK, were married in May 1998 and live on a 13-acre farm outside Lexington. "Craig's a triathlete, so we bike and run together as much as we can," she says. "He's a very well-rounded person, and I'd like to think I'll be one too someday." Dickey and Grimes often travel together to conferences. One will participate in a conference and the other will travel as the spouse and speak at a nearby university. "We went to

change. It makes it easier to be so involved at work because your best friend is coming with you."

Juggling a personal life, teaching and research is challenging, Dickey says, but she looks forward to getting more involved in the community. "Since I've been back in Kentucky, I've been so busy with this job that I haven't had time for much else," she says. "I'd like to see what things I can get involved in outside the university." One thing she'd like to do is become more involved in the 4-H program. "They're giving me the Outstanding Young Kentuckian Award this year and I'm very flattered. Being involved with 4-H was a wonderful thing for me, and I'm glad 4-H is still helping kids realize their potential."



TOA VEERASETHAKUL
TESTS THE DURABILITY
OF A CYLINDER COMPOSED
OF SAND, CONCRETE
AND FLY ASH.

It should come as no surprise that at the University of Kentucky research is being conducted in areas as diverse as organic chemistry, autism, bacterial pathogens and epilepsy. But it may come as a surprise that some of this work is being done by Kentucky high school students.

Several programs at the university focus on providing high school students with an interest in research the chance to gain experience in discovering new knowledge and working with established scientists as mentors. Three of these programs are profiled in the following pages.

Igniting Youthful Curiosity

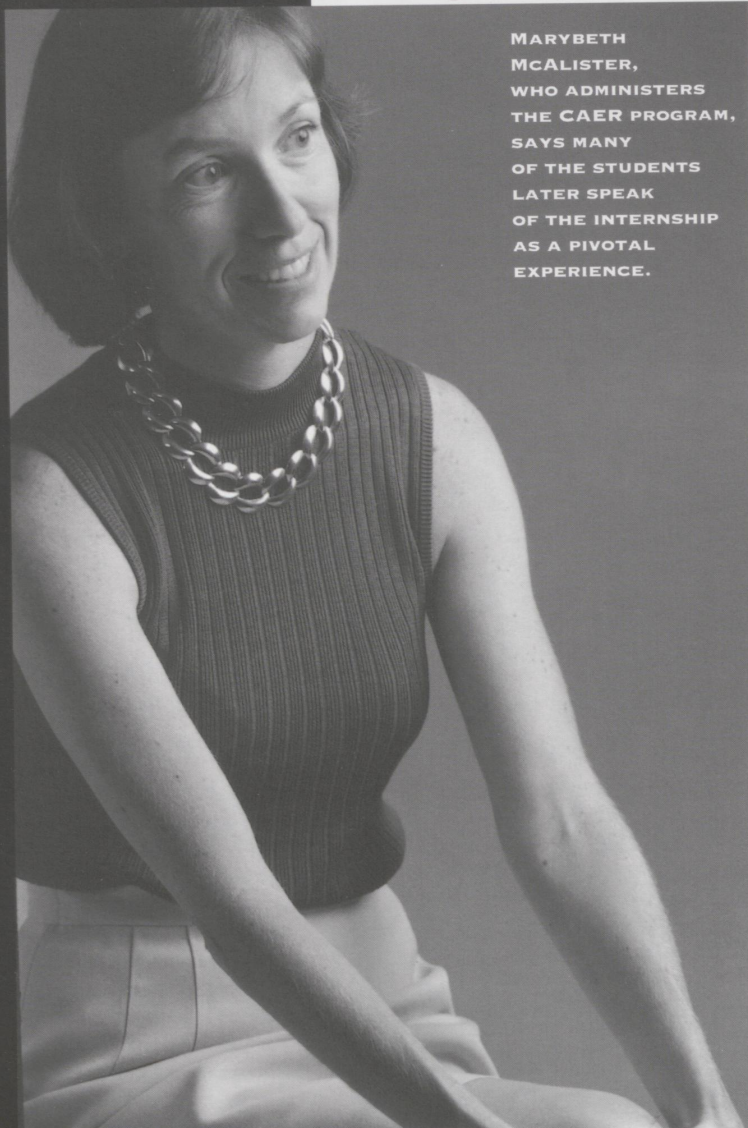
High School Students In Research

WRITTEN BY
JEFF WORLEY

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Igniting Youthful Curiosity

CAER Summer Internship Program



MARYBETH
MCALISTER,
WHO ADMINISTERS
THE CAER PROGRAM,
SAYS MANY
OF THE STUDENTS
LATER SPEAK
OF THE INTERNSHIP
AS A PIVOTAL
EXPERIENCE.

Call researcher Allie Hobbs a junk dealer. She doesn't mind.

"The major focus of my work is to find useful things to do with waste," says Hobbs, an engineering associate in the waste management group at UK's Center for Applied Energy Research (CAER). "The fancy name for what I do is 'beneficiation': taking fly ash, for example, and making a useful product out of it."

She explains that fly ash is the by-product of the burning of coal and that typically this ash is dumped into artificially constructed ponds. "These ponds are costly—they have to be properly lined and so forth. And they obviously take up space that could be used in more environmentally friendly ways," says Hobbs.

So she is interested in trying to make useful products that contain fly ash, and one of these is concrete. She is currently using a mixture of sand, concrete and fly ash molded into cylinders and is testing its strength. And this past summer, Hobbs had "some very good help" with this research.

Since 1993 CAER has operated a high school summer internship program, with UK researchers serving as mentors. This past summer Toa Veerasethakul, now a senior at Franklin County High School, became an intern because of her strong interest in science. Toa (pronounced "tao") eventually plans to go into the medical field.

"One of the things I did was work in the lab in Anderson Hall with Allie," Toa says. "So I got to discover firsthand the different properties and consistencies of the cylinders we tested." In testing the cylinders' strength, she found that certain types of ash have cementation properties and others don't. "The company that produces this fly ash wants cement strong enough so you can walk on it, yet they don't want it too strong that they can't go back and dig it up if they need to."

Hobbs and Toa did their experiments using a triaxial compressor, a piece of equipment consisting of two upright steel bars and a platform at the base. A compressed cylinder composed of a specific percentage of fly ash, sand and water is placed on the platform and secured at the top by a metal cap. The platform moves upward at a rate of half an inch per minute. A computer measures durability of the cylinder as the pres-

"Allie guided me but then let me try this myself, let me see how things work rather than just telling me."

— Toa Veerasethakul

sure on it increases.

"We're interested in measuring the point at which the cylinder fails—crumbles and then cracks apart," says Hobbs, who was impressed with Toa's "many intelligent questions." "We're basically trying different mixes to get it to this point."

Toa says that this two-week program was a tremendously valuable experience for her. "Allie was great. She guided me but then let me try things myself, let me see how things work rather than just telling me. It was also fun."

At the final meeting of the two-week internship, Toa and the other five students from central Kentucky high schools gave presentations on what they'd learned at UK. "This seems to be a natural and appropriate kind of closure for the program, as well as a way for the students to formally share their new knowledge," says Marybeth McAlister, who administers the program. McAlister, publications and public relations manager at CAER, explains that the idea for this program grew out of an earlier attempt to reach out to young people interested in science.

"In 1993 we had a day program for local high school students. Typically, a chemistry class would come and they'd have a nice tour of the labs for an hour. But I thought, how much can they get out of an hour? So I began tinkering with the idea of something on a much larger scale." McAlister subsequently talked with Frank Derbyshire, CAER director, and the two decided to significantly expand the program, funding it initially, Derbyshire is quick to point out, "with our own money."

He is also quick to point out that any successes the program has celebrated are due to McAlister's tireless work. She not only develops and organizes the program, and does all the paperwork from her office at CAER, she also drives to neighboring

counties to interview students who "look right for the program on paper," Derbyshire says.

"I make appointments with either their counselors or high school teachers in each of the schools. It's important for me to talk face-to-face with these students," she says, "to try to make sure of their level of interest and to see if we have a useful match for them among the volunteer mentors at CAER." Students selected are given a stipend from CAER of \$400 for the two weeks, they are reimbursed for any travel expenses, and they are housed in one of the UK dorms, where they eat free in the cafeteria. CAER also hires resident advisors who drive the students in a van back and forth from the dorm to CAER, located nine miles from the Lexington campus.

Part of the summer curriculum also includes two field trips. This past summer students were taken to a mine an hour west of Lexington, near Elizabethtown, and to a coal-burning power plant.

"I loved this part of the program," says Josh Northcutt, a senior at Harrison County High School. "We got to see a drag bin operate and stand inside it." Josh spent two weeks working with several mentors, primarily chemical engineer Dennis Sparks. "I spent a lot of time with him troubleshooting—fixing small problems with reactors in the building," Josh says. "And one day I helped him build a new reactor from scratch."

The other students worked in the areas of coal liquefaction, coal preparation and carbon materials synthesis.

"Although CAER has been part of the university since the inception of the center, we've traditionally been seen as strictly a research unit," Derbyshire says. "And while the bulk of our activity necessarily has to be in that area, we've been working very hard for the last 10 or 11 years to also include

teaching and community outreach as part of what we do. I believe this summer program accomplishes both."

One other very important thing the program has accomplished is garnering the financial support of EPSCoR, the Experimental Program to Stimulate Competitive Research. This Department of Energy program, with matching state funds, has supported the summer internship program since 1997 with a grant of \$56,000 a year.

"If we want to create and continue an effective interface between the high schools and the university, we need to dedicate some resources to this, so we're obviously hoping that we can continue to attract funding for this program," Derbyshire says.

In part for the requirements of their federal funding and in part for their own information, McAlister sends material yearly to former program participants. "We want to know where they are and what they're doing, what kind of influence the work they did here has had on their lives," McAlister says. From a look at the responses from the most recent mailing, she says many of the students talk about their internship as a "pivotal experience."

"It's rewarding to see how many have gone into engineering or into the sciences," she says. "That makes all the work worth it. It makes us feel like we're doing something really positive and far-reaching."

Thirty-eight students have participated in the CAER program since 1993.

A sad note: As this article was going to press, Frank Derbyshire, CAER director, passed away while on a trip to England. See article on page 36.

Igniting Youthful Curiosity

Kentucky Young Researchers Program

Nine Lexington students from Paul Laurence Dunbar High School and a Hazard High School student recently completed their work in the Kentucky Young Researchers Program, which was established three years ago by Fitzgerald Bramwell, vice president of Research and Graduate Studies at UK. Thirty students have participated in this program since its inception.

"The concept for developing a formal pipeline of students into our research programs was the result of several conversations I had in early 1996 with Dunbar math and science teachers Walter Koetke and Elizabeth Kikuchi," Bramwell says. "We wanted to promote a city-wide program to encourage students to enter research early in their scholastic training. I felt that such an experience would open our programs to contributions from bright and innovative young minds, and that in turn the university would provide these students with ac-

cess to our faculty, students and superb research facilities."

The program has drawn most of its student participants from Dunbar's Math, Science and Technology Center, which has requirements that make the UK program attractive. "This is an academically rigorous program for students who have high ability and strong work ethics," says Jimmy Adams, director of the center. "We have them do a year-long research project, typically through UK." The students begin their project in the fall of their junior year and must complete it during the early spring of their senior year. They present the results of their work at Dunbar in early March.

"We usually have from 20 to 25 students in the program at any one time," Adams says. "We expect the students to put in eight to 10 hours a week working on their project."

He explains that the students tend to be highly motivated, resourceful self-starters. They are encouraged to do their own research to initially find an area of interest and to find a mentor at UK who will work with them.

"I made appointments with people in agronomy and civil engineering to find out what they were doing and if I was interested in what they were doing," says Andrea Lubawy, who graduated from Dunbar in 1998 and is now a student at Rice University. "I found a professor in civil engineering, Dr. Yi-Tin Wang, who was doing bioremediation with constructed wetland systems. I'd had an interest in the environment for a long time and wanted to do some kind of remediation project, so his work sparked my interest." Andrea also talked with one of Wang's colleagues, Gail Bryon, and the three of them hammered out a plan for Andrea to assist him in his research.

