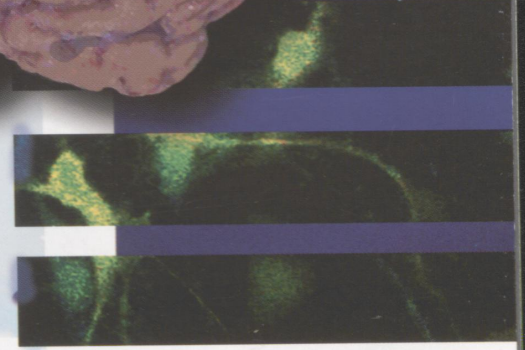
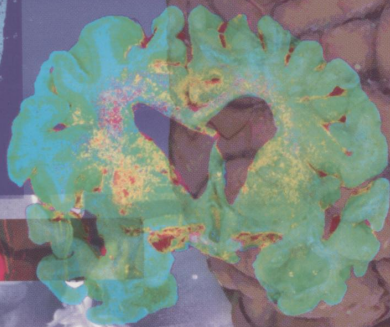
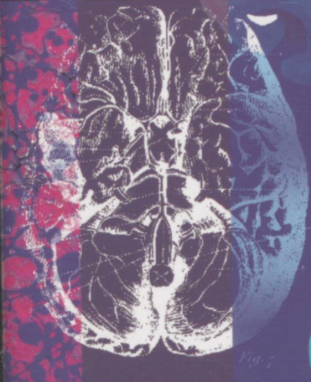
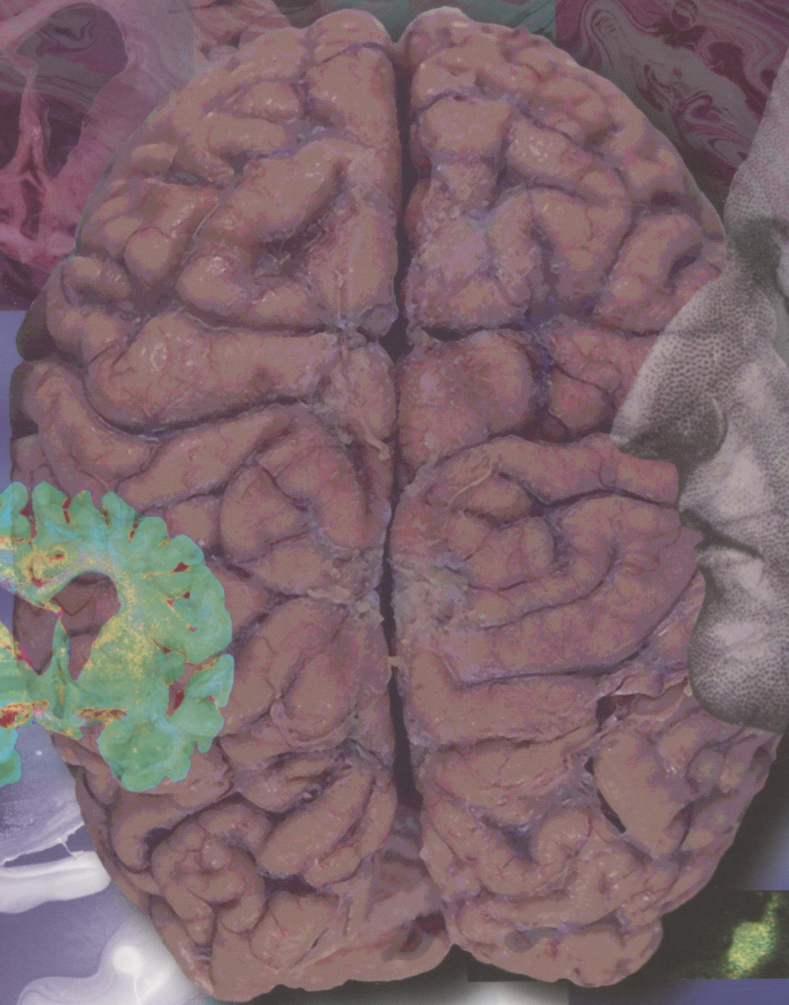


THE MAGAZINE OF UNIVERSITY OF KENTUCKY RESEARCH AND GRADUATE STUDIES • FALL 1998

ODYSSEY



Alzheimer's: Fighting Back



Fitzgerald B. Bramwell, Vice President

Office of the Vice President
for Research and Graduate Studies

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Dear Friends of UK,

The University of Kentucky is now in the process of directing multimillion-dollar expenditures over the next several years to enhance research programs and assist graduate students as a result of the 1997 Kentucky Postsecondary Education Improvement Act.

The Research Challenge Trust Fund's \$16 million portion of UK's current operating budget comes from a dollar-for-dollar match of funds provided through the Council on Postsecondary Education and from reallocation of university funds. Research Challenge Trust Fund money will be used to support additional faculty, graduate students and staff in eleven strong research programs, provide student-centered support for the Graduate School, and for substantial lab renovations.

The research programs targeted by the university to receive additional faculty and staff are gerontology and aging, advanced medical research, clinical pharmaceutical sciences research and graduate training, molecular mechanisms of toxicity, computer science and electrical engineering, materials synthesis, plant sciences, biological chemistry, management and economics, psychology of substance abuse and prevention, and geography.

The Graduate School is providing graduate assistant support packages in the form of 32 new graduate fellowships and tuition assistance for 225 graduate research assistants in targeted programs of excellence.

UK has requested \$17.5 million from a second incentive fund, the Research Equipment and Laboratory Replacement Pool. With this investment we will be able to replace aging equipment with state-of-the-art instrumentation.

For now, we are investing our resources and concentrating our efforts on our most valuable asset, our people. In all, we are hiring 54 new faculty, supporting 87 graduate students as graduate assistant fellows, adding technical support staff, and distributing 255 graduate assistant tuition scholarships.

UK's faculty, graduate assistants and staff will be the ones to advance our already prominent research programs. Another record year of attracting \$131.4 million in research contracts, grants and gifts proves this fact. Together, with your continued support, we are moving forward to make a great university even greater.

Yours truly,

Fitzgerald B. Bramwell



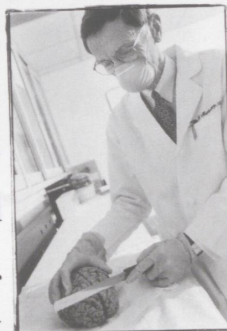
ALZHEIMER'S: FIGHTING BACK

*UK researchers are working at the cell level
to discover the pathways of the disease and how to counter it*

BY JEFF WORLEY

About a quarter of a century ago, a new word entered public usage: *Alzheimer's*. Named after the German physician Alois Alzheimer in 1907 and long-used in medical circles, the word put a label on the dehumanizing condition of degenerative memory loss and physical deterioration which ultimately leads to death. An estimated 14 million Americans will have Alzheimer's by the year 2020.

At the University of Kentucky, researchers began working to understand this disease in the mid 1970s, according to William



WILLIAM MARKESBERY, ONE OF THE FIRST SCIENTISTS AT THE UNIVERSITY OF KENTUCKY TO DO RESEARCH INTO ALZHEIMER'S DISEASE, PERFORMS AUTOPSIES ON BRAINS DONATED TO UK'S ALZHEIMER'S DISEASE RESEARCH CENTER. "ONLY THROUGH AN AUTOPSY OF THE BRAIN CAN IT DEFINITELY BE DETERMINED WHETHER SOMEONE HAD ALZHEIMER'S OR NOT," MARKESBERY SAYS.

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Markesbery, director of the Sanders-Brown Center on Aging. "I worked with Bill Ehmann in the chemistry department here for over 20 years, and we had our first grant to study Alzheimer's in 1976 or '77," Markesbery recalls. "This was the first grant at UK, and at this time there weren't many grants around the country to study the disease."

In the 1960s and 1970s the study of Alzheimer's disease focused on describing the effects of the disease, trying to describe what Alzheimer's "looked like." "Back then it was very descriptive," Markesbery says, "but all the descriptive work is behind us and now we're at the molecular level trying to understand the mechanisms of the disease. And," he adds, "it's gotten to be very exciting."

Markesbery is now a member of a research team, which includes Chemistry Professor Allan Butterfield and Mark Mattson, a neurobiologist and professor at UK's Sanders-Brown Center on Aging. Four years ago Butterfield, Mattson and John Carney (then a professor of pharmacology at UK) made an exciting discovery that captured international attention: they discovered how brain cells are killed in the process of Alzheimer's disease, a finding that National Institute on Aging director T. Franklin Williams called a "breakthrough in the understanding of the disease."

Butterfield was instrumental in developing at that time what he called the "molecular shrapnel model" of brain cell death in Alzheimer's disease.