Her allotted time to work with Wang began in the early afternoon, 6th hour at Dunbar. "My work involved me driving to Scott County and taking wetland samples," says Andrea, whose father is a UK professor

WITH UK MENTOR DOUG KALIKA, DUNBAR STUDENT MATT WOODYARD WORKS ON A COMPUTER SIMULATION OF HOW PLASTIC FLOWS THROUGH A MOLD.



photo by Alicia P. Gregory

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ODYSSEY

in the College of Pharmacy. She drove to a farm owned by a UK agronomy professor which had a septic tank system connected to a constructed wetland ("think of a wetland as a garden but with very marshlike plants—cattails, water irises and sweetflag," Andrea says).

She and Wang sent the liquid from the septic tank through the wetland and took periodic samples from various points to see how much of the bacteria in the liquid was eventually removed by chemical reactions that take place in the wetland soil and plants. "We found that the rate of removal was significant," Andrea explains, "that the level of fecal coliforms (bacteria like *E. coli* found in the intestine) decreased dramatically. By the time the liquid got to end of the 40-foot wetland, the coliforms were 99 percent removed, a dramatic decrease."

This was an important finding, she says, because if the soil and plant root systems can so successfully remove these bacteria, there's no need for costly chemicals that may also be dangerous to the environment.

Chemical and materials engineering professor Doug Kalika, another UK mentor, found himself in dual roles in the program. He not only mentored Dunbar student Matt Woodyard, whose project involved computer simulation of how plastic would flow through a mold, but he also helped two other students hook up with UK mentor and psychology professor Ruth Baer. Baer is involved in developing new behavioral analysis techniques to help children with autism. And Kalika's interest in Baer's work is quite personal: the child that Baer and the two Dunbar students worked with to develop and test methodology is Kalika's daughter.

"In this case the mentoring mostly took place at our home," he says. "And though the students—Jonathan Keefe and Margaret Wallen—have graduated from high school, they are still working with my daughter. They are spending the summer doing additional behavioral therapy intervention with her and with other children with autism in Fayette County."

Adams at Dunbar is clearly excited about every aspect of this program. "It's a win-win proposition," he says. "We've got high school students doing college-level research, and several have had their work published."

But what about the UK mentors, professors whose time is already eaten up by research, teaching, grading, committees, and community involvement—what do they get out of it?

"The work done by Dunbar's students helps drive and support the research that goes on in my laboratory," says Kalika. "I also think it helps me from a teaching standpoint. Not only can I take some of the work Matt does and integrate it into the courses that I teach on polymer processing, but I think I've become a better teacher for the experience. The program challenges you to teach fairly sophisticated material in a way that will be meaningful to the student who doesn't have the prerequisite coursework."

"Of course it's time consuming, but most of the mentors who have volunteered tell me they're happy to take another student," says Joe Fink, UK assistant vice president for Research and Graduate Studies, who administers the program. "And faculty can receive from our office up to \$500 to be used for chemicals or supplies, photographic services or travel to collect data or report results."

"It benefits everybody," Baer says. "The students get a good head start on experiencing college, and they earn stronger credentials for their resumes. The researcher benefits because these students can be an integral part of the research effort."

*"It's a win-win proposition.
We've got high school
students doing college-level
research, and several have
had their work published."*

— Jimmy Adams, Dunbar's
Math, Science and Technology
Center

*"The students get a good
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— Ruth Baer, UK psychology
professor

Igniting Youthful Curiosity

Young Women in Science



From 1971 to 1991, 11,989 doctoral degrees were awarded in the natural sciences in this country. Only 3,122 (approximately 27 percent) were awarded to women. And though women in higher education are moving into science and engineering in greater numbers than in the past, there are still some significant gender disparities. Of the 49 undergraduates who declared physics as their major in the 1998 fall semester at the University of Kentucky, for example, only six were women.

A new program at UK is working to change this imbalance. Supported by a \$1,292,096 grant from the National Institute on Drug Abuse, UK's Center on Drug and Alcohol Research (CDAR) has developed the Young Women in Science Program to encourage young women from Appalachia to pursue scientific careers in drug abuse research.

"Very few opportunities exist for rural high school women to learn about the excitement of science and the related scientific career opportunities in drug abuse research," says Carl Leukefeld, professor of psychiatry and director of CDAR. "This project will provide scientific education and mentoring to attract more young women to the field."

"The possibility to apply for funding for this program came across our desks, and we thought this was a very good fit for us," says Alayne White, director of UK's Institute on Women and Substance Abuse. "So often what we do are one-time things," she says, "a four-week summer program, for instance. We wanted to design a program that brought the girls in at the beginning of high school and that would stay with them through their high school careers," White says.

This three-year, "year-round" initiative includes a three-week residential program each summer at UK for 26 young women entering ninth grade in 13 counties in southeastern Kentucky. In addition, five Saturday sessions are scheduled at both Hazard Community College and Prestonsburg Community College throughout the year.

Students are expected to participate in this program for the full three years. The on-campus sessions include seminars on alcohol and drug issues, wellness, personal growth and development, and self-esteem. Each student is matched with a mentor, a UK faculty member or a woman who is involved in science in the Lexington area. Each summer a new group of young women will begin the program.

"We also schedule field trips to various places of interest, hands-on science activities, time for fitness and recreation, and the opportunity to meet and interact with scientific mentors," says Caroline Reid, the director of this program. While the focus is on education, she says that they also want the students to have fun. "One of the first activities we had was a campus-wide scavenger hunt," Reid says. "We came up with a list of objects and items for the girls to find on campus, then turned them loose with maps. It was a fun way for them to get a bit oriented to the campus, and the students also felt encouraged to talk to people along the way who'd help them."

"My group had to find something called Ovid's, we had to find a *Kentucky Kernel* [the student newspaper], and meet a police officer and get his badge number," says Kristin Adams, from Johnson County. Ovid's, it turned out, is a new café in UK's year-old William T. Young Library. "This was a fun way to find ourselves in the library for one thing," she adds.

The students took field trips in July to Raven Run, a local wildlife sanctuary, to Versailles for a train ride, to the Toyota Plant in Georgetown, to Shaker Village, to Six Flags Kentucky Kingdom, to the Louisville Science Center, and to the Cincinnati Museum of Natural History and Science, which Megan Howard from Magoffin County characterizes as "awesome."

"We want to emphasize a variety of 'life experiences,'" Leukefeld says, "along with the academic component." "What we are really trying to do is connect science to the real world," adds Reid.

The various field trips were scheduled for the afternoons, after morning sessions in which the young women attended classes

and worked in different laboratories. The classes focused on human anatomy, the nervous system, drug use and the influence of peers, the effects of depressants and stimulants, the properties and effects of alcohol, and data collection.

Jessica Coleman from Pike County says a favorite session for her was with Don Frazier, professor of physics and biophysics, and director of UK's Outreach Center for Science and Health Career Opportunities. "We got to see—and handle—human lungs, hearts and kidneys," Jessica says, adding that all the students wore plastic gloves to do so. "I held a heart that had had bypass surgery," says Carter Florence of Hazard. "It was neat because you could see where they had stitched it up."

All of the mentors in the program are women. "It is important that the students make meaningful contacts with women who are succeeding in scientific and mathematically based careers that are traditionally dominated by males," Reid says. "A mentor can reaffirm that society's pressures are real and also provide assurance that young women can conquer these obstacles."

Reid says the young women in this program are well taken care of. "We cover the expense of room and board—the girls stay in a campus dorm—and give each student \$30 a week for the three weeks." Upon completion of the three-week program, they are each given a small stipend, and upon completion of the three-year program each young woman is provided with a \$1,000 scholarship for any college she chooses to attend."

And Leukefeld and Reid emphasize the importance of extending the program beyond this three-week campus session. Among the topics to be covered later at the Saturday sessions are research on drug abuse and brain function, the relationship between drug abuse and hormones, often abused medications, and drug abuse prevention.

Kristin Adams was already thinking about the October meeting of the group at one of these community colleges. "It'll be like a reunion," she says, adding that the girls won't be strangers since the group plans to keep in



CAROLINE REID: "ALL OF THE MENTORS IN THE PROGRAM ARE WOMEN. A MENTOR CAN REAFFIRM THAT SOCIETY'S PRESSURES ARE REAL AND ALSO PROVIDE ASSURANCE THAT YOUNG WOMEN CAN CONQUER THESE OBSTACLES."

contact primarily through e-mail exchanges. Several of the ninth graders also plan to stay in touch with their mentors via e-mail.

How does Reid feel about the success of the program this first time through? "I think we can say we are successful when we see the students enjoying the classes and see that they are able to apply concepts. They definitely now have a greater appreciation of the interrelatedness among scientific endeavor, human relations and drug abuse research," Reid says.

"I can't imagine my life now without being involved in research," says Megan Howard, who plans to come to UK after high school graduation. "And right now, I feel I'm probably way ahead of the other kids in science."

Igniting Youthful Curiosity

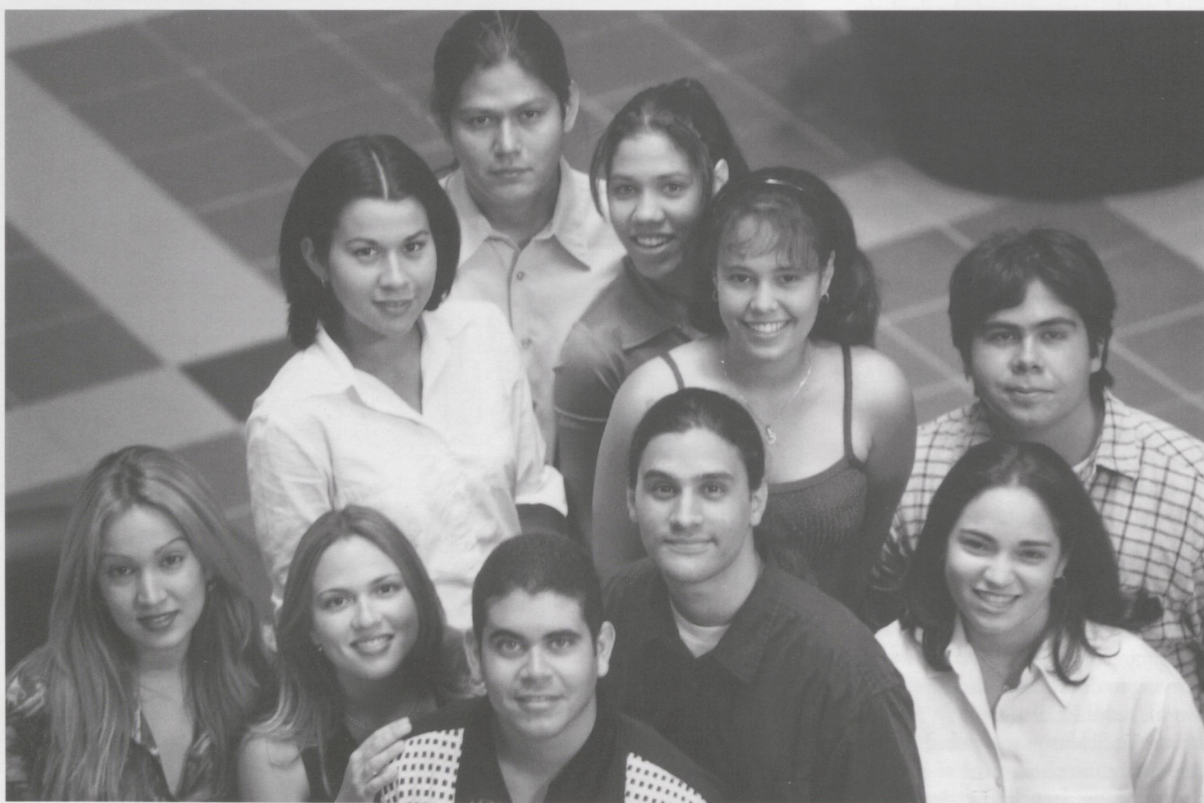
University of Puerto Rico Summer Research Experience

Del Collins, vice chancellor for Research and Graduate Studies at the Chandler Medical Center, has been involved in some monkey business for a long time, and he's the first to admit it.

"Primate reproduction has been one of my research interests for years now," says Collins, who came to UK in 1991. "In the '80s, when I was at Emory University, I spent a fair amount of time at the University of Puerto Rico, where they have a small island populated only by rhesus monkeys. I did a lot of field work there." Collins explains that the University of Puerto Rico (UPR) maintains a database on these monkeys, including maternal lineage, genetic, social and behavioral information. "My main interest was on reproduction and the effect of hormones on behavior, particularly reproductive behavior, which we studied extensively."

After coming to UK, Collins kept in touch with several of the researchers and administrators at the University of Puerto Rico, including Norman Maldonado, who became president of UPR in 1993. UK began a research and education collaboration with the university the following year. "The result is, we now have a number of collaborations with UPR in place for research and graduate education," Collins says.

In the summer of 1998, eight undergraduates from UPR who were interested in potential careers in biomedical and biological research came to UK. In this eight-week summer program, the students were mentored by UK faculty. This past summer the program was expanded to 12 students, including students in chemical engineering and computer science.



"Though there are active research programs at UPR, they are primarily a teaching institution. The students' exposure to working laboratories is limited, so they can come here and spend eight weeks in a research lab working with a mentor," Collins explains.

In the summer of '98, Xabier Arzuaga was one of the UPR students who came to UK. His research involved the study of two proteins—metallothionein and FZnBP—that bind to zinc and other heavy metals in the body. "These proteins limit bioreactivity of, for example, zinc," Arzuaga says. "They work to handcuff these metals when they reach dangerous levels." He worked that summer with Christer Hogstrand, an associate professor of biology. Arzuaga enjoyed the experience so much that after his return to Puerto Rico he applied to graduate school at UK. As a graduate student here, he initially continued his research in a basement lab in the Morgan Biological Sciences Building, isolating FZnBP from samples.

The samples, in this case, come from the squirrelfish, a nocturnal, beet-colored tropical fish common in Puerto Rico that reaches a size of about eight inches. Because this fish produces copious amounts of metallothionein, it is an excellent animal model to use in this work.

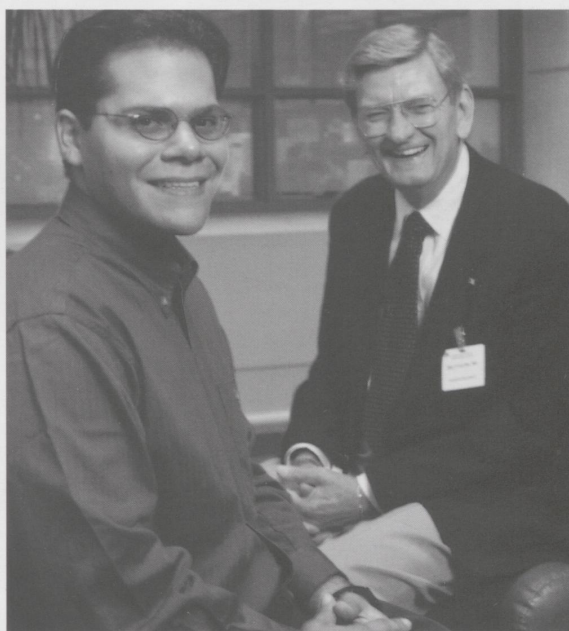
A basic understanding of how certain proteins interact with heavy metals may have important environmental implications, according to Mary Vore, director of the Graduate Program in Toxicology at UK. "We have heavy metal pollution in Kentucky, and Xabier's work and the work of others in this line of research may lead to a better understanding of how to detect toxic heavy metals in water," she says. "If you find a high level of metallothionein expression in a fish, then you know there are heavy metals in the water, metals that may be toxic to humans."

Vore and Arzuaga agree that this work may also play a significant role in helping to clean up some of the Puerto Rican waterways. "When I went to Puerto Rico and visited the campuses with Dr. Collins and the rest of the UK delegation, one of the things we talked about is the contamination of many of their lagoons with heavy metals and organic pollutants," Vore says.

Collins hopes that by next summer a few UK students will be participating in research and education experiences at UPR. "We're working now to set in place a second program, which will involve a true exchange of students between the two universities," he says. The University of Puerto Rico has several special characteristics which would make it attractive for a number of UK students, Collins explains, including not only the primate facility, but also a marine biology institute and the only tropical rain forest in North America.

"There are a lot of unique features from the standpoint of research, too, because of the Spanish population, their strength in the Spanish language, of course, and also in music and art."

Collins has already talked with several biology professors and students at UK who are interested in the possibility of doing



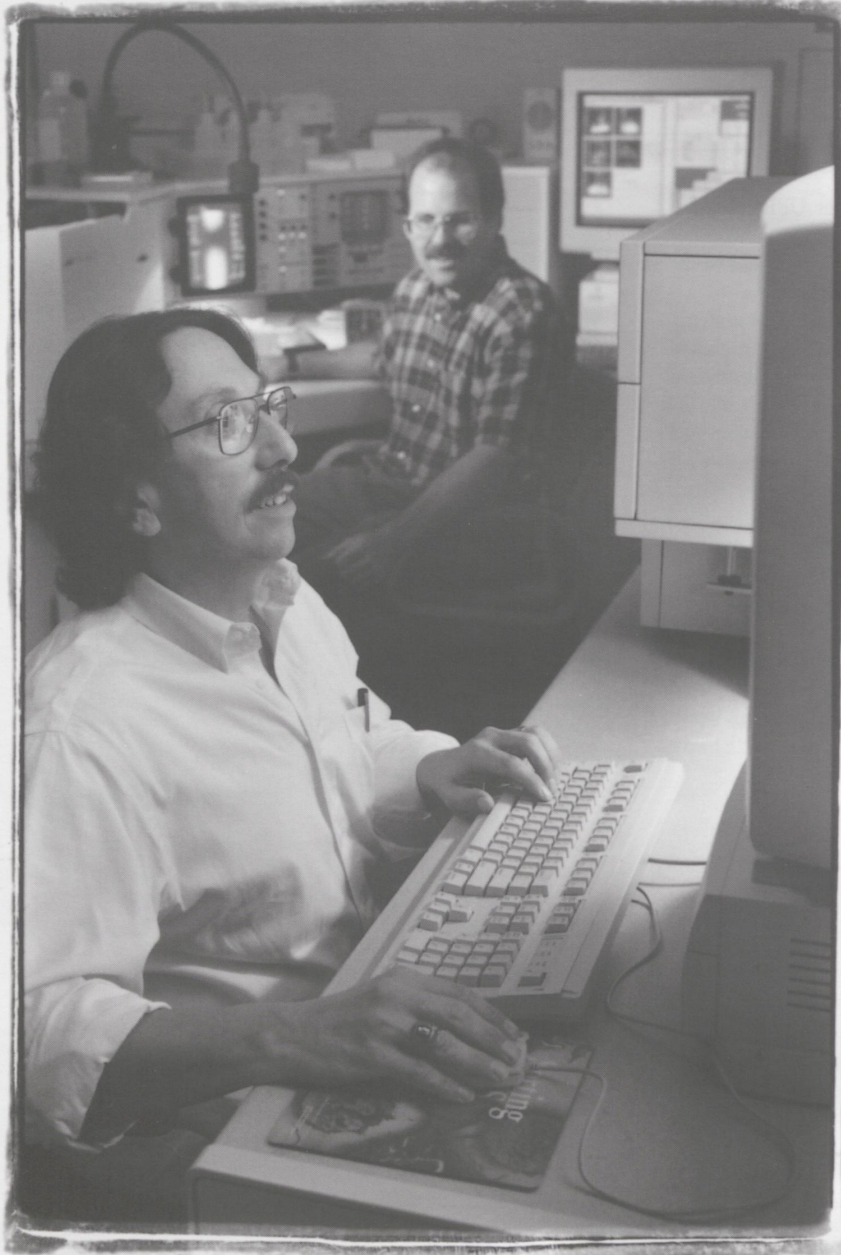
XABIER ARZUAGA WITH MEDICAL CENTER VICE CHANCELLOR DEL COLLINS. ARZUAGA CAME TO UK IN 1998 AS PART OF THE SUMMER RESEARCH EXPERIENCE PROGRAM AND RETURNED AS A UK GRADUATE STUDENT TO CONTINUE HIS RESEARCH.

collaborative research with faculty and students at UPR. "We could set up research and education experiences for UK students which would be based on UPR's unique strengths," says Collins, who points out the special ecological challenges of a population of 3.5 million people living on an island 50 miles wide.

And Collins looks forward to visiting Cayo Santiago again, the island primate colony of free-ranging rhesus monkeys. "Yes, I can picture myself on the boat that takes researchers from the mainland out to the primate colony." When asked if there wasn't some danger in walking out among hundreds of rhesus monkeys in the wild, Collins pauses slightly before responding.

"Well, these monkeys don't usually go after humans, but you need to know, too, which ones not to challenge. You don't look an alpha male straight in the eye. If you do, you're asking for trouble." ■

W R I T T E N B Y
D E B B I E G I B S O N



JOHN YANNELLI (FOREGROUND) AND CRAIG JORDAN ARE WORKING ON A NEW GENE THERAPY THAT HOLDS PROMISE FOR CANCER PATIENTS WITH ACUTE MYELOID LEUKEMIA.

Knowing the enemy's location is critical to winning any war. In the war against cancer, the enemy—cancer cells—have a distinct advantage. These errant cells are able to exact serious damage because they frequently go undetected and, therefore, do not trigger an alarm to activate the body's immune system.

Two scientists at the UK College of Medicine, however, may have found a way to help the immune system detect these destructive cells so the body's natural defense system can marshal its forces and destroy the cells. Craig Jordan, an assistant professor of medicine

in the UK College of Medicine, and John Yannelli, an associate professor of internal medicine, are putting the finishing touches on a new gene therapy that holds promise for cancer patients, particularly those with acute myeloid leukemia, a form of cancer which has been particularly difficult to treat with traditional therapies.

An update from the front lines

"People once thought that cancer occurred because of a weakness in the body's immune system," says Yannelli, "but we have known for years that overall that is not the case. The immune system in cancer patients actually works quite well. Otherwise, they could not survive the disease for long periods of time nor could they fight off other viruses, which they routinely do. The problem is not that the immune system doesn't work; it is that the immune system doesn't recognize the tumor."

According to Yannelli, for the body's defense system to work properly, key antigens must be presented in a specific way to lymphocytes, the cellular mediators of the immune system, which then kill the

cancerous cells. Normally, antigens are tipped off by co-stimulating molecules. When the co-stimulating molecules are not present, the immune system does not "see" the cancer cell, and therefore does not act to destroy it.

Scientists have discovered that lymphocytes have very narrow job descriptions, each one designed to attack only a specific molecule. The researchers have also discovered a wide range of co-stimulating molecules. A critical co-stimulating molecule is CD80. Because cancer cells do not express CD80, they are invisible to the lymphocytes responsible for destroying them.

Enter Jordan, a molecular biologist educated at Princeton University and the University of California, and Yannelli, an immunologist educated at the Medical College of Virginia.

In 1998, the two scientists received a \$321,459 grant from the Leukemia Society of America. Their major goal is to develop genetically modified tumor vaccines for treatment of acute myeloid leukemia (AML). They believe this gene-therapy-based treatment will help leukemia patients avoid recurrence of the disease, which today is a common and frequently fatal problem.

Currently, oncologists treat leukemia by attacking the tumor with chemotherapy. Three-quarters of all patients can be successfully brought into remission (an absence of cancer cells in the body) with chemotherapy. However, three-quarters of those relapse later, meaning tumor cells make a comeback. This can happen because cancer cells often travel throughout the body, and some malignant cells may escape chemical or surgical removal. When cancer recurs, chemo-

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Creating Cancer Killers

*"In essence, we
are putting a
billboard on
the tumor cells
which says,
'Here I Am.'"*

— John Yannelli

"We are not replacing traditional chemotherapy. We are trying to augment it. At first, we hope to help patients stay in remission longer and have a better quality of life. In the long-term, we hope that this therapy is so effective that the tumor never comes back."

— Craig Jordan

therapy is used again, but with each relapse the patient's long-term prognosis worsens.

The gene therapy developed by Jordan and Yannelli will work in concert with chemotherapy, giving oncologists a new strategy to beat this deadly disease.

"It is important to note that we are not replacing traditional chemotherapy," Jordan says. "We are trying to augment it. At first, we hope to help patients stay in remission longer and have a better quality of life. In the long-term, we hope that this therapy is so effective that the tumor never comes back."