"I began thinking about the beta-amyloid protein, a peptide [a series of amino acids] that is the core block of abnormalities in the brain called plaques," says Butterfield, who also directs UK's Center of Membrane Sciences. "Plaques are one of three features always found in the brains of Alzheimer's victims. The odd thing about this peptide in plaques is that no matter how you try to dissolve it, you can't do it. As

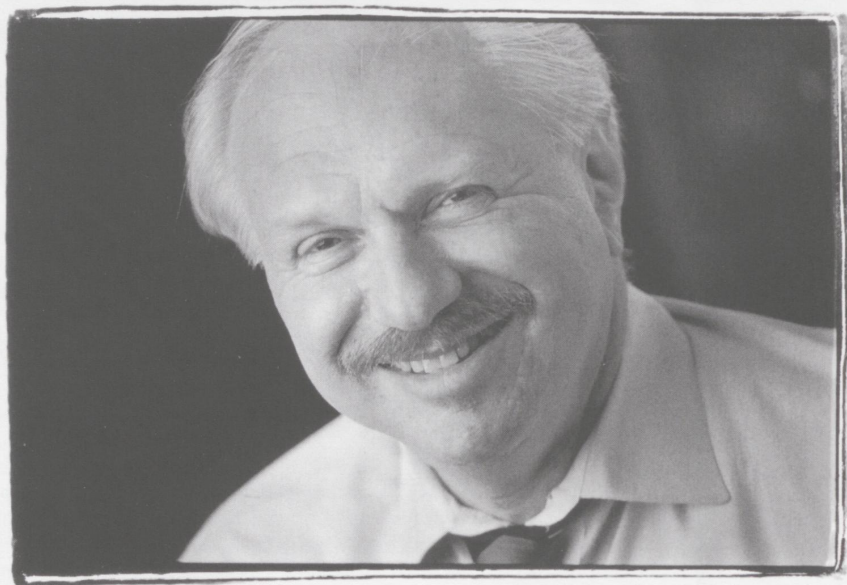


photo by Lee Thomas

PHILIP LANDFIELD'S RESEARCH EXAMINES THE ROLE OF CALCIUM IN AGING BRAINS. LANDFIELD AND COLLEAGUES HAVE FOUND THAT CALCIUM CHANNELS INCREASE IN DENSITY AS THE BRAIN AGES, A CONDITION WHICH RESULTS IN A GREATER INFLUX OF CALCIUM INTO THE CELLS OF AGING NEURONS.

a scientist, I asked myself, 'How can you account for this?' The only answer I could come up with is that the peptide was forming covalent bonds—very strong chemical associations. 'And how are covalent bonds formed?' I asked. The answer that occurred to me is by peptide free-radical reactions."

Free radicals, Butterfield explains, are molecules with one or more unpaired electrons, an imbalance that causes them to be extremely unstable and reactive. "Nature abhors having unpaired electrons," says Butterfield. "So free radicals are very reactive because they are always trying to either give up or accept an electron."

Butterfield, Mattson and Carney set to work immediately to see if they could detect free-radical activity from the beta peptide. After several control experiments using electron paramagnetic resonance spectroscopy, the researchers found that this villainous

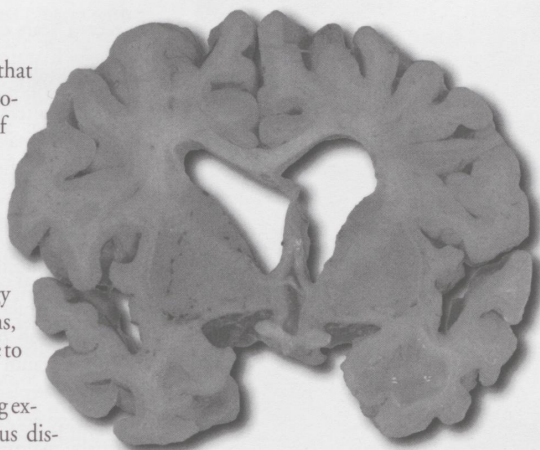
peptide was, in fact, associated with free radicals. The free radicals attacked the cell membranes, substantially damaging them.

Recent Findings about Cell Membrane Death

That was four years ago. Armed with the first theory that put Alzheimer's disease into an understandable and verifiable framework, Butterfield, Mattson and Markesbery (Carney left UK for a job in private industry) subsequently found that the beta peptide causes nerve cell damage by inducing a free-radical-mediated process called "lipid peroxidation" in the nerve cell membrane. Lipids are fatty or waxy substances which constitute, along with proteins and carbohydrates, one of the principal components of living cells.

"We found that such lipid peroxidation results in the impairment of protein func-

THE CROSS SECTION OF BRAIN BELOW IS FROM THE FRONTAL AND TEMPORAL LOBES OF A PATIENT'S BRAIN THAT HAS LITERALLY BEEN WORN AWAY BY ALZHEIMER'S DISEASE. THIS BRAIN SLICE IS CHARACTERIZED BY ENLARGED VENTRICLES (SPACES IN THE CENTER), AND SHRINKAGE OF THE FOLDS AND WIDENING OF THE SPACES BETWEEN THE FOLDS OF THE BRAIN INDICATING ATROPHY AND A SUBSTANTIAL LOSS OF GRAY MATTER. THE OTHER CROSS SECTION (RIGHT) IS FROM A NORMAL INDIVIDUAL. THIS SLICE SHOWS MUCH SMALLER VENTRICLES AND MINIMAL ATROPHY OF THE GRAY MATTER.



tion in the membrane that normally transports ions (sodium and calcium) out of the cell and glucose into the cell," says Mattson. "This results in excessive elevation of intracellular calcium levels and reduced levels and reduced energy production in the neurons, rendering them vulnerable to being 'excited to death.'"

Mattson says this finding explains the group's previous discoveries showing that the beta peptide disrupts calcium regulation in neurons, making them sensitive to degeneration.

More recently, the researchers have focused on one of the products of the free-radical attack, a molecule called 4-hydroxynonenal, or HNE. This molecule was found to be elevated in Alzheimer's

brains. The scientists believed that this extremely reactive molecule, which targets amino acids (the chief components of proteins) on the cell membrane, caused their dysfunction. HNE, they thought, led to the membrane being weakened, a condition which subsequently allows calcium to leak into the cell and kill it.

Mattson showed in 1996 that if amyloid is introduced into neuronal cells in culture that HNE will be formed, and Butterfield showed in 1997 that if HNE is added to brain cells, the conformation of cell membrane proteins will be changed.

"This finding confirmed an earlier discovery of ours—amyloid's effect on various transport proteins," says Butterfield. "This was a very, very good finding," he adds.

"This result, that amyloid was associated with free radicals, also might explain another enigmatic feature of Alzheimer's disease," Butterfield says. "We see many reports in the scientific literature of different proteins and lipids being altered in this disease." Butterfield proposed that amyloid-associated free radicals, being reactive, would bind to these transport proteins and alter their function in Alzheimer's brain tissue.

"These free radicals also weaken the structure of membrane lipids," he says. "Together, these free-radical-induced effects on membranes might explain the altered enzymes, transport proteins and lipids in the brain."

Most recently, the researchers have focused their attention on a molecule called glutathione, a tri-peptide normally found in everybody's cells. An important characteristic of this molecule is that it naturally counteracts HNE, preventing it from damaging transmembrane proteins.

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DURING THE LAST 10 YEARS, MARK MATTSON HAS BECOME A LEADER IN STUDIES OF MECHANISMS OF NEURONAL DEREGLATION.



Photo by Lee Thomas

USING
HIGH-PERFORMANCE
LIQUID CHROMA-
TOGRAPHY, ALLAN
BUTTERFIELD
SEPARATES
PEPTIDES FOUND
IN THE ALZHEIMER'S
DISEASE BRAIN.

*"There's
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and to
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to reason
clearly."*

— William Markesbery

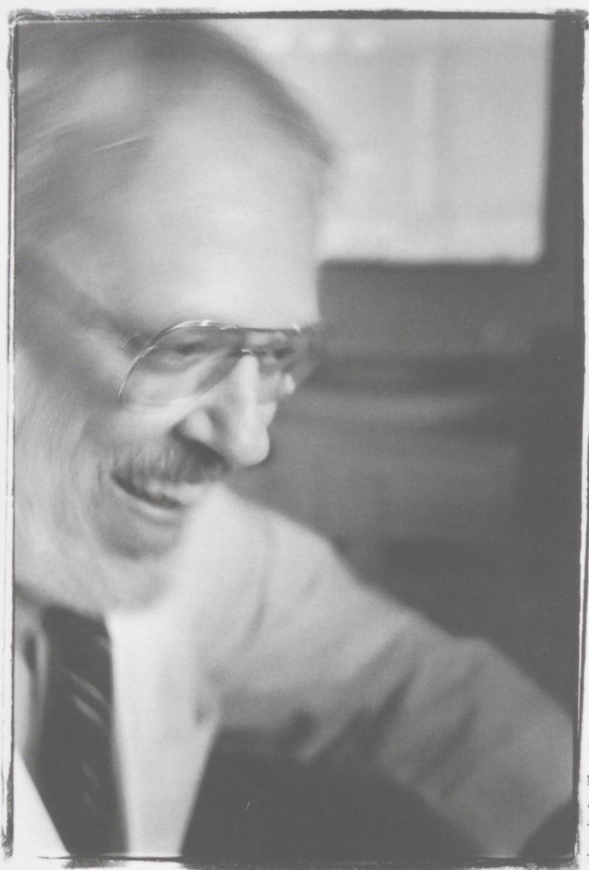


photo by Lee Thomas

"We have just completed a study in which we chemically reduced the glutathione level in a living animal—we used gerbils—with the question in mind: With a lowered glutathione level, would the oxidated stress be worse than it would be with the regular level of glutathione present?" Butterfield says. "And the answer is yes. And then we turned the question around: If we increase the glutathione level, would there be increased protection? And the answer is, again, yes."