Invisible no more

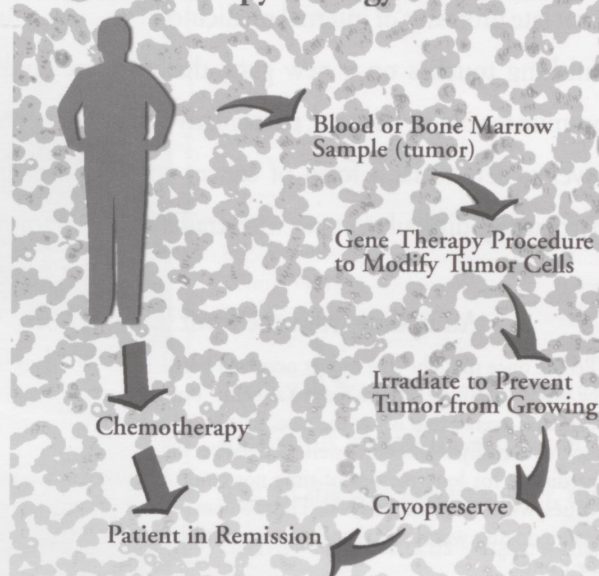
The key to this new approach is making the cancer cells visible.

"We are making tumor cells more recognizable," says Yannelli, who conducted similar work as head of the Cellular Immunotherapy Laboratory for the National Cancer Institute before he joined UK in 1996. "In essence, we are putting a billboard on the cells which says, 'Here I Am.'"

Erecting this billboard begins when the patient enters the hospital for treatment. As always, the patient will undergo a standard course of chemotherapy, designed to eliminate, or at least minimize, the number of cancer cells. Prior to administering the drugs, physicians will draw 250 milliliters of blood from the patient, a sample which is typically loaded with tumor cells.

Cells from this blood sample are then subjected to a procedure that isolates the cancer cells. Once isolated, the cells are genetically engineered so that they express the co-stimulating antigen and can

A Gene Therapy Strategy for Leukemia



be recognized by the body's immune system. To perform this gene transfer, a common virus—an adenovirus which has been disabled so it will cause no harm—is used as the vehicle for the transfer process. This process takes from 12 to 24 hours.

The re-engineered cells are then crippled by radiation. They will not die but will lose the ability to reproduce. Once chemotherapy is complete, the patient receives a vaccine containing the cells—his or her own cells—which have been re-engineered. The scientists hope that the genetically engineered cells will "rev up" the patient's immune system so that it seeks and destroys any remaining cancer cells, thus preventing a relapse of the cancer.

Another benefit of the approach is that the treatment is almost completely non-toxic.

"Ever since doctors began treating cancer, there has been a basic strategy—give people a very toxic drug that's more toxic to cancer cells than normal cells," Jordan says. "The unfortunate drawback is that the normal cells are affected, and this causes people to be sick."

The gene-transfer process has no such effect, which is no doubt one reason it is so appealing. Gene transfer gained national attention when physicians used the technique to treat the "bubble boy," a child who had to live in an enclosed area because he had no immune system. Since then, it has become one of the hottest subjects in science, and research is being done across the country using this

THE MEDAL IS NOT FOR CLASHING

process. However, the gene therapies developed to date have not been effective on AML cells.

"A large technical problem arises from AML cells," says Jordan. "They tend to be different, and traditional gene transfer does not work with them."

Jordan and Yannelli's technique for performing the gene transfer does appear to be effective with AML. Furthermore, the researchers believe that the technique may be useful with other forms of cancer. Yannelli is planning to use the same technique in his current research on lung cancer, for example.

The two scientists hope to begin Phase I clinical trials of the process soon and will be working closely with Dianna Howard in this endeavor. Howard, a clinical faculty member in UK's Blood and Marrow Transplant Program, has focused her work for the past 18 months on the care of leukemia and bone-marrow transplant patients. Under Jordan's guidance, she has also participated in the laboratory research, infecting primary human leukemia cells with viruses to encode gene expression.

"We would like to think our work may be ready for a Phase I trial within six months to a year," says Howard, who is board certified in pediatrics and internal medicine. "Typically, this type of trial would be limited to the University of Kentucky and perhaps a few collaborating institutions."

Meanwhile, their technique will go through the approval process at the Food and Drug Administration (FDA). "One of our first hurdles is obtaining FDA permission for use of an investigational new drug," Howard says. "Patient participation is also a challenge—letting patients know about the new therapies that are available and educating them to the value of clinical trials."

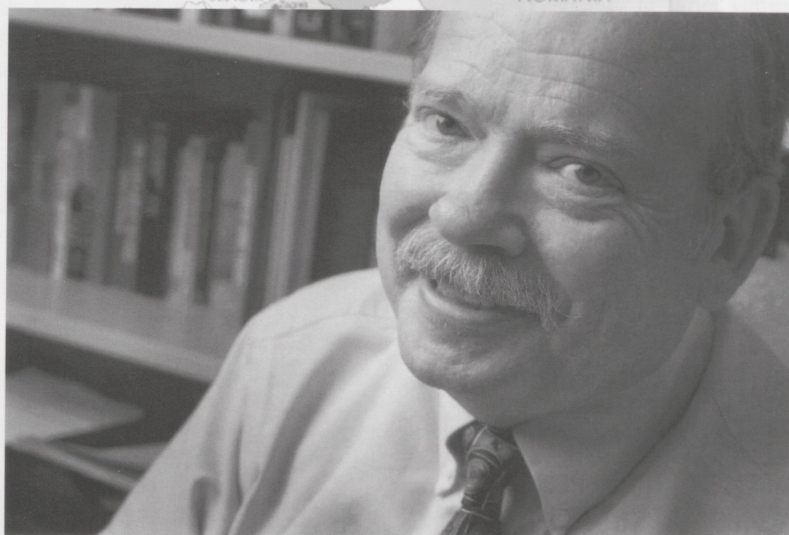
After the initial tests are complete, Jordan and Yannelli hope to get a second grant to do the next phase of trials, which will run from four to five years. These trials would determine the effectiveness of the vaccine as well as such variables as the proper dosage.

For now, the scientists have filed a patent on their technique and have caught the attention of the scientific community with an article about their research that appeared in the October 1998 issue of the journal *Leukemia*. ■



DIANNA HOWARD BELIEVES THAT CLINICAL TRIALS INVOLVING THIS NEW GENE-TRANSFER PROCESS WILL BEGIN WITHIN A YEAR.

BRINGING NEW INTELLIGENCE TO THE UNIVERSITY



After three decades in the trenches of the Cold War, in a world of secrecy and need-to-know, Bob Pringle has come in from the cold. The former Russian analyst for the Central Intelligence Agency is now trading in information in a different milieu, telling UK students firsthand stories of secrets and lies, traitors and patriots, Andrei Sahkarov and Aldrich Ames.

Pringle retired from the CIA last year to become an adjunct professor at the Patterson School of Diplomacy. In tribute to his 15 years of service, the agency awarded him the Career Intelligence Medal, a prestigious honor, though the CIA's public information office won't reveal how often the award is given, how many officers have received it or how long the award has been bestowed. Still, agency spokesman Tom Crispell says the award is a high honor few officers receive. "This medal is not the CIA's equiva-

"SPYING IS DONE BY BUREAUCRACIES. THE IDEA OF THE LONE WOLF AGENT OUT IN THE FIELD OVERTHROWING THE GOVERNMENT OF SOME HOSTILE COUNTRY IS NOT ACCURATE."

—BOB PRINGLE

lent of a gold watch. This is a prestigious award given on the basis of an outstanding career."

Pringle's career in government spanned 29 years and 25 countries with stints in the military, State Department and CIA. When he lived in Moscow in the late 1970s, Pringle used to receive regular visits and information from Nobel laureate Andrei Sakharov. After the Cold War, the Pittsburgh native spent a month at a missile base in Belarus, observing the destruction of Soviet nuclear

warheads once aimed at the United States. He also served nine months as the boss of Aldrich Ames, a one-time CIA official convicted in 1994 of spying for

the Russian security agency known as the KGB.

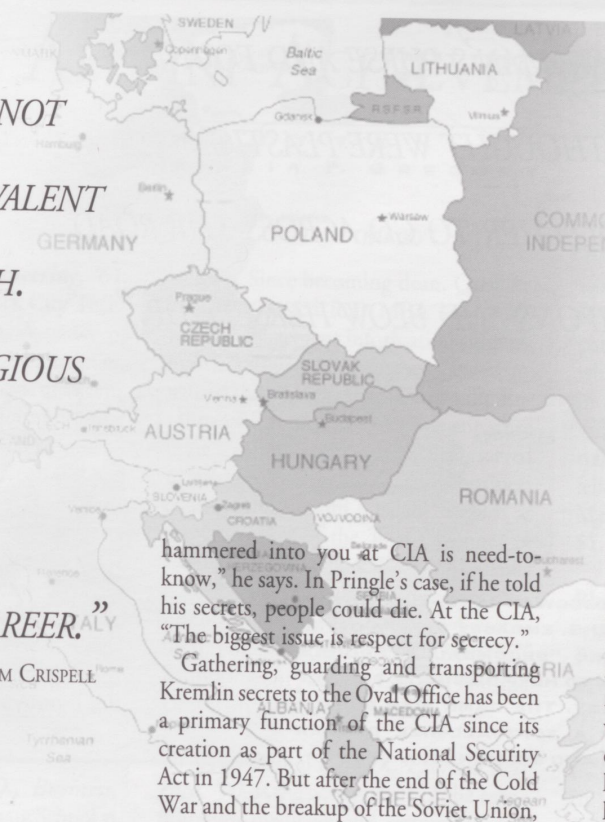
He recalls Ames as an intelligent and engaging man and didn't suspect him of being the mole whose activities the CIA had been aware of for some time, yet in retrospect, his colleague's arrest made some sense. "He was the most disillusioned person I knew at CIA. He was not happy about his position. He was angry about not being promoted." From his own work with Soviet defectors, Pringle knows that often, "The thing that turns people is anger."

In the latter days of the Cold War, another of Pringle's duties was debriefing Soviet defectors to the United States, a process involving extensive conversations (Pringle

WRITTEN BY
GRAHAM SHELBY

"THIS MEDAL IS NOT
THE CIA'S EQUIVALENT
OF A GOLD WATCH.
THIS IS A PRESTIGIOUS
AWARD GIVEN ON
THE BASIS OF AN
OUTSTANDING CAREER."

—CIA SPOKESMAN TOM CRISPELL



then spoke good Russian, an ability that he admits has lapsed some) and lengthy interviews. Many of the defectors feared the KGB would hunt them down and kill them. "You were dealing with very nervous men who had risked a great deal," Pringle says.

Pringle reasoned that the men, nearly all well-educated government officials, would feel comforted if he showed them some of what he had learned in the course of earning his Ph.D. in Russian history at the University of Virginia. "The most important thing that I could do is show that I knew Russian literature, Russian history—Russian culture—and that I respected it."

He once loaned a popular Russian children's book to a defector so the man could read it to his son. The CIA officer developed a deep respect for some of the men he interviewed, many of whom had held jobs similar to his own. "You think, 'This is what I would be like if I had been in that system.'"

Partly out of obligation to those men, he won't discuss details of the debriefing and relocation process. "One of the things that's

hammered into you at CIA is need-to-know," he says. In Pringle's case, if he told his secrets, people could die. At the CIA, "The biggest issue is respect for secrecy."

Gathering, guarding and transporting Kremlin secrets to the Oval Office has been a primary function of the CIA since its creation as part of the National Security Act in 1947. But after the end of the Cold War and the breakup of the Soviet Union, debates have arisen about the mission and even the need for the CIA.

Pringle believes the United States still needs what the CIA, more than any other government agency, is designed to provide: reliable, current and impartial information on people and events inside other countries. "The next president, Republican or Democrat," Pringle says, "is going to wake up at six o'clock in the morning and want a CIA morning report—the presidential daily brief—on his desk."

Preparing such reports occupied a lot of Pringle's time in the CIA, making his job a far cry from the laser-and-martini world of espionage depicted in spy movies. In fact, according to Pringle, films like *Mission Impossible* or the James Bond series portray spying about as accurately as a Donald Duck cartoon depicts the life of waterfowl. "Spying is done by bureaucracies," he says. "The idea of the lone wolf agent out in the field overthrowing the government of some hostile country is not accurate."

Though working for the CIA is a far cry from a James Bond kind of existence, Pringle says that his assignments did sometimes

involve fear and danger. "In the Moscow office one day, a young man came in claiming to be an American citizen," Pringle says. "After talking with him for three minutes, I knew he wasn't. It turned out that he was a merchant marine sailor, a Russian, who wanted to defect; and he decided that if he could get into the embassy someone could help him do that." When Pringle said that he couldn't help him defect, that the man would have to leave, he threw open his peacoat.

"The man said then: 'No, I don't have to leave—I have a bomb strapped to my stomach.' Well, it sure looked like a bomb, so I called the ambassador and we evacuated the embassy." The KGB was brought in and talked with him for about four hours. The man had a lot of grievances and seemed mentally unstable. "Finally, one of the Soviets told me, 'We are going to "take steps."'" I knew this meant they were going to shoot the guy. Which they did. He exploded the bomb then. I was about eight feet away, and the full force of the explosion hit me from the top of my forehead on; but luckily I just had some cuts and bruises, nothing major. The man died within a few minutes. This was a terrible tragedy and I felt deeply sorry about it," Pringle says.

Pringle recounts another scary incident when he was assigned to the Mozambique embassy. "One day I was bringing in our new communicator, a young woman (whose name I've forgotten) who had never been out of the United States. We got to the Mozambique-Swaziland border, and the

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*"THEY OPENED UP THE WOMAN'S PURSE AND FOUND
TAMPONS, WHICH THEY THOUGHT WERE PLASTIC
EXPLOSIVES. SO THEY TOLD HER TO GO ACROSS THE ROAD
AND STAMP ON THE TAMPONS AND BLOW HERSELF UP."*

**IN MOSCOW IN 1976, THE BRITISH
AND U.S. EMBASSY STAFFS OFTEN
PLAYED "BROOMBALL," PRINGLE
SAYS, TO HELP DISSIPATE PENT-UP
ENERGY. THE GAME WAS PLAYED
WITH A SOFTBALL-SIZE RUBBER
BALL AND SIX MEN ON A TEAM.**



border guards decided that the woman was a spy. They demanded to see our luggage, and when people with AK47s—angry people—make a demand like that, you just say yes," Pringle says.

"They opened up the woman's purse and found tampons, which they thought were plastic explosives. So they told her to go across the road and stamp on the tampons and blow herself up. We were both scared spitless. She stamped on the tampons and of course they didn't blow up, so the guards let us go on. This woman left the foreign service two months later."

Pringle says that in his work in Washington and through his stints at various foreign embassies, he was extremely lucky to have the steady support of his wife and family.

"I made it a point early on that I would always have dinner with my wife and family," says Pringle, "and I went to my kids' Little League games and my daughter's swim meets. And I've been very blessed with having a wife who has supported what I've chosen to do and is a professional woman, a very successful counselor who shares my interests in community service and in national service."

Pringle's family went with him, he says, on all three foreign-service postings—twice to Africa and once to Moscow. "Our daughter Kate was born in Swaziland, and when she was born she received a Swazi name, Gugu, which means 'precious' in Zulu."

Offering UK students insight into the life and work of a CIA officer has been a priority for Pringle ever since he arrived on campus in 1996 as a CIA officer-in-residence. For two years he taught classes at the Patterson School while still doing work for the CIA until he retired from the agency last November. Pringle came to UK partly because he knew Patterson School director John Stempel, a former U.S. diplomat.

Prior to Pringle's arrival, Stempel had been teaching courses on intelligence, but was glad to assign them to his newest faculty member. "He brings exactly the kind of practitioner expertise that we need," Stempel says. "He gives us tremendous insight into Russia, based not only on scholarship, but on personal experience."

Pringle is incorporating that experience and perspective in his current research, which examines Yuri Andropov's effect on the Soviet Union during his reign as head of the

KGB. Gathering and presenting research in both written and oral form has been a part of Pringle's job description long before he came to UK. CIA senior analyst Ann Jablonski worked under Pringle for four years at the agency and says her former boss is a natural as a college professor. "He's just very passionate about the subject, very engaged. Just being around him, people got more enthused, more passionate about the work."

Instilling that same passion in students at the Patterson School is an assignment Pringle takes as seriously as he did his work at the CIA. "What I really want to do is teach other people to be even better than I was as an analyst, as a public servant," he says. "One of our jobs as we get older is to prepare the next generation. I don't think you have any option; I think that's one of your responsibilities."

Julie Anglin, a second-year graduate student at the Patterson School, is excited to have a teacher like Pringle. "It's great to have someone with such pertinent life experience," she says. "He's just an invaluable resource, and his door is always open." ■

ALUMNI ACHIEVEMENTS

WRITTEN BY
ALICIA P. GREGORY

Fred Beaufait, M.S., Engineering, '61, is the president of New York City Technical College in Brooklyn. A native of Vicksburg, Mississippi, Beaufait most recently spent seven years as dean of Wayne State University's College of Engineering in Detroit. At Wayne State he created an innovative curriculum called the Greenfield Coalition, which combined three hours a day of traditional liberal arts courses with eight hours of on-site work at companies such as General Motors, Chrysler and Ford. Beaufait previously worked with the Army Corps of Engineers as a structural engineer and established graduate studies at the Army Tank Automotive Command.

Steve Graham-Hill, Ph.D., Business, '96, is the dean of the Graduate School at Sullivan College in Louisville, Kentucky. Most of Sullivan's graduate students are working adults; about half are working

women. Since becoming dean, Graham-Hill has created four MBA concentrations: management information systems, human resources management, entrepreneurial skills, and management skills. Enrollment has increased 48 percent since these programs were established. He served in the U.S. Marines and taught business communication and business English at the University of the Thai Chamber of Commerce in Bangkok. Graham-Hill was a visiting professor in organizational behavior at Guilford College in Greensboro, North Carolina, the University of Leithbridge in Alberta, Canada, and the University of Louisville.

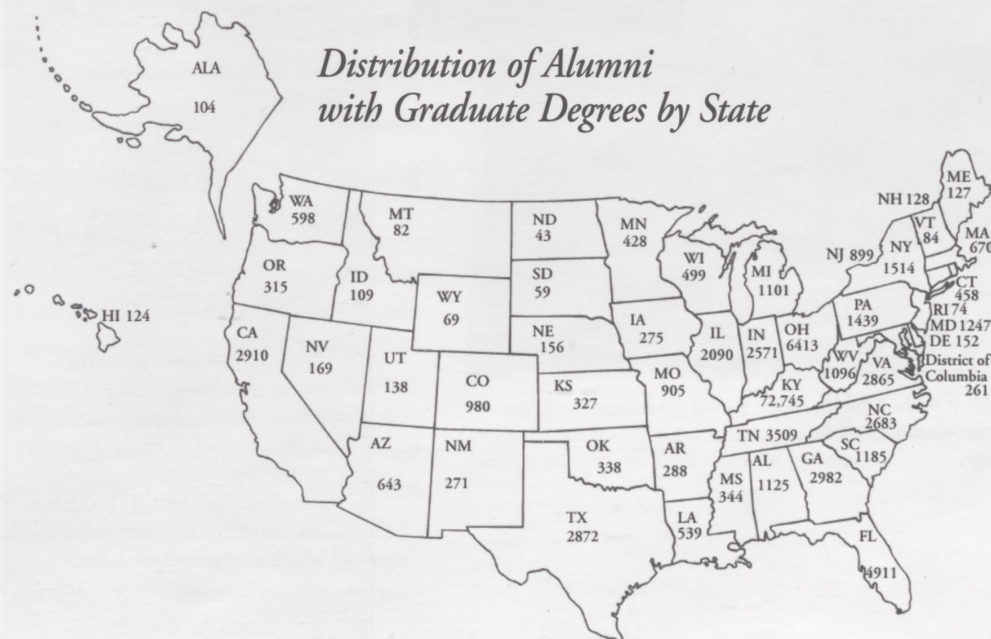
D. Drew Pringle, Ed.D., Exercise Science, '90, is the acting chair of the rehabilitation medicine and restorative care department in the Wright State University School of Medicine in Dayton, Ohio. He is a rehabilitation researcher working

with people who have spinal cord injuries. The laboratory Pringle directs holds patents for the electrical stimulation cycle which actor Christopher Reeves is using in his rehabilitation. Pringle is also involved in research on Parkinson's, transfemoral amputees, and aging. He is a fellow of the American College of Sports Medicine and has received more than \$1.1 million in grant funding.

Rhonda Reeves, M.A., English, '92, recently released her first book, *Reality Truck, Volume 1*, a collection of her nationally syndicated columns that appear in *ACE Magazine*, Lexington's free alternative news-



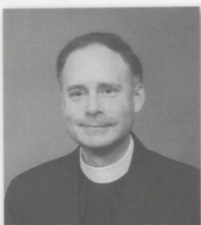
*Distribution of Alumni
with Graduate Degrees by State*



continued on page 24

paper which is celebrating its 10th anniversary this year. Her work has also appeared in the *Nashville Scene*, the *Sacramento News and Review*, the *Santa Fe Reporter*, and *Creative Loafing*. Last March she launched a Web site, <www.realitytruck.com>, offering article archives and book excerpts, and she is currently at work on her second book, *The Hanging Tree*, a research project based on her family in Eastern Kentucky. Reeves started her freelance career at the *Lexington Herald-Leader* as a book and theater critic, and began at *ACE* in the late '80s, working as a freelance writer, music editor, arts and entertainment editor, managing editor and, now, editor. She is also currently teaching writing to UK freshmen.

Travis Talmadge du Priest Jr., Ph.D., English, '72, is the executive director of the DeKoven Foundation, an institution of continuing education, recreation and reflection in Racine, Wisconsin. The DeKoven Foundation operates a 23-acre, historic campus on the shore of Lake Michigan between Milwaukee and Chicago, and hosts local and national groups. An Episcopal priest, Du Priest wrote and edited *The Living Church Magazine*, a national weekly publication, for more than 15 years. He is currently teaching creative non-fiction in the English Department at Carthage College in Kenosha, Wisconsin. Du Priest has received fellowships and grants from the University of the South, the University of Chicago, and the Andrews Clark Library at the University of California in Los Angeles. His wife Mabel (Ph.D., English Literature, '76) is chair of the English Department at Carthage.



H. Lowell Webb, M.A., Business Education, '68, is the retired dean of business affairs at Maysville Community College in Kentucky, where he also taught classes in accounting. During his 24 years as dean, he received the Service to Student Government Award and the Service to Education Award. Before his position at Maysville Community College, Webb taught for 11 years at Bryan Station Senior High School in Lexington, where he was chairman of the business department, supervised many student teachers from UK, Georgetown College, and Transylvania University, and he was elected to the Delta Pi Epsilon honor society for business educators. His wife Patricia Webb (formerly Patricia Ruth Jarvis) received her B.A. from UK's College of Arts and Sciences in 1961. She is a professor of English at Maysville Community College.



Graduate Alumni:

We want to feature you!