This is an important discovery, Butterfield says, because it means that the body's natural antioxidant system might be used to fend off free-radical damage. If the level of this molecule could be significantly increased in our bodies, we would have a natural system of damage control.

Calcium's Role in Cell Death

In recent years calcium's role in cell death has been hypothesized by researchers. In the early 1980s speculation began to grow that aging alters the calcium balance and this in turn makes the neurons more vulnerable for Alzheimer's disease.

"It's well known that calcium is critical to a wide range of cellular processes," says Philip Landfield, UK professor of pharmacology. "But if calcium becomes, for some reason, deregulated and the level rises, the nerve cell will be gradually damaged because of calcium's toxicity at higher levels." Landfield explains that calcium, a basic mineral we get from some foods and milk, is usually maintained at a very low level by a series of buffering mechanisms and is normally cleared rapidly from the cell.

Backed by a recent \$1.4 million NIH MERIT award and a \$5 million program project award from the National Institute on Aging, Landfield and a team of scientists at UK's Chandler Medical Center are investigating calcium regulation in aged cells. The effort includes multiple projects, based primarily in pharmacology and the Sanders-Brown Center on Aging.

"We received this MERIT award in part because of our discovery here at UK that there are more calcium channels in the membranes of aged neurons," Landfield says. "We had the essential advanced technology here and the experienced researchers who'd been trained how to use it."

The technology Landfield refers to begins with a powerful microscope that allows the viewer to observe the dissecting of a cell. Using this microscope, Research Associate Eric Blalock can view one nerve cell from an aged rat and then—through a very precise and delicate procedure—study the calcium channels within that cell. Landfield explains: "Every membrane has channels in it. Since we want to study only calcium channels, we introduce drugs known to react

with and block other types of channels. Then we attach a small glass pipette with a hole in the tip to the surface of the nerve cell. Now, what's under the mouth of the pipette is all that's recorded, the activity of a single channel or single molecule." A series of blips—peaks and valleys—on a printout records this channel opening and closing.

When told that this all sounds extremely complex and futuristic, Landfield says that this observation is understandable and is half right. It is difficult science, but the method for exposing the cells has been around "for all of seven years or so now," he says, adding that the scientists who developed this method won the Nobel Prize for it in the early '90s.

After the neuron's channel activity is recorded, the cell is pulled up by the pipette and placed in a small test tube. It is then taken to the lab next door, to Kuey-Chu Chen, a research assistant professor. "We want to analyze molecular contents of the cell, but there's a problem," Landfield says. "There's simply not enough material to work with in one cell."

That's where Chen comes in. Her job is to take the DNA from the cell and through a common technique called PCR (polymerase chain reaction) keep recycling (duplicating) the DNA until there's enough to actually work with. This process amplifies the genes in the cell just as turning up the volume on a radio amplifies a song. The result is what looks like, to the untrained eye, a series of darker and darker smudges displayed on a computer screen. These marks tell the researchers how much DNA is present to make proteins the researchers want to study.

"This work focuses on one of the central questions our group is trying to answer: Why are there more of these calcium channels in aging? There are two possibilities," Landfield says. "Either more channels are

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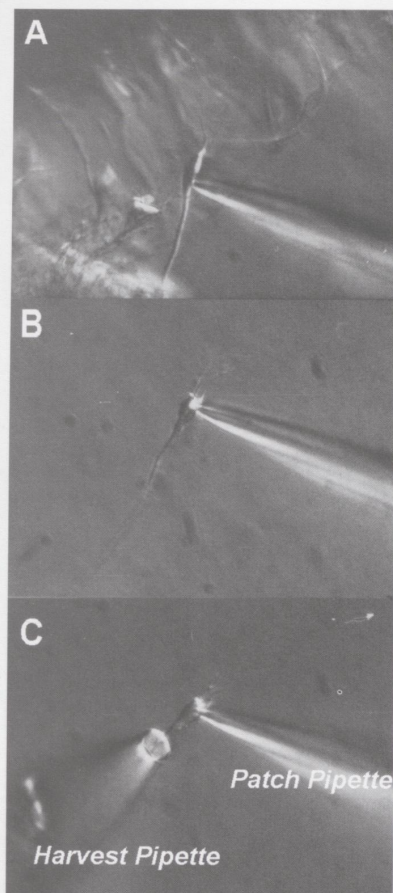
photo by Lee Thomas

"In addition to taking vitamin E and vitamin C, measures can be taken to forestall Alzheimer's disease. You should restrict your dietary intake to 1,600 to 2,000 calories per day throughout your adult life."

— Mark Mattson

PHILIP LANDFIELD'S RESEARCH TEAM AND COLLABORATORS ARE INVESTIGATING THE ROLE OF CALCIUM IN CELL DEATH. FROM LEFT TO RIGHT: (BACK ROW) LAWRENCE BREWER, POSTDOCTORAL FELLOW IN THE BIOLOGY OF AGING PROGRAM; JEANISE STATON, RESEARCH ASSISTANT; CHRIS NORRIS, POSTDOCTORAL FELLOW IN THE DEPARTMENT OF PHARMACOLOGY; (FRONT ROW) GREG CLODFELTER, GRADUATE STUDENT IN PHARMACOLOGY; ERIC BLALOCK, SENIOR RESEARCH ASSISTANT; AND KUEY-CHU CHEN, RESEARCH ASSISTANT PROFESSOR.

THIS SEQUENCE OF PHOTOS SHOWS A SINGLE BRAIN CELL BEING RECORDED AND THEN COLLECTED FOR MOLECULAR ANALYSIS. IN A) A PATCH PIPETTE IS USED TO RECORD THE ELECTRICAL ACTIVITY OF THE NERVE CELL'S CALCIUM CHANNELS. B) THE NEURON IS GENTLY PULLED AWAY FROM THE MAIN TISSUE SLICE. C) THE NEURON IS TRANSFERRED FROM THE PATCH PIPETTE TO THE HARVEST PIPETTE. THE HARVEST PIPETTE IS REMOVED FROM THE BATH AND ITS CONTENTS PLACED INTO A COLLECTION TUBE FOR ANALYSIS OF THE CELL'S PROFILE OF GENE EXPRESSION. THE RESEARCHERS HOPE TO IDENTIFY HOW GENES REGULATE ACTIVITY OF THE CELLS AND EVENTUALLY DETERMINE HOW THIS GENE EXPRESSION CHANGES WITH AGING.



"All the descriptive work is behind us and now we're at the molecular level trying to understand the mechanisms of the disease. And it's gotten to be very exciting."

— William Markesbery

being made or fewer are being broken down. Either way, it's a deregulation problem that results in a buildup of calcium." Further study of the amplified genes will lead to understanding the activity of these calcium channels, Landfield says.

"Although PCR is an established technique, very few labs in the world do this from a single cell," says Landfield. "But this single-cell amplification allows us to compare young cells with old, to correlate the amount of different gene expression with channel functions and determine the cells' vulnerability to being killed."

The ultimate goal is to determine which gene pathways are involved in killing neurons. "What's unique about this work is that we're using new techniques that are only beginning to be available in basic biology and applying them to the problems of brain aging."

Down the hall from Chen's lab, the calcium question is being explored in another way. Olivier Thibault, an assistant research professor, sits in a small semi-darkened room surrounded by an impressive array of equipment. A large microscope with numerous attachments is complemented by two computers that capture different types of data on calcium. A TV screen records a procession of peaks and valleys from, Thibault explains, "the currents from the nerve cell channels under scrutiny."

The pulses that translate on the screen are being recorded from a pipette lodged in the center of the rat brain slice, which, according to Landfield, is a spot that will least affect the normal firing of the cell. "Each time the cell fires, there's an electrical change in the membrane, and it opens the calcium channel," Landfield explains.

Another screen shows the magnified neuron, some of it glowing red. The red dye is a reagent added to the cell. When it comes into contact with calcium, it glows red so that the researchers can see where the calcium is in the cell, and how much there is.

"This confocal laser scanning microscope can show us whether there is calcium present in the cell and, beyond that, we can see where the calcium is in different layers and levels within the cell," Thibault says. "It's very sensitive and difficult to use but is an indispensable instrument for this kind of research." An advantage to this approach, once it is mastered, Landfield says, is that the electrical activity of young cells can be compared with that of older cells, and the amount and location of calcium can be compared. "It's a very powerful method for us to see calcium influx at different depths in the cell," he says.

A few doors down the hall from where Thibault does his work, the calcium question is being explored on another front. Nada Porter, an assistant professor of pharmacology, and Veronique

Thibault, Olivier's wife, are working with rat brain cells in culture. This is a type of fast-forward research, Porter explains, because embryonic cells develop the same changes in calcium channels in four to five weeks in a Petri dish as the animal itself develops over a period of years.

"One clear advantage to this," Porter says, "is that since some of the same things are happening in cell culture as happen in the living animal, we may be able to reduce the number of animals we are studying and focus more on the calcium changes in culture that are most responsible for making neurons vulnerable."