- ☉ Please tell us about your current position, company/institution and location, and career highlights, including past positions, projects and awards.
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RIISING TO THE NSF CHALLENGE

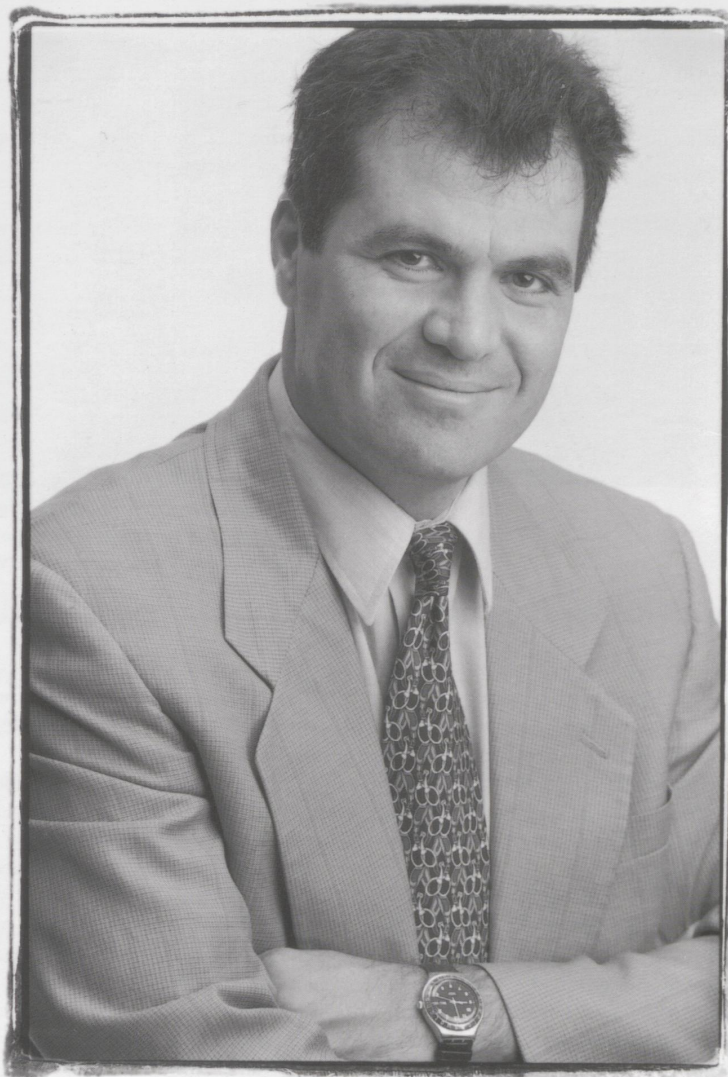
W R I T T E N B Y
K I M C U M B I E

The National Science Foundation issued an open challenge: design an innovative graduate education and research training program for scientists and engineers. The foundation received 620 proposals in response, and after fierce competition the University of Kentucky joined ranks with 16 other awardees of NSF Integrative Graduate Education and Research Training (IGERT) grants. The list reads like a "Who's Who" in top university research—Harvard, the University of Texas—Austin, and the University of Wisconsin—Madison, to name a few. The IGERT award reflects research quality in UK's chemistry, chemical and materials engineering, and electrical engineering departments, all of which participate in the initiative.

"NSF gave us funds to enhance what is already here," says IGERT program director Leonidas Bachas. In part, UK's competitive edge resulted from departmental research track records and well-established collaborations. The departments realized the industrial need for cross-disciplinary training of Ph.D.s long before NSF announced the IGERT program.

"There's a need in the real world for graduates at the Ph.D. level who can work in teams,"

continued on page 26



LEONIDAS BACHAS SAYS THAT A PRIMARY FOCUS OF THE IGERT GRANT IS TO ANSWER THE REAL-WORLD CHALLENGE FOR ENGINEERS TO BE ADEPT AT WORKING IN TEAMS.



JENNIFER LEWIS'S POSTER PRESENTATION FOCUSED ON A LIGHT-PRODUCING PROTEIN SHE ENGINEERED TO IDENTIFY THYROXIN, A HUMAN HORMONE.

says Bachas, also a professor of chemistry. "A lot of the problems our society faces now in terms of research and engineering are multidisciplinary in nature, so they have to be addressed by taking advantage of tools from more than one discipline."

The five-year, \$2.25 million NSF award for UK's project, "Integrated Sensing Architectures," provides education, research and training for 15 Ph.D. students who have an advisor in their primary department and receive mentoring from advisors in other disciplines.

"The IGERT program emphasizes interdisciplinary work, collaboration among departments, interaction with industry and training our students to excel in new cutting-edge arenas," says Janet Lumpp, professor of electrical engineering. "The laboratory facilities of the various research groups are open to

all of the IGERT fellows, so they have access to instruments not available in their home departments."

Graduating chemistry Ph.D. student Jennifer Lewis says the program's multidisciplinary aspects helped her secure a position with Pfizer pharmaceuticals. "One strong benefit is that you demonstrate through the IGERT program that you can work with scientists in other disciplines." She says interviewers told her they were particularly interested in her combined disciplines, analytical chemistry and molecular biology, as industry projects a future need for scientists with multidisciplinary backgrounds.

"By working with scientists in other disciplines, you get a whole new perspective on your project, your results and how to come up with new applications for your project," she says. Lewis's

primary research focus was development of analytical tests for small biomolecules. Her IGERT research with primary professor Sylvia Daunert of chemistry and with Bachas was intriguing; she genetically engineered a light-producing protein to identify thyroxine, a human hormone.

"You get twice the attention on your project, and by working with two professors, you get the contacts of both and the knowledge of both. When you have problems, two professors might ask you to do two totally different things; it's great to have two inputs on your project," she says.

Not only do IGERT fellows benefit from having more than one professor, they also gain a wealth of knowledge imparted by visiting speakers during weekly seminars. The program provides students with funds for travel to confer-

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ences and meetings, students present posters at an annual mini-symposium and have special classes designed to promote cross-disciplinary interaction.

A four-week experimental summer course provided IGERT fellows the opportunity for hands-on experience in casting membranes, screen printing films, laser micromachining, electrochemistry and membrane characterization. As a finale, students wrote a mock proposal using an NSF Request for Proposals as a template. Lumppp believes the ideas generated by students after learning the new techniques may someday result in formal proposal submissions. IGERT fellows will continue to have classes which integrate different areas of emphasis to expand both research and teaching capacities, and all are required to attend a research ethics course.

"We give students a scenario and ask, 'What would you have done?' Putting students into problem-solving group situations helps prepare them for future academics and industry," says Dibakar Bhattacharyya, professor of chemical and materials engineering. "IGERT has opened the door for faculty and students to learn from one another. The students are excited, and it's invigorating for faculty." He attended the summer course and added a new tool to his own repertoire by participating in a demonstration of microlaser technology. And, while providing a foundation for new skills, the interaction also sparks new ideas.

"It will be a great advantage," says Chris Ball, a first-year chemistry Ph.D. student. "Instead of creating a generation of chemists, now we'll have a generation of chemists who understand engineering models."

Ball participated in a summer internship at the NASA Ames Research Center in Moffett Field, California. He joined NASA's only research group dedicated to

the development of sensors for space flight. Specifically, Ball developed platforms for glucose biosensors that astronauts will ingest or will have implanted subcutaneously to allow for remote monitoring of an individual's vital signs. Commercial or government internships are another integral component of an IGERT fellow's program, strengthening bonds between UK and industry.

The program's goal to develop sensing systems with commercial applications is exemplified by another project, based in Bhattacharyya's laboratory, that is gaining industrial attention. IGERT fellows Stephen Ritchie and Jamie Hestekin are researching microfiltration membranes to which polymers can be attached. These polymers can recognize and separate heavy

"The students are the asset," Bhattacharyya says. "They put us in the forefront of research and bring recognition to the university. With IGERT making the interactions possible, we're bringing in new areas of research which otherwise might not be possible," he says.

The program gains momentum as it passes its first anniversary. Bachas plans to initiate a program that will provide students with a certificate for their work in joint disciplines and will open doors for more students to obtain credit for multidisciplinary studies affiliated with the IGERT program. ■

"The students are the asset. They put us in the forefront of research and bring recognition to the university."

—Dibakar Bhattacharyya

metals out of water. The concept of microfiltration isn't new, but the polymers add a new twist.

"These membranes work as good particle filters, just like a coffee filter," says Ritchie, a fourth-year Ph.D. student. "It's a smart membrane—it can actually remove all these metals, too—so it has two purposes and it works really well."

The membranes could be attached to a kitchen faucet or be utilized in industrial endeavors. Both semi-conductor and plating production processes require large quantities of rinse water that could someday be treated by the membranes for recovery of heavy metals; and the resulting pure water could be recycled back into the system.

TOWARD A MORE DIVERSE PROFESSORiate

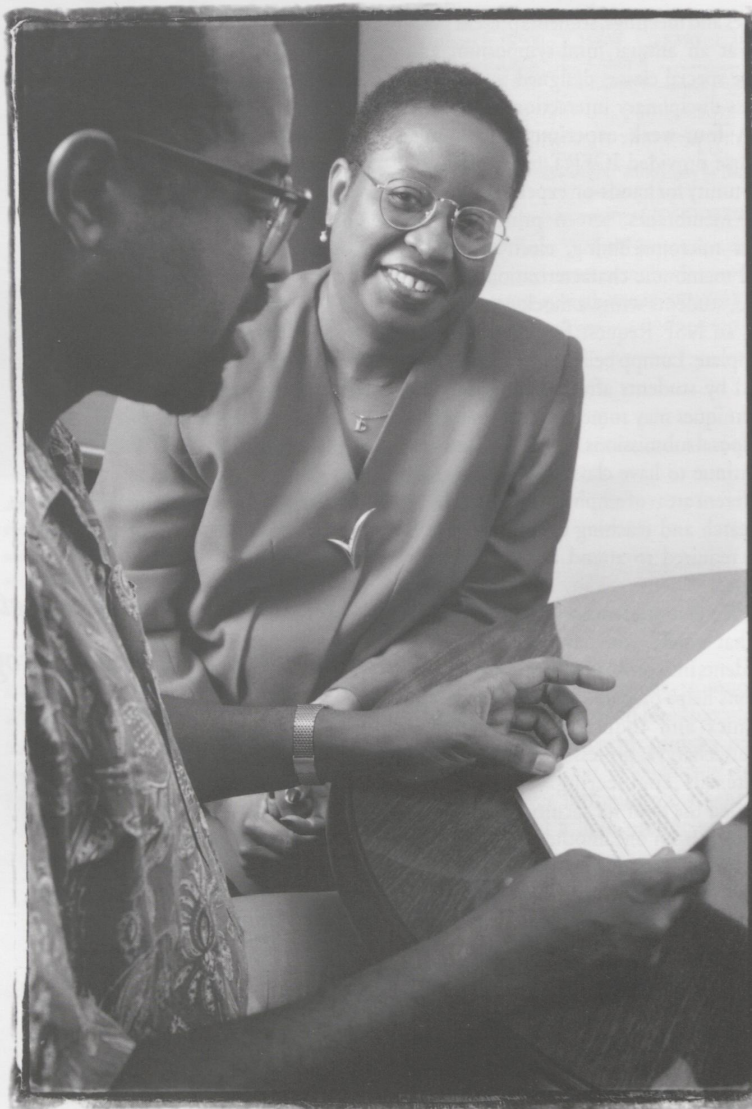
W R I T T E N B Y
D E B B I E G I B S O N

As a Ph.D. student at Texas A&M, Deneese Jones found the work exhilarating but the environment difficult. In class, she was often the only person of color in the room, increasing her sense of isolation. In addition, only one of her professors was African American. She knew that if things were to change, she would have to be a catalyst.

Jones began by writing and submitting several research grants to support her work. Her most significant mentor was her African-American professor, who understood the challenges she faced. Jones developed a deeper professional relationship with this professor, and soon she had established a supportive network that allowed her to thrive and achieve her goals. In 1991, she received her doctorate in curriculum and instruction, focusing her research on reading instruction and issues of equity.

Today, Jones is associate dean of the Graduate School providing leadership for a program aimed at eliminating some of the problems she encountered. She is also an associate professor in the Department of Curriculum and Instruction at UK.

The Southern Regional Education Board (SREB) Doctoral Scholars Program seeks to address the present under-representation of minorities in higher education by encouraging ethnic minority students to pursue doctoral degrees and become college-level professors. "The program takes a multifaceted approach," Jones says. "Besides the



DENESEE JONES WITH SREB DOCTORAL SCHOLAR
TOMAS WAYNE EDISON, WHOSE RESEARCH FOCUSES
ON AFRO-CARIBBEAN LITERATURE

financial support, students also have an opportunity to work closely with faculty members in research. This teaches them the expectations and strategies for future faculty positions they will hold." At a national conference held each fall, students also meet with other scholars and mentoring faculty across the country, opening up a vast network for them.

"This is perhaps the most valuable aspect of the program," Jones says. "SREB scholars are able to make valuable and worthwhile connections across the United States. Since I believe the goal of all universities should be to strive for a diverse, globally oriented learning environment, a challenge for us is to attract different perspectives, talents, and experiences of competence. Even today, many minority students sometimes find themselves in an environment where they seem to be on the outside. This program offers them the opportunity to work with others who understand this."

Four students at UK have received scholarships through the SREB Doctoral Scholars Program this year. Tomas Wayne Edison will complete work on his dissertation in Spanish. Angela F. Cooke-Johnson will now be able to attend UK full-time to work on her degree in communications. Artress Bethany White, who will study English, will be able to come to UK for the first time, and Cameron T. Alsup will study statistics.

Edison says the scholarship will enable him to concentrate on his first love—research. His current research focuses on Afro-Caribbean literature.

"For my dissertation, I am looking at the presence of the African worldview in four writers of the Caribbean," he says. "This is a fascinating topic and one which a lot of people don't know much about." When his dissertation is complete, the Louisville native wants to teach at a re-

search institution such as UK. Edison clearly understands the importance of being able to meet others with similar goals. "This scholarship gives me a chance to meet my peers and connect with them," he says. "It also gives me a supportive environment where I feel I have the freedom to totally pursue my research."

This is precisely what Deneese Jones knew she needed almost a decade ago at Texas A&M. "It is really important to continue the effort to diversify university faculty," Jones says. "This program helps keep that struggle in the forefront. We need the talents of all our citizens if we are to become a hallmark of excellence."

Ethnic minority students who are U.S. citizens, including Native Americans, Hispanics, Asians, and African Americans, who hold or will receive a bachelor's or master's degree from a regionally accredited college or university can apply. Because minorities have been particularly under-represented in science, mathematics, math or science education, and engineering, the program particularly encourages applicants seeking a Ph.D. in these fields.

The program is part of the Southern Regional Education Board (SREB) and is affiliated with similar programs through the Compact for Faculty Diversity. It is funded in part with support from the Pew Charitable Trusts and the Ford Foundation. The University of Kentucky also supports this program as does the Kentucky Council of Postsecondary Education.

For more information, visit
<www.peach.net.sreb/srebdoctoral.html>.

*Even today,
many minority
students sometimes
find themselves in an
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they seem to be on
the outside. This
program offers them
the opportunity to
work with others who
understand this."*

—Deneese Jones

KIOSK

RIVER, KENTUCKY: THE ABRIDGED VERSION

The little community of River, Kentucky, boasts a brand new tourist attraction—the world's longest plastic-deck bridge—and people are coming from all over to see it. "We had some people the other night from New York. We've had some from Connecticut—everywhere," says Patsy VanHoose, postmaster of River in Johnson County.

Completed last April, this cable suspension footbridge spans the Levisa Fork of the Big Sandy River, and the bridge makes the second world record for Issam Harik, UK civil engineering professor. He and his former students also designed the world's longest plastic-beam bridge, located in Kentucky near Cave Run Lake, which received international attention. Harik, with doctoral students Chris Hill and Sasan Pascha, and Jack

Sellars of S.E.A. Engineers, designed the Johnson County bridge.

Harik read about the need for a new bridge in the *Lexington Herald-Leader*, and immediately saw an opportunity. "The whole idea behind doing it was to build the longest plastic-deck bridge in the world," he says. The 420-foot pedestrian bridge in River surpasses by 30 feet the second longest plastic-deck bridge, Scotland's Aberfeldy Bridge.

The technical name for the material in the deck is "glass fiber-reinforced polymer composites," Harik says. "But the layman's term is 'plastics,' which can be confusing because most folks automatically think of Tupperware." Household plastic shares little in common with this material, though—some of the fibers

Harik works with are many times stronger than steel. "The main advantage of the composites is that they're quite durable," he explains.

The plastic deck was manufactured in Virginia, then delivered to River where it was cut and assembled. Though more expensive than a wooden bridge, the new one is safer and will last much longer. "The existing deck was made out of wooden planks. They needed constant replacement," Harik says.

"We were replacing a board about every week," says Freeman Cantrell, la-

borer for the Johnson County Road Department. The original 1930s bridge also swayed, leaned to the south, and had broken and rusted wires.

"There were times in the winter when I refused to walk on it," says Dennis Lyons, a River resident who began lobbying for a new bridge 10 years ago. But some of the locals were more daring.

"Kids rode their four-wheelers, bicycles and motorcycles across the old one," says VanHoose. "This one guy even took his horse across. He had to blindfold it."

BEFORE



AFTER



MERCURY NO CULPRIT IN ALZHEIMER'S

The pedestrian bridge saves an otherwise 20-mile drive to the post office, general store, and friends and family who live directly across the river. Residents used the old bridge because they grew up with it and had no fear of it.

"I walked on it the night before they tore it down," recalls VanHoose, who now uses the new bridge to walk from her house to the post office. "I didn't realize how dangerous it was until they put the new one beside it."

Harik is careful to give credit to others involved in the project, such as Freddie Goble, of the Big Sandy Area Development District. "Goble was really the one who was able to link everybody to the project," he says. The contractor was Bush and Burchett Inc., and the engineers were Bocook Engineering and S.E.A. Engineers Inc.

The \$527,560 bridge was funded by the Federal Highway Administration, the Kentucky Transportation Cabinet and local resident R.B. Preston.

—DAVID WHEELER

Mercury used in dental fillings does not appear to cause Alzheimer's disease, according to a new study by University of Kentucky researchers. The study compared mercury levels in autopsied brains, and dental amalgam status and history in Alzheimer's disease subjects as well as control subjects. The researchers found no significant association of Alzheimer's disease with the number, surface area or history of dental amalgams.

"Our key finding is that there is no relationship whatsoever between mercury found in the brain and amalgam," says Stanley Saxe, one of the study's authors and a professor emeritus of periodontics and geriatric dentistry in the UK College of Dentistry.

"Although very small amounts of mercury are released from dental amalgam—generally when rubbed or abraded due to brushing or eating—it is not taken up by the brain." Funded by a grant from the National Institutes of Health, the study was prompted by scientific controversy that has been brewing for several years on the topic.

The study, which began in 1991, was a collaborative effort among researchers from the UK Sanders-Brown

Center on Aging and the College of Dentistry. Saxe and William Markesbery, director of the Sanders-Brown Center on Aging, led the research team.

"The uniqueness of the collaborative effort between the departments of chemistry, statistics, the College of Dentistry and leadership from the Center on Aging, made this research possible and successful," Markesbery says. "This is the only study that has looked at this question in a large group of people," Saxe adds.

Dental amalgam has been used since the early 1830s and is considered an excellent restorative material in dentistry because of its strength and durability. However, because dental amalgam is comprised of 50 percent mercury, a neurotoxin, it has been the subject of continuing controversy as a possible public health risk.

"The fact that there was no differential found in brain mercury levels due to dental amalgams is very exciting news for the dentistry profession," Saxe says.

"It's good to know that dental amalgam is safe because it is a very good restorative material," says Steve Rider, of the Lange, Rider and Reynolds restorative dental practice in Lex-

ington. It's also good news for dentists and dental assistants, he says. "Though we don't actually touch amalgam, we're in close proximity to it on a daily basis." Rider adds that the scope of this research at UK is also important.

"There are millions of people with silver fillings around the world, which makes this finding even more significant."

TOXIC CHICKEN

In recent years, chicken has vaulted to the top of the nutritional hit list. Low in fat and a good source of protein, it has become a staple in many meals. Carol Pickett is among those who regularly enjoy chicken, but the UK microbiologist also has a serious warning about this popular food: handled improperly, fresh chicken could make you ill or even kill you.

Pickett, an associate professor in the Department of Microbiology and Immunology, has found that every fresh, whole chicken she tested was contaminated with a bacterium called *Campylobacter jejuni*.

Although few have heard of it, *Campylobacter jejuni* is now believed to be the most common bacterial cause of human diarrhea in the United States and in many other countries. The Center for Disease Control in Atlanta estimates that about four million cases occur every year in the United States. Most people affected by the bacterium experience severe abdominal pain and diarrhea for seven to 10 days. A small percentage of people who get the diarrhea can develop a serious autoimmune response called Guillain-Barre syndrome that causes generalized paralysis and can even lead to

death.

"This bacterium is very under-appreciated by the public," says Pickett, "but it is much more prevalent than the *E. coli* found in hamburger."

Pickett is researching how *Campylobacter jejuni* causes diarrhea and is delving into the little-known epidemiology of a toxin, CDT, produced by the bacteria. In the process, her research has also proven just how prevalent the bacterium is.

During the summers of 1996 and 1997, Pickett worked with a graduate student in animal sciences. The student went to every grocery chain in the Lexington area and purchased fresh, whole chickens. Pickett and the student then examined the birds and found that 100 percent were contaminated with *Campylobacter*.

"We quickly discovered that regardless of the store or the brand, if you buy a whole, fresh chicken, you can count on it having the bacteria," she says. (The bacterium does not survive freezing well so is much less prevalent on frozen chicken.)

The bacterium is so pervasive, Pickett believes, because it is hard to elimi-

nate. "The bacteria can easily inhabit chickens, and processing lends itself to all the birds getting contaminated," Pickett says. "The USDA has new processing regulations designed to control *Salmonella* that might also be helping reduce the *Campylobacter* problem, but they by no means solve the problem."

The good news is that proper cooking will kill the bacteria, according to Pickett. The bad news is that it can easily contaminate other foods or other surfaces in the kitchen. Therefore, Pickett recommends thoroughly wash-

ing your hands and any surfaces where the chicken has been. She also recommends that small children not be allowed in the kitchen while fresh chicken is being prepared since diarrhea tends to affect children more severely than adults.

Pickett's research on this subject was published in the April 1999 issue of *Applied and Environmental Microbiology*. Intrigued by what she has discovered so far, the scientist is continuing research into what she calls a "unique and very interesting" toxin.

—DEBBIE GIBSON



WITH FLAGELLA ON BOTH ENDS, *CAMPYLOBACTER JEJUNI* IS A UNIQUE BACTERIUM.

Journal of Infectious Diseases, University of Chicago Press, Volume 166, p. 311.

BOB VOLK IS NEW DIRECTOR OF KWRRI



Bob Volk, the new director of the Kentucky Water Resources Research Institute, is pleased about his recent move from Nebraska to Kentucky. "My wife Shari and I are thoroughly enjoying Lexington. I have never seen so many flowering trees in my life," says Volk, who worked for the past eight years as director of the University of Nebraska Water Center, Environmental Program before taking his new job at UK. "We see Lexington as a big city with smaller town advantages."

Volk, who started his position here last March, is also a professor of agronomy with the UK College of Agriculture. In this position, he admits that he's following in his father's footsteps. "Dad was a professor of soils at Auburn; then we moved to Columbus, Ohio, where he became chairman of the agronomy department," Volk says, adding that he considers Columbus to be his home.

Volk, who also served as president of the National Institutes of Water Resources while at the University of Nebraska, had the opportunity to take a close look at the functions and activities of water institutes across the country. He examined the potential for water resources-related research and education at several institutes and viewed UK as having an outstanding potential for building on the success of KWRRI.

"Next to its people, I view water as Kentucky's most important resource," Volk says. "Wise use and preservation of clean water is something important to all of us and I look forward to making a contribution to that end."

DECONSTRUCTING STEREOTYPES

A father and son are involved in a horrific automobile accident. The father is killed, and the son is rushed to the hospital for emergency surgery. Upon their arrival, however, the surgeon takes one look at the child and says, "I cannot operate on him. He is my son." How is this possible?

The riddle—playing on gender stereotypes—is an excellent example of the power stereotypes play in shaping our thoughts and actions, according to UK social scientist Margo Monteith, an assistant professor of psychology. If you did not figure out that the surgeon is the child's mother, don't feel bad. Monteith says she was on the cusp of receiving her Ph.D. from the University of Wisconsin-Madison in 1991 when she first heard the riddle. At the time, she did not figure it out either.

Today, Monteith regularly uses this riddle as a way to help her students think about stereotypes, a subject she began researching in graduate school. From a psychological perspective, stereotypes are merely evaluations stored in memory. They function as a kind of mental shorthand, helping save cognitive resources, particularly when we are doing multiple men-

tal tasks at one time.

This mental shorthand, a way of sorting things by type, is particularly useful for small children who have so much to learn about the world and are learning at such a fast pace. Perhaps that is one reason research has found that 25 percent of three and four-year-olds have well-ingrained stereotypes, and that by age five, almost all children have stereotypes in place.

Of course, this sorting is not all benign.