"Our strategy has been, and continues to be, to bring the most advanced techniques in the field to the study of aging," Landfield says. "We're using cutting-edge methodology comparable with any in the world to track down the key changes that come with age to make a cell more vulnerable to Alzheimer's disease. When I started on this research 20 years ago, I figured it'd take about 10 years to solve the role of calcium in aging and cell death. I didn't realize how long it would take just to test each aspect of this. I guess 10 years always looks a lot longer when it's in front of you rather than behind you."

Alzheimer's Disease Research Today

In contrast to the research climate for Alzheimer's 20 years ago, there are now hundreds of projects worldwide that are focusing on the disease and how to understand it and control it. One reason for this mushrooming of projects is that the largest population group in the country, the Baby Boomers, are now dealing firsthand with the disease as they see mothers and fathers, aunts and uncles, suffer and die from Alzheimer's. Other reasons include population growth and longevity.

"We just have so many more people now," says Markesbery, "and the elderly

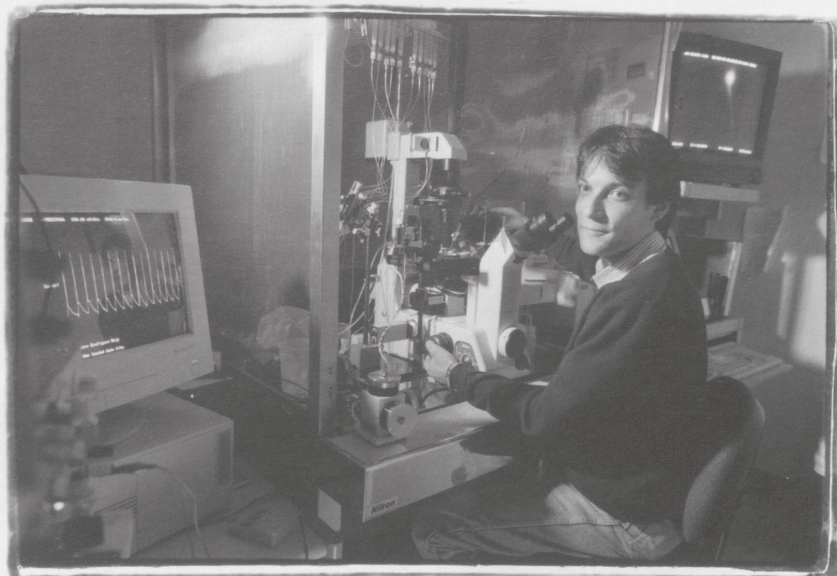


Photo by Forrest Payne

generation is fairly outspoken and has a major political impact on our congressional leaders. You know, there's nothing more frightening for an older person than the thought of losing his ability to remember and to think and reason clearly; so there's a large and vocal group of folks in the over-65 bracket lobbying very strongly to do something about this disease."

Alzheimer's researchers are pleased about such groups as the AARP (American Association of Retired Persons), because the pressure they bring to bear on political leaders translates directly into more federal funds for research into Alzheimer's. "The money we get from agencies like NIH also helps support graduate students and post-docs to be trained how to do good science," says Butterfield, "and Kentuckians should be proud that we're training first-class students how to do first-class science."

The short-term goal for Butterfield and his research team is to continue to try to understand the HNE molecule, to pinpoint its role in damaging healthy brain cells. Butterfield says they will better understand how these cells die based on the free-radical model and how to prevent that damage mostly through further exploration of the glutathione molecule and other brain-accessible antioxidants.

"As a consequence, we're going to gain a lot more insight into how to limit or prevent the damage associated with Alzheimer's disease, our overall goal," Butterfield says.

USING A CONFOCAL LASER SCANNING MICROSCOPE, OLIVIER THIBAUT COMBINES THE RESEARCH TECHNIQUES OF ELECTROPHYSIOLOGY AND IMAGING. TWO COMPUTERS CAPTURE INFORMATION ON THE CURRENTS FROM THE NERVE CELL CHANNELS UNDER SCRUTINY, AND THE AMOUNT AND LOCATION OF CALCIUM IN RAT CELLS.

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THE BRAIN DONATION RESEARCH PROJECT

Vitamin E's Protective Role

There have already been payoffs from Alzheimer's research, including recent studies that show the effectiveness of the much-heralded vitamin E to gobble up free radicals. "We've published two papers that show vitamin E is protective against free-radical damage," says Butterfield. "And another study, by a group of 12 clinical scientists who published their work recently in the *New England Journal of Medicine*, showed that high-dose vitamin E given to late-stage Alzheimer's patients prevented their institutionalization up to seven months. Such studies are important in themselves and also important to our work since this is further proof that our concept about free-radical oxidative stress may be accurate."

High-dose vitamin E, he explains, means 2,000 units a day, which Butterfield says is beyond what someone not afflicted with Alzheimer's should take. "Though I have to toss out the caveat here to see your doctor before deciding how much vitamin E to take, I take a thousand units a day myself."

Markesbery, who besides being a researcher into Alzheimer's is a well-respected clinician, says that the strategy in the '90s is to treat the disease before it starts in those at risk, a sort of neuroprotective therapy.

"Vitamin E is clearly beneficial if taken in the right dosages," he says. "And there are other compounds such as non-steroidal, anti-inflammatory drugs. Estrogen seems to slow free radicals down. And of course we're working now on the possibility that part of the body's own machinery—glutathione—can fight off free-radical damage. And I'm certain there are other things that are going to come along, too."

"With this recent news about vitamin E and various other therapies, I think it's

reasonable to believe that we will soon be delaying some of the more deleterious effects of Alzheimer's," Butterfield says. "And if you could delay them for even a year or so, think of the enormous benefit in terms of lifestyle and daily living for these patients and their families."

Mattson, in a recently published article which appeared in *Science & Medicine*, specifies what these "other therapies" are. "In addition to taking vitamin E and vitamin C, measures can be taken to forestall Alzheimer's disease," he says. "You should restrict your dietary intake to 1,600 to 2,000 calories per day throughout your adult life. Why? Because a number of studies have shown that reducing calorie intake also reduces cellular oxidative stress."

It's also important, Mattson says, to sustain a high level of intellectual activity and vigorous physical activity. And postmenopausal women, he adds, should consider estrogen replacement therapy.

"These recommendations probably

An estimated 14 million Americans will have Alzheimer's disease by the year 2020.

sound familiar, because they are also the approaches that reduce the risk of developing cardiovascular disease and cancer," Mattson says. "The reason is straightforward. Cellular oxidative stress plays a major role in all of these age-related disorders. Reducing the level of oxidative stress reduces the risk of each disorder." ■

One Sunday David Wekstein's home telephone rang at 9 a.m., alerting him that he and other researchers at the University of Kentucky's Alzheimer's Disease Research Center were about to receive a special gift.

"You don't know me," the caller told Wekstein, who is the associate director of the center, "but I'm one of your control subjects. My next-door neighbor is also one of your controls. He just died two minutes ago. Call me back at this number in about five minutes. By then his sister will be here and we'll get this thing going."

Within an hour of that phone call, the neighbor's body was on its way to the University of Kentucky, where researchers would immediately perform an autopsy on the man's brain. Both Wekstein's caller and his neighbor are part of a group of older Fayette County residents who have agreed to donate their healthy brains after they die to help researchers learn more about Alzheimer's disease.

Most agree to participate in the control group because they have personal knowledge of Alzheimer's disease. They've lost a parent, spouse, sibling or another relative or a friend to the disease, which afflicts an estimated four million people in the United States over the age of 65, including an estimated 60,000 Kentuckians. Alzheimer's disease is marked by progressive, irreversible declines in memory, performance of routine tasks, time and space orientation, language and communication skills, abstract thinking, and the ability to learn and carry out mathematical calculations. Other symptoms include personality changes and impairment of judgment.

Since it opened in 1985, UK's Alzheimer's Disease Research Center has diagnosed and followed hundreds of older people with non-treatable memory disorders—almost always Alzheimer's disease. The next of kin of many of the patients who are followed by the Memory Disorders Clinic give permis-

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sion, when the patient dies, for an autopsy, which must be done as quickly as possible because of biochemical changes in the brain after death. The autopsy serves two purposes: it lets the family know for sure if the patient had Alzheimer's disease, which can be definitively diagnosed only through an autopsy, and it allows the center to use the brain for research. "It's a way for us to correlate what we find with the patient clinically with what we find in the brain after death," Wekstein says.

But studying the brains of Alzheimer's patients alone was not enough. Researchers needed a control group. "We can study Alzheimer's brains for the next 20 years and if we don't study brains of people who don't have Alzheimer's disease, we can't draw valid conclusions," Wekstein says.

So in August of 1989 Wekstein began recruiting people for a control group. The Sanders-Brown Center on Aging already had a pool of 1,200 older Fayette County residents who were called on periodically for research projects, and Wekstein began writing letters to those volunteers 10 at a time.

"Basically, it was a polite letter that said, 'When you die, will you give us your brain?'" Wekstein says. Phone calls followed the letters. "Some of the people would pick up the phone and say, 'Hell, no!' And others would politely say, 'Thank you, but this is not my thing,' and about 20 percent said, 'Yes, I would be very much interested,'" Wekstein recalls.

Researchers met with those who were interested, explaining in detail what they were obligating themselves to do and asking them to sign informed consents. The researchers also administered neuropsychological tests to verify the volunteers' normalcy.

From those beginnings in 1989, 499 volunteers were recruited by the end of May 1998, with 380 of them still being followed (81 have died and a few have



photo by Lee Thomas

DAVID WEKSTEIN HAS DIRECTED THE BRAIN DONATION RESEARCH PROJECT SINCE ITS INCEPTION IN 1989. "THE PRIME MOTIVATION OF THE VOLUNTEERS IS ALTRUISM," HE SAYS.

either moved away or withdrawn from the project). The center has not actively recruited donors for several years because the group is self-generating, with members of the group recruiting their friends, says Gail Cohen, research volunteer coordinator.

To join the control group, individuals must be 60 or older (55 or older for people who have a blood relative with Alzheimer's disease), reside in the greater Lexington area, have normal cognitive function as determined by neuropsychological tests, have no history of neurological or psychiatric disease, and have no history of drug or alcohol abuse.

Researchers telephone the volunteers every six months and ask them to assess their general health and memory. Once a year volunteers undergo neuropsychological testing to determine mental function, and every two years they receive a physical and neurological exam.

Almost two-thirds of the control group subjects are women. About half of the volunteers are in their 70s, a quarter in their 60s and a quarter 80 or older. They are highly educated, with almost nine out of 10 having attended or graduated from college or having done post-graduate work. The majority are married—in fact, several couples are in the group. Most of the volunteers say their health is excellent or good.

The prime motivation of the volunteers is altruism, Wekstein says. They receive no money. "No one is doing this so that every couple of years they get cookies and punch," Wekstein says, referring to the receptions held periodically for control-group members at Spindletop Hall, where researchers update them

on the latest findings.

"The tissue received through this program is the central resource at UK for those of us inspecting the molecular mechanisms of Alzheimer's disease," says Rosemary Booze, associate professor of anatomy and neurobiology. "The lack of feasible animal models for the disease heightens the need for a program such as this. The combination of pre-mortem clinical testing and post-mortem pathological confirmation of this disease creates a reliable source of tissue that is indispensable in Alzheimer's research."

Jim Geddes, a UK associate professor of anatomy and neurobiology, says that because the brain deteriorates rapidly after death, it's vital that an autopsy be performed as soon as possible. "The support of families has been tremendous. We are often able to perform the autopsy within three hours of death," Geddes says. "This does mean coming in at all hours of the night sometimes, but luckily we have a dedicated group of neuropathologists and researchers who do that."

Geddes adds that the 60,000 people in Kentucky who have Alzheimer's represents one in nine individuals over age 65 and approximately 45 percent of those who reach 85.

"When the baby boomers begin to turn 65 in 2010, the number of elderly will increase dramatically," he says. "In Kentucky, we will have 200,000 people with Alzheimer's by the year 2020 unless a cure or effective treatment is found."

BY ELIZABETH K. HANSEN

A LAST LEAVING

Lexington resident Betty Morgan will leave her brain to science

BY ELIZABETH K. HANSEN

Memories spill from Betty Morgan's mind as she explains why she's part of the Alzheimer's Disease Research Center's control group—volunteers who have agreed to donate their brains to science. These memories include her childhood in the Australian outback; her days as a nurse in the South Pacific during World War II where she met her husband, Dr. William "Bill" Morgan; the 35 years the two worked together in his medical practice in Paris, Kentucky; Bill's battle with Alzheimer's disease and his death a dozen winters ago; her travels around the world since then and her return to school as a Donovan Scholar at the University of Kentucky.

Although she loves talking about her past adventures, Morgan, in agreeing to donate her brain for research after she dies, has made a special present to the future.

"It just seemed the right thing to do. I'm a nurse and I guess it's a little pay back," she says. "I would like to have donated Bill's, but nobody asked me for it." Donating her own brain is the next best thing, she explains.

In addition to her former career as a nurse, Morgan is also a poet. Her husband's illness inspired her first poems, which were published in nursing journals and collected in a chapbook titled *Alzheimer's Alters Us All*.

"I saw little things slipping," Morgan said. "Then one day Bill could not remember what normal blood pressure was. He was losing his memory." They closed the medical practice and Morgan cared for him at home for seven years. "Finally I couldn't do it any longer." He was admitted to the Veteran's Administration Hospital in Lexington where he died 14 months later.

Since then, Morgan has traveled to Europe, Asia and Africa. Aboard a freighter she visited Australia and islands in the South Pacific, including one called Santo near Guadalcanal where she had been in charge of an operating room for three years as a captain in the Army Nurse Corps.

"Travel makes me write," says Morgan, who documents her travels in verse. Now 84, she no longer goes abroad but continues to travel throughout the United States, often participating in Elderhostel programs. Between trips, she takes classes at the University of Kentucky through the Donovan Scholars program.

She delights in sharing her poetry. Last winter she hosted 10 poetry readings for small groups of her neighbors. Her favorite audience, though, is fifth graders from the Fayette County schools' Quest program for gifted students. She hosts tea parties at her apartment for a dozen of them and reads her poems. "Just having those kids up once or twice a year, that's an absolute joy for me," Morgan says.

Morgan sees her poetry as "just a little gift that was given to me in my later years that was fun to have. It changed my life. When you're a poet,

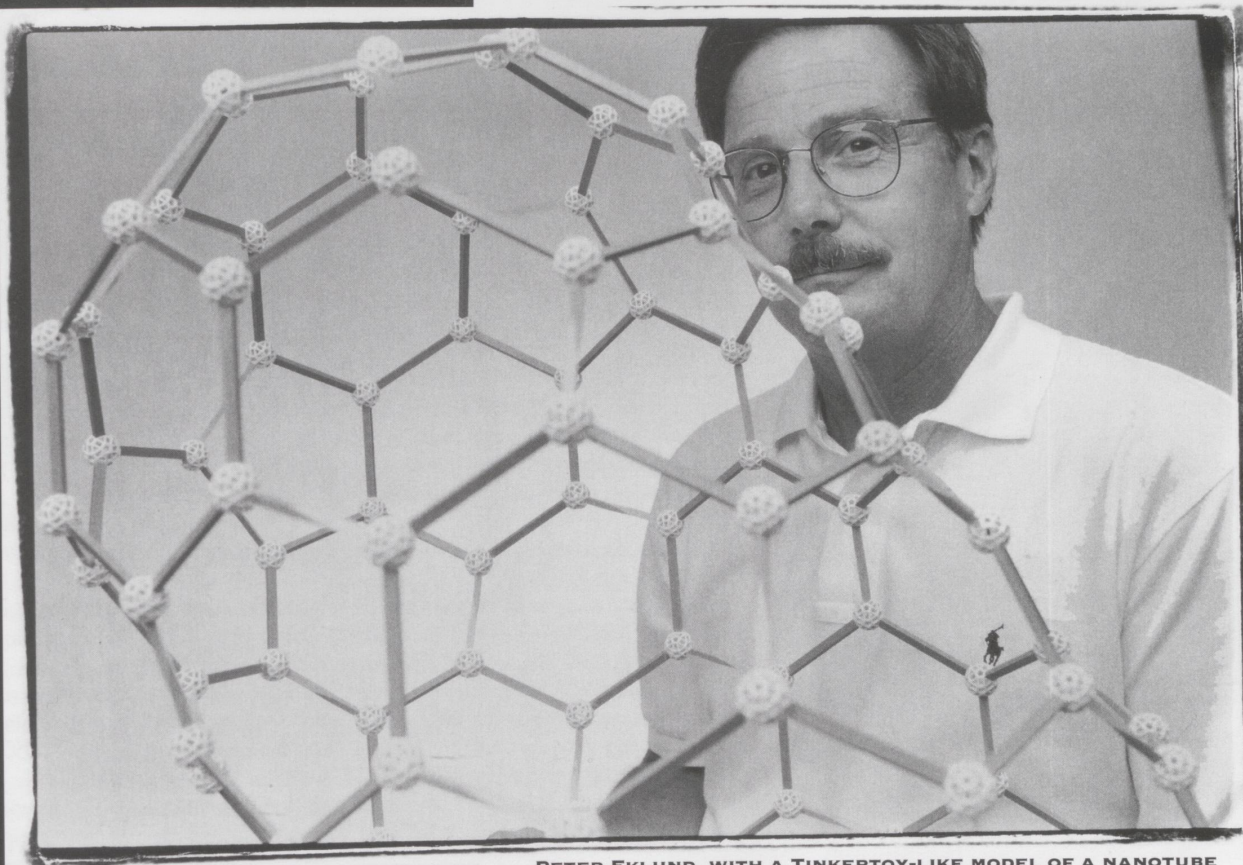


BETTY MORGAN

people don't treat you like an old lady." Here is the final verse of "A Last Leaving," a poem about her decision to donate her brain to UK after her death:

*In a few years I'll die.
Scientists will take my brain
and do their comparisons.
I hope they find it normal enough,
but
I'll never know.*

BY DEBBIE GIBSON



PETER EKLUND, WITH A TINKERTOY-LIKE MODEL OF A NANOTUBE

THINKING BIG BY THINKING SMALL

You have probably never heard of them. And in all likelihood, you will never see one since they can be viewed only under an electron microscope. Nonetheless, one of the hottest new discoveries in science—the nanotube—may soon change the world around you as surely as the Beatles changed music and Jackie Robinson changed baseball.

Nanotubes are straw-like, cylindrical structures measuring only a few atoms in circumference. They are so small that they are measured in nanometers—billionths of a meter. Attempting to put their size in perspective, two scientists described it this way: A chain of “nanotubes sufficient to span the 250,000 miles between the Earth and the moon at perigee could be loosely rolled into a ball the size of a poppy seed.”

Their diminutive size belies another fact, however. Nanotubes are stronger than steel. Their unusual structure mimics the atomic arrangement of the buckyball—a hollow sphere with 60 symmetrically arranged carbon atoms. Nanotubes differ only in that they are strands rather than spheres.

These molecular structures captivate scientists in other ways as well. Although they are made of carbon, they can conduct electricity. And because they are hollow, their shells may someday be used as storage devices for a variety of purposes.

It is this eclectic collection of properties and possibilities which intrigues four UK scientists exploring various aspects of nanotubes and nanotechnology, the study of functional structures at the atomic level.

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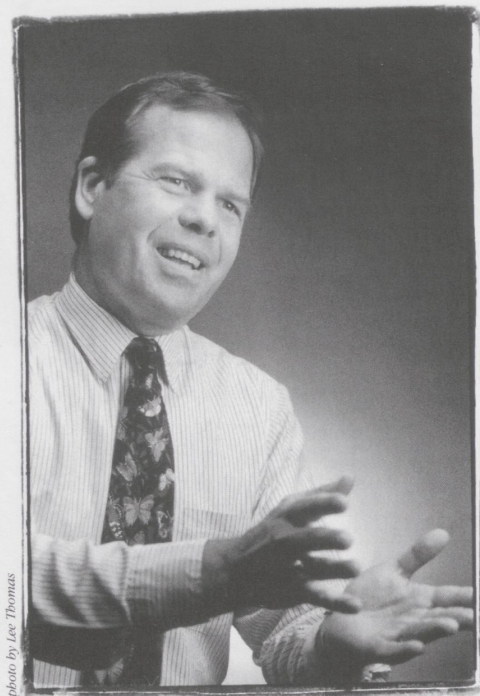


photo by Lee Thomas

ERIC GRULKE SAYS THAT NANOTUBES HAVE SOME IMMEDIATE APPLICATIONS IN HIGH-STRENGTH COMPOSITE FIBERS AND LAMINATES AND THAT THERE MAY BE SOME NOVEL APPLICATIONS IN TERMS OF COATINGS.

Producing Nanotubes

Sumio Iijima of NEC Corporation first discovered nanotubes in 1991, and since that time one of the most daunting challenges facing researchers has been to obtain sufficient quantities of the molecular structures.

Quantities of nanotubes will also be essential if they are to be used for practical applications. However, these tiny structures are still expensive to make. The carbon itself is cheap by scientific standards, but the process of turning garbage carbon into useful carbon nanotubes is expensive.

But it's becoming less so. Two UK researchers—Peter Eklund, a professor of physics, and Robert Haddon, a professor of chemistry and physics—believe they have solved this problem and now have a patent pending for a process to produce nanotubes.

Their research into mass producing nanotubes started in earnest in 1993 when an inauspicious plastic bag containing what looked like charcoal-colored soot arrived at Eklund's office. The bag held a sample the UK scientist had requested from Richard Smalley, a Nobel Prize winner at Rice University who had just discovered a method of producing

A chain of nanotubes sufficient to span the 250,000 miles between the Earth and the moon at perigee could be loosely rolled into a ball the size of a poppy seed.

material containing 90 percent nanotubes and only 10 percent junk carbon. The sample was the first time that Eklund had access to any significant amount of nanotubes.

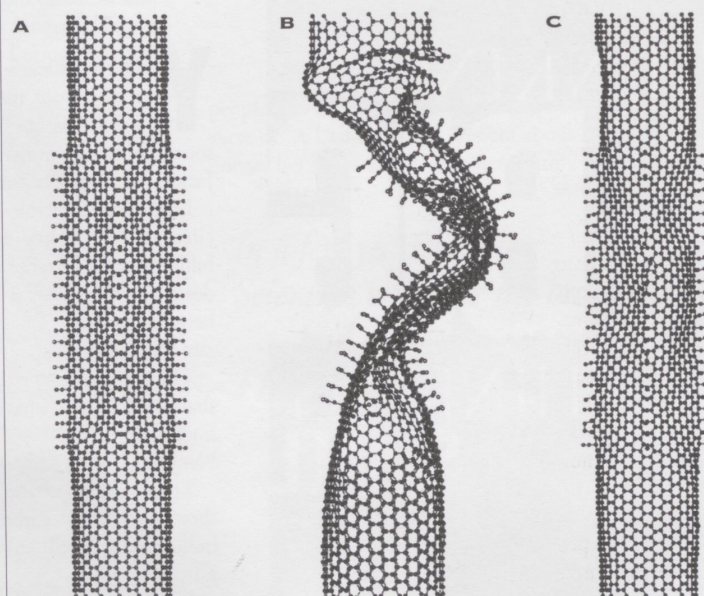
"In 1993, we [Eklund's research team] duplicated the process for making nanotubes in small yields," Eklund says. "We published a few papers, but then pretty much set the work aside because the actual material that the nanotubes were in was the overwhelming constituent. In other words, the nanotubes were a few percent and the rest was 98 percent junk - carbon junk, nanodust."

"It was difficult to do a wide range of experiments, but we did those experiments that we could do. That was essentially to pick out the signal coming from the nanotubes and reject the signal coming from the nanodust."

Still, Eklund recognized the tremendous potential for nanotubes and encouraged Haddon to join him at UK so they could combine their respective physics and chemistry expertise to collaboratively research the fascinating structures.

The scientists still needed a reliable method to mass produce nanotubes, however. Sources were not abundant nor reliable. About that time, a group in France published a report saying that pure nanotube samples could be made using Eklund's 1993 method if the catalyst were changed.

"We tried that, made some important modifications, and moved the French development forward," Eklund says. "That is the basis for the process improvement



THE INITIAL CONFIGURATION OF A NANOTUBE (A) IS COMPRESSED (B) AND THEN RETRACTS (C) TO ITS INITIAL STATE.



SUSAN SINNOTT SAYS THAT UK RESEARCHERS ARE WORKING TO MAKE THE NEXT GENERATION OF COMPOSITES WITH MUCH SMALLER FIBERS—NANOTUBES THAT ARE MUCH STRONGER.

patent."

It is also the basis for their continued work into nanotubes, including a company the pair formed to work on a variety of commercial applications for nanotubes. The company is called CarboLex.

"We are not able to mass produce tubes yet, but we are moving in that direction," Haddon says. "We are able to make several grams of nanotubes an hour compared with the milligrams per hour produced by the French."

"We are really just beginning," Eklund says. "We haven't fiddled around with the catalyst, the chemical composition of the catalyst or the amount of the catalyst. We have simply tried to understand how the process works and explore how to maximize the yield for this particular catalyst. We have also worked hard to automate the process."

"We would like to do chemistry on the objects to expand their role as structural materials and also as conductors," Haddon adds. "If we can truly produce a high enough quantity, they could become engineered materials. They could be very useful in a number of different industries such as aerospace, the automobile industry, and pharmaceuticals."

Testing Nanotube Performance

Another UK researcher investigating the nanotube is Susan Sinnott, an assistant professor in materials science engineering. By looking at the mechanical properties of nanotubes, Sinnott helps other scientists decide whether the end result will be worth the expense for any number of applications.

Using computational nanotechnology, Sinnott simulates nanotube structures and tests nanotubes in various situations. For example, scientists are concerned that the process used to create a composite from nanotubes might degrade them and cause them to deteriorate. Sinnott's computational work thus far has found that while the properties degrade slightly, overall the nanotubes continue to perform well. The structures have also proven to hold up well when tested for strength. When striking a stronger substance, nanotubes bend but do not break.

Coupled with mechanical properties of the nanotube, these findings offer exciting possibilities. Because they are hollow, for example, nanotubes may be used in the future as storage devices. It might be possible to store liquid hydrogen inside the tubes and release the hydrogen on demand. This would eliminate the need for the massive tanks of liquid hydrogen now required for the space shuttle to escape the Earth's atmosphere. Likewise, the hollow tubes might be used as membranes for pharmaceuticals or as a support for catalysts.

"There are some people who still think that this (nanotechnology) is pretty far out, but I think everyone realizes that we have made strides we never thought were possible," Sinnott says. "I think that the detractors' point of view is that, so far, no one can point to any useful application that has emerged from this. But right now we are still learning

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ADVANCED CARBON MATERIALS CENTER ESTABLISHED AT UK

The tiny but mighty nanotube will continue to be the subject of several research projects at the University of Kentucky, thanks in part to a highly competitive and prestigious grant awarded recently by the National Science Foundation for a Materials Research Science and Engineering Center (MRSEC). The MRSEC center, known as the Advanced Carbon Materials Center, will be funded by both NSF and UK at \$8 million over five years and will be located at the Center for Applied Energy Research.

The center will foster research in four related areas: carbon fullerenes and nanotubes, polymer and pitch composites, electronic devices, and activated carbons.

The grant to UK is one of only a few of its kind given out nationally, according to Vice President of Research and Graduate Studies Fitzgerald Bramwell. "In the past, such centers have gone to the top-ranked institutions," he says. Of the 113 applications received for MRSEC centers, NSF awarded only 12.

"UK's award reflects a coordinated, multidisciplinary effort involving four university units as well as a strong effort from university administrators and support from private industry," says Robert Haddon, a UK professor of chemistry and physics, and director of the new center. In addition to Haddon, the core team consists of Peter Eklund, physics; Eric Grulke, chemical and materials engineering; and Frank Derbyshire, Center for Applied Energy Research. The mission of the center, Haddon says, will be to become internationally known for the synthesis, study and application of carbon-based materials and to further education in these areas to create new industries.

Commercialization and technology transfer are important components of the center. Haddon says several large multinational companies have already expressed interest in the center's research. Two new spinoff businesses - ASA Products and CarboLex - have already been formed. Both are located in ASTeCC, UK's Advanced Science and Technology Commercialization Center, which is an incubator for start-up ventures and multidisciplinary collaborations.

"We expect new companies to arise from concepts developed with the assistance of this prestigious MRSEC award. In short, this funding will assist us in making practical applications, products and economic impact out of university-funded research," Bramwell says.

It might be possible to store liquid hydrogen inside nanotubes, eliminating the need for the massive tanks now required for the space shuttle to escape the Earth's atmosphere.

to walk. Once we gain control, it is only a matter of time before we can create appropriate devices."

Currently, Sinnott and her research team are undertaking several different projects related to nanotubes.

"We are investigating the use of nanotubes as probes to see how they respond when they are crashed into various surfaces," she says. "We are also studying nanotubes that are embedded into a polymer matrix. Right now, carbon composites are made of polymer matrices with graphite fibers distributed throughout to toughen the material. We are trying to make the next generation of composites with much smaller fibers—nanotubes that are much stronger."

Making Nanotubes Useful in the Everyday World

Sinnott's theoretical and computational work is complemented by experimental work being done by Eric Grulke, chair of the Department of Chemical & Materials Engineering. Grulke is developing the engineering science needed to use nanotubes in a variety of applications.

"Nanotubes may follow conventional engineering science theories or may not," Grulke says. "We don't know. We are doing the work to either demonstrate that they follow the conventional theories or discover what theories they do follow."

Grulke will take the results of the work done by other scientists and determine ways to disperse the nanotubes in solutions, in polymer melts (polymers above their flow temperatures) and polymer systems (mixtures containing polymers, fillers and/or other additives such as solvents and stabilizers). He is also looking at processing and forming those systems into useful products as well as testing the properties of the products.

"We want to try them in liquid systems, similar to today's polymer systems," says



photo by Lee Thomas

ROBERT HADDON: "WE WOULD LIKE TO EXPAND THE ROLE OF NANOTUBES AS STRUCTURAL MATERIALS AND CONDUCTORS. THEY COULD BE VERY USEFUL IN AEROSPACE, THE AUTOMOBILE INDUSTRY AND PHARMACEUTICALS."

Grulke. "We expect that nanotubes can be combined with commercial polymers to provide systems that can be highly oriented with great strength. Our challenge is to determine whether we can use conventional polymer processing equipment to achieve the high tensile strength and the unusual properties that people expect from other materials."

Grulke's work in this area is just beginning, made possible in large part by the work done by Eklund and Haddon to produce gram quantities of the tubes.

"We're doing rudimentary experiments on simple properties like viscosity, and we're getting surprising results," he says. "These molecular-size fibers have not really been available for test, for research. So these are new and unique."

The results of this work could lead to any number of applications.

"Because they have such high tensile properties, nanotubes have some immediate applications in high-strength composite fibers and laminates, and there may be some novel applications in terms of coatings," Grulke says. "Because we expect them to be expensive relative to normal carbon fibers, we may find that we have to use a coating of nanotubes dispersed in a continuous phase

rather than generate a bulk solid. So one focus of our experiments is to learn how to work with these nanotubes in coatings systems.

"For example, it is quite possible that because they can be oriented and strong, they may impart good wear properties to thin films. We are looking at methods for dispersing the nanotubes in coating materials, in delivering the coating materials to an object, orienting the nanotubes on the object, and setting the coating in place."

Someday, this could help scientists create composites that are lighter but stronger than current materials. Composites such as this could find their way into aircraft bodies and into a myriad of military uses. They may be useful for pharmaceuticals and in the space program. A few years from now, the cars we drive may even be coated with a nanotube composite. Whatever their eventual applications, it is clear that the small but mighty nanotube ushers in a new wave of possibilities, not just for scientists but for all of society. ■

W R I T T E N B Y
A L I C I A P . G R E G O R Y

BACK ON THE TRACTOR:

UK nurse studies how farm amputees overcome their injuries

“When I was laying there in the hospital, it dawned on me that my cattle put on as many pounds last night as they did the night before, and the weeds grew just as tall in my tobacco as they did yesterday. Really, it’s the same world. I just have to relate to it different.”

This is what Ken Montgomery told his family and friends when he returned home to Lancaster, Kentucky, after losing his arm in a farming accident last June. “I don’t think life’s about what I can do—life’s about how I relate to whatever comes along,” he says. That statement echoes the feelings of many injured farmers Deborah Reed encountered during her Ph.D. research at the University of Kentucky. She says her findings were born out of a personal desire to help farm families.

“I am a nurse, but I am a farm girl first,” says Reed. Her family grew tobacco and raised beef cattle on a 200-acre farm in Woodford County. “Early on, I was given the choice to stay inside with my mom or go out with my father and brothers,” she says. “I loved to be outside, so that’s what I chose. I’d work hay in the summer and help with the tobacco, do a little veterinary work and feed the cattle.”

Working with the farm animals was her first taste of nursing. Her second was working as a candy stripper at Woodford Memorial Hospital. These experiences, in part, eventually led her to UK—where she earned her bachelor’s, master’s, and Ph.D. in nursing, and master’s in public health—and eventually sent her back to the farm.

“Between 80,000 and 170,000 disabling injuries are sustained by farmers each year, but very little is known about the process of rehabilitation and reentry to work after an injury,” says Reed, who is now a research assistant professor in the UK College of

Medicine’s preventive medicine and environmental health department. The variables involved in the rehabilitation process were the focus of her dissertation. Reed interviewed 16 farmers in six states with upper-extremity amputations in order to explore this question.

Reed’s dissertation was related to a project called Kentucky AgrAbility, one of 18 programs nationwide providing rehabilitation resources to farmers with

disabilities. AgrAbility offers farmers on-farm technical assistance, links them up with other disabled farmers, and helps them search for financial support for farm equipment modifications.

“I remember when I was growing up doing some pretty dangerous things because we didn’t have all the safety features available now to farmers,” Reed says. “In my work I urge farmers to put a roll bar on every tractor and wear a seat belt, keep equipment in good repair, and always closely supervise children. It only takes one time of being careless to be seriously injured.

“Every farmer I interviewed blamed himself for his injury. He’d say, ‘It was my fault. I was careless, tired, in a hurry or chose to violate a safety rule I usually followed,’” Reed says.

In her study, she found the variables that had the most significant impact on farmers with permanent injuries were community and family support, a sense of retained personal control, and the bond to the farm.

Farmers are very independent, but they are also very community oriented, Reed says. “When a disability occurs, the community comes in to help the family with the harvest and prepare the field for next season. This is always done with the expectation that the farmer will be back to work soon.”

At one point in his hospital stay, Montgomery says he came to a personal realization that helped him to adjust after

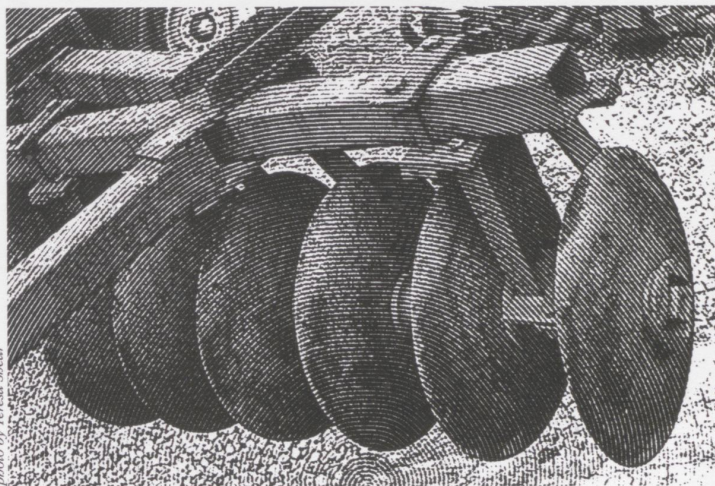


photo by Teresa Shear

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LAST YEAR DEBORAH REED'S DISSERTATION ON OCCUPATIONAL REHABILITATION WON THE INTERNATIONAL DISSERTATION AWARD FROM SIGMA THETA TAU, AN INTERNATIONAL NURSING HONOR SOCIETY.

"Farmers with disabilities most often rehabilitate themselves. They don't go to physical or occupational therapy. Most see returning to the fields as their therapy and, often, the first place they go when they get out of the hospital is back to the fields."

— Deborah Reed



photo by Lee Thomas

losing his right arm in a hay baling accident. "I decided that God would never again ask me to do a two-handed job, and I shouldn't expect anything of myself that God doesn't expect of me," he says. Reed says many injured farmers told her that they cope with their disability by relying on the faith they have in God and the faith they have in themselves. "Farmers with disabilities most often rehabilitate themselves. They don't go to physical or occupational therapy. Most see returning to the fields as their therapy and, often, the first place they go when they get out of the hospital is back to the fields," Reed says.

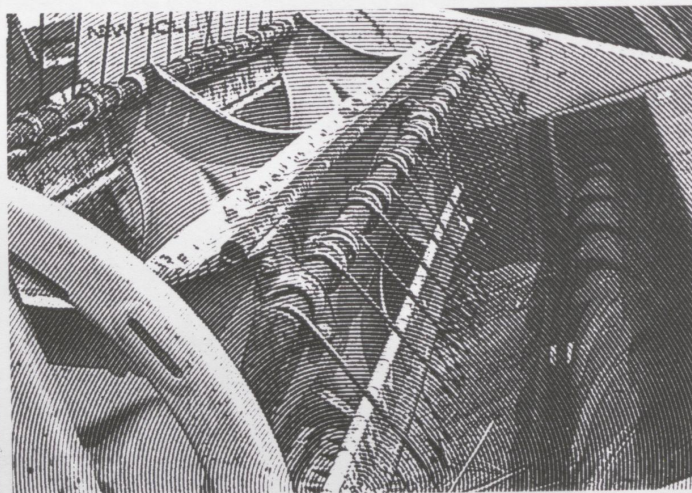


photo by Teresa Sheer

"The first thing I did when I got home was got in my truck and went to Lincoln County and bought some tobacco sticks," Montgomery says. On his 500-acre farm, Montgomery continues to buy and condition feeder steers as well as operate a lathe and milling business that makes parts for

farmers and industry. With his son working the tobacco crop and two employees running the parts business, Montgomery focuses on other farm jobs like feeding the animals, and he does most of the driving. "I've got a one-ton truck with a stick shift that I can drive nicely because it steers real easy. I can steer it with the top side of my forearm while I'm changing gears."

Farmers with hand or arm amputations rarely use prosthetic devices, Reed says, mainly because of the risk of re-injury from getting them caught in equipment. "Most of the assistive devices on the market are not made to take the physical abuse of farming so the farmers invent their own," Reed says.

Doing veterinary work on animals and repair work on machinery are two challenging areas for injured farmers. "Simple vice grips are indispensable to farmers with amputations," Reed says. "One farmer put a ring device on the terminal end of his full arm prosthesis and slides his pressure washer through it so he can wash his equipment and buildings." Montgomery modified a tong originally used to carry concrete blocks in order to carry his own salt blocks. "When I saw the tong, I saw right off I could use it to carry the salt to the cattle," he says. "Just a short time before, I had dropped two blocks on the ground, and I finally just rolled them over to the feed trough and that took a while."

These simple modifications are part of what Reed termed "getting along," the final step in the adaptation process. "Farmers felt they were getting along when they could return to doing most of the things they did before the accident," she says.

"When I've talked to these injured farmers they all say 'farming is in my blood.' It's all

AFTER LOSING HIS ARM IN A FARMING ACCIDENT LAST JUNE, KEN MONTGOMERY SAYS, "I DON'T THINK LIFE'S ABOUT WHAT I CAN DO; LIFE'S ABOUT HOW I RELATE TO WHATEVER COMES ALONG."



they've ever wanted to do," Reed says. "Some will try another type of work, but they always seem to end up back on the farm."

Montgomery says his strong bond to the farm and his dedication to hard work was passed down. His family has owned land in Garrard County for more than three generations. "My daddy has a little money by virtue of the fact he just liked to work hard. He worked until he was 88 years old. It made him happy," says Montgomery. "For me, the thought of sitting at a desk all the time is just depressing. I'd rather be out doing something."

Based on the information Reed has gathered, agricultural health professionals will be able to develop better vocational retraining programs to take to the farm site to help farmers and their families adjust after disabling injuries.

"The wife of one farmer came up to me after I talked to her husband and asked why everybody wanted to talk to him. She said, 'I have a story to tell, too. I'm part of this,'" Reed says. "I realized by focusing only on farmers, we were neglecting an important part of the farm – the women. We are looking at developing a support system to meet the needs of these women who have had to assume more roles on the farm after a man is injured."

This system, however, may have to go beyond traditional support groups to really serve the needs of farm families, according to Montgomery. "If I had a prosthesis, I think talking to somebody who's been there and done that would be a big help," he says. "But support groups – they come up with some good stuff, but they keep the negative before you. I don't want to dwell on this condition. I don't feel any different now than I did before I lost my arm."

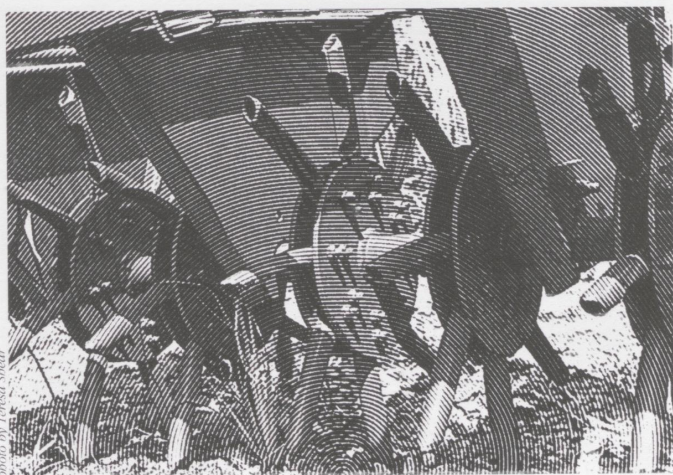
Reed agrees that most farmers want to be able to find the information they need after an injury, but they want to work through the challenges on their own. Providing farmers with information about the resources

available to them is part of Reed's current clinical work.

Last year Reed's groundbreaking dissertation, titled "Occupational Rehabilitation of Farmers with Upper-Extremity Amputations," won international recognition, and her continued work is casting a fresh light on nursing. Her study won the regional dissertation award and went on to win the 1997 International Dissertation Award from Sigma Theta Tau, an international nursing honor society. Reed's dissertation was chosen from 29 regional winners from around the world.

CONTINUED ON PAGE 20

The variables with the most significant impact on farmers with permanent injuries were community and family support, a sense of retained personal control, and the bond to the farm.



USING A FULL-ARM PROSTHESIS
JOHN TUCKER MODIFIED A TERMINAL
HOOK TO MANAGE THIS WAND
FOR POWER WASHING HIS METAL
BUILDINGS.



*"Between 80,000 and 170,000
disabling injuries are sustained
by farmers each year, but very little
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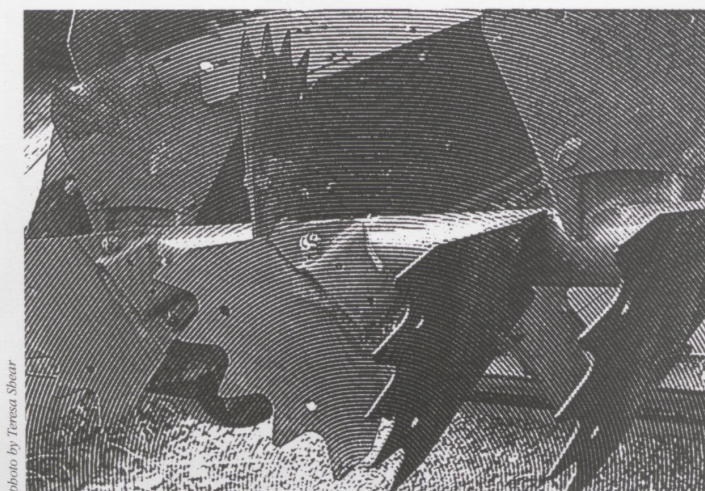


photo by Teresa Shear

"It was pleasant to know that the people who nominated my dissertation at UK liked it. It was thrilling to receive the regional award, and it was awesome to win the international award," she says. "Traditionally, these dissertations focused on quantitative studies, and the fact that they chose this qualitative study on such a new area in nursing as the best says something."

"This is a new arena for nursing," Reed says. "There are very few agricultural health nurses in the country, and of these, most are clinical. They go to farms to do check-ups. Very few are involved in research."

Lynne Hall, associate professor and assistant dean for research in the UK College of Nursing, says Reed's work is opening up an important arena for future study. "Debbie's background in community health nursing and her personal background growing up on a farm, as well as her master's and doctoral training, has all blended together to influence her work, which is just the beginning of some excellent research with strong relevance for clinical nursing practice," says Hall.

"Debbie's work is unique in that her clinical arena is different than we typically think of because it's outside institutional walls