"Stereotypes are also used as justifications for actions," Monteith says. "For example, the stereotype of blacks prior to abolition was that of the happy Sambo, always a smile on his face, docile but not very smart—someone who needed to be cared for. That stereotype justified slavery. After abolition, the stereotype of blacks changed, and they became people to be feared. This justified the violence that was taken against them." Fortunately, people are capable of controlling the influence of stereotypes. How we do this—and could learn to do it better—is the focus of Monteith's current research on the subject.

"I am interested in understanding the self-regulatory

continued on page 34

FARMING BY
SATELLITE

process we use to decrease the influence of stereotypes," Monteith says. "Psychology literature has always assumed that something automatic cannot be controlled because by definition it is automatic. However, my research has shown that people regularly catch themselves using stereotypes and then control their reaction."

The researcher uses a 16-scenario questionnaire which asks participants to answer a series of "should" questions followed by a series of "would" questions. For example, I should laugh at racist jokes/ I would laugh at racist jokes. The questions are random, so the shoulds and woulds for a particular action are not consecutive. The questionnaire is then validated by behavioral tests. Interestingly, the tests prove that people answer the questionnaire accurately and are more aware of their use of stereotypes than might have been predicted.

"People are much more aware of stereotypes than we might think," she says, "but it is a confusing struggle. They don't know why they have the stereotypes and may not even believe them on a conscious level." Whether they ever pin down the plethora of reasons why the stereotype exists (media im-

ages, parental influences, etc.), awareness of the stereotype is the key to controlling it, according to Monteith's research.

"You have to be on the lookout, to be aware of your responses," she says. "Otherwise, there is no possibility of controlling them. Secondly, you have to have a sense of self efficacy, that you really can control your response." Change is neither easy nor quick, she adds.

"Change is very difficult, but once people are aware of the stereotype, they become more self focused, asking themselves questions such as, 'Why did I do that?' or 'Why did I say that?' When they are in a similar situation—exposed to a similar stimuli—they can begin to halt the association between the stimuli and the predicted response."

—DEBBIE GIBSON

Kentucky farmers are challenged by highly variable land. Slight differences in soil structure, elevation, slope, fertility, and drainage can frustrate a farmer trying to decide the correct types and quantities of seed, fertilizer and chemicals to apply to his crops.

To help these farmers optimize production, researchers at UK's College of Agriculture are experimenting with new and evolving "precision agriculture technologies." Precision agriculture helps producers recognize the variations of their land and helps them adjust inputs to the land to optimize production.

"Precision agriculture has been described by other researchers as doing the right thing, in the right place, at the right time," says Scott Shearer, biosystems and agricultural engineer at UK.

The focus of precision agriculture in Kentucky has been on grain production, and the key is the Global Positioning System. The Department of Defense developed this satellite system for the United States' security interests. Since then, civilians have used the satellites much more than the developers anticipated. Agricultural professionals have become one of the primary groups to use GPS.

An analogy might help to illustrate how this system works. You can estimate the distance between yourself and lightning by counting the seconds between the flash and the thunder. GPS is much the same; the difference is that GPS is a space-based navigation system. A satellite generates a radio signal that is transmitted to a GPS receiver on Earth. The receiver measures the time it takes that signal to travel from the satellite to the receiver. With four signals from separate satellites, the position can be accurately fixed.

"GPS allows farmers to locate their position in a field within less than one meter," Shearer says. "This means they can go back to that same spot, within one meter, time and time again. This is the beauty of the technology."

Before, when farmers applied chemicals or fertilizer, they made decisions on a field-average basis. They used to apply the same amount of fertilizer over the entire field. With new technology, this is no longer the case. Now, with high-tech

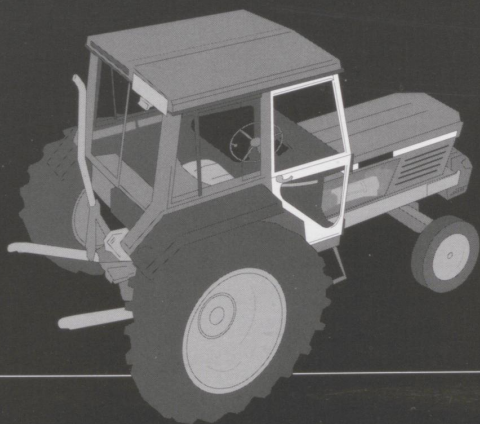
farming, the farmer has a GPS receiver on his machinery, which is connected to a laptop or task computer that already has a stored database of optimal field requirements for fertilization. The computer runs a program that controls the mixing of nutrients—nitrogen, phosphorous and potassium—for fertilization and spreads them as needed as the farmer drives across the field. “With GPS, producers can identify the exact places that soil fertility changes,” says Shearer.

He estimates that about one-fourth of Kentucky’s grain producers are using some form of precision agriculture technology, and he expects that percentage to increase. Many farmers already are using sophisticated bookkeeping and accounting practices. Some have networked computers in their farm offices. So adding a technology such as precision agriculture does not seem like a stretch to them.

Precision agriculture research continues in the College of Agriculture. This fall, a new, indoor yield-monitoring test facility will open. It will be the most sophisticated facility of its kind in the world. Also, studies on electrical conductivity of the soil and the use of satellite imagery are ongoing. “The college will continue to work with producers to gain important real-life pictures of how precision agriculture is helping them be more efficient with their resources,” Shearer says. “This technology has opened a whole new avenue for researchers and producers.”

—AIMEE D. HEALD

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FRANK DERBYSHIRE 1945-1999

It came as a great shock to all of us to learn that Frank Derbyshire passed away August 17 while on a trip to England. Director of the Center for Applied Energy Research since 1989 and a professor in the chemical and materials engineering department in the College of Engineering, Frank enjoyed a career that spanned nearly 30 years.

"He embodied all the qualities of a great researcher. He took CAER to new heights and was one of the leading forces in our materials research program," says Fitzgerald Bramwell, RGS vice president. "He was instrumental in securing a \$3.5 million grant from NSF for the study of carbon nanotubes. And under his leadership, UK hosted several international conferences on new energy materials. He was a superb scientist, an absolute gentleman, and a really nice guy."

Frank joined UK after serving as research director at Sutcliffe Speakman Carbons Ltd. in England and as an associate professor in fuel science at Pennsylvania State University. He published 150 papers about energy research and held 13 patents related to coal, hydrocarbons, graphites and other energy materials.

After graduating with honors in chemical engineering from Manchester University in England, Frank earned a master's degree from McMaster University in Ontario and a Ph.D. from Imperial College in London. In 1987, he received the Richard A. Glenn Award from the Bituminous Coal Research Association, and in 1997 he received the Henry H. Storch Award in Fuel Chemistry from the American Chemical Society.

"His professional accomplishments are well documented in a research career that spanned the range from government research, to private industry, academia, and ultimately to CAER, which combines some of each," says Frank Burke, president of the CAER advisory board and a longtime friend. "To my mind, what most strongly characterized Frank as a scientist, administrator, and a friend was his ability to engage others in productive and cooperative endeavors through his intelligence, persistence and his personal charm and wit. There is a saying that delight is measured by the degree to which actuality exceeds expectation. In all respects, Frank Derbyshire was a delightful fellow."

"I think the key to Frank's success in life, in what he accomplished and in his relationships with his large worldwide network of friends and acquaintances, was that he never took

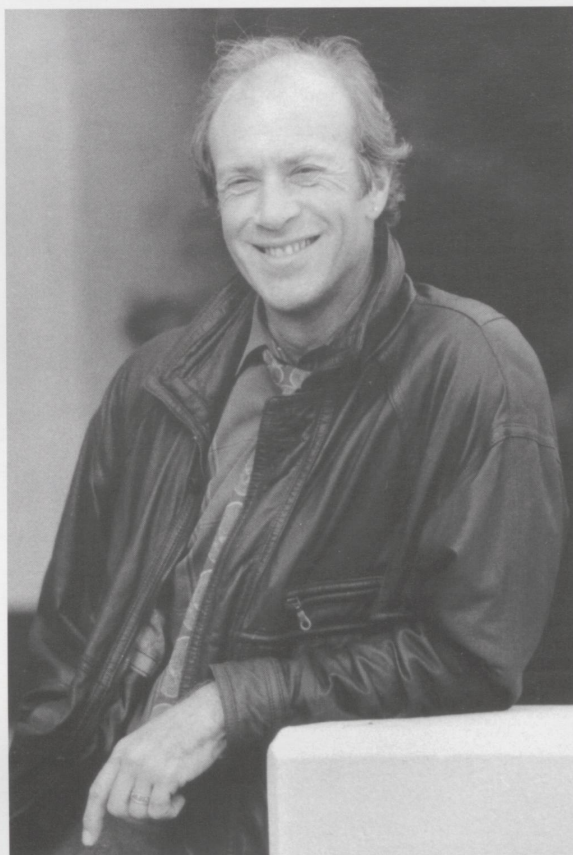
himself too seriously—and he never took anybody else too seriously either," says David Gray, director of energy systems analysis for Mitretek, a non-profit consulting company in McLean, Virginia. "This attitude allowed him to deal fairly and honestly with people from all stations in life—students, academicians, industrialists, politicians, and bureaucrats. He knew exactly who he was and he knew exactly who you were beneath your cloak of authority or title or office."

"Frank was the embodiment of a humane and cosmopolitan scientist," says Lubisa Radovic, professor of energy and geo-environmental engineering at Penn State and editor-in-chief in North America of the *CARBON* journal. "His legacy will be in the science that has earned him the Storch Award in Fuel

Chemistry as well as in his contributions to the science and technology of novel carbon materials. But we shall cherish him just as much for his joy of living, the erudition, the enthusiasm, the urge to interact—that elegant, sophisticated and yet unpretentious and warm interaction."

Radovic also singles out what she calls Frank's "opportune humor" as a unique and memorable trait. Burke agrees, recalling one incident where Frank was the featured speaker at a Pittsburgh Coal Technology Group luncheon meeting. The restaurant had offered to supply a screen for projection of his slides. It turned out that the screen was tiny—only about three feet wide and two feet tall—and the top could be raised only a few feet off the floor. "After being introduced for his presentation," Burke says, "Frank approached the screen, dropped to his knees, and began his presentation with complete aplomb."

Burke remembers Frank as unflappable in the face of adversity or surprise. "At a session at an American Chemical Society meeting in Anaheim, not far from Disneyland, Frank was on the agenda. Inspired by the locale, I arranged for members of the audience to don those famous mouse ears when Frank took the po-



dium. This prompted him to confess that many people thought his experimental methods were Mickey Mouse and his data were Goofy, but he was going ahead with the presentation nonetheless."

"We worked for 10 years together and considered it a great partnership—Frank with the science, me with the administration—so much so that it carried over outside of the CAER. He was also my business partner in a thriving start-up business at ASTeCC and soon to be Coldstream, and my tennis partner," says Don Challman, an associate director at CAER. Challman characterizes Frank as a "globe-trotter extraordinaire" who did anything he could for students. "He loved creating opportunities for young people," Challman says. "He was a veritable Pied Piper: wherever he travelled, he would lead students back to Kentucky."

"It is clear to me that Frank was the heart and soul of the Center for Applied Energy Research," says Radovic. "He has put CAER on the U.S. map. He has prepared his center well for the 21st century, as if he had known that it will have to get there without him."

Frank, you will be missed.

—ALICIA GREGORY AND JEFF WORLEY

PARTING SHOTS

"There is a single light of science, and to brighten it anywhere is to brighten it everywhere."

—Isaac Asimov (1920-1992)

"The scientific theory I like best is that the rings of Saturn are composed entirely of lost airline luggage."

—Mark Russell

"The best way to have a good idea is to have lots of ideas."

—Linus Pauling (1901-1994)

"Only two things are infinite, the universe and human stupidity, and I'm not sure about the former."

—Albert Einstein (1879-1955)

"Man will occasionally stumble over the truth, but usually manages to pick himself up, walk over or around it, and carry on."

—Winston Churchill (1874-1965)

"If it keeps up, man will atrophy all his limbs but the push-button finger."

—Frank Lloyd Wright (1869-1959)

"The universe is full of magical things, patiently waiting for our wits to grow sharper."

—Eden Phillpott (1862-1960)

"The great tragedy of science — the slaying of a beautiful hypothesis by an ugly fact."

—Aldous Huxley (1894-1963)

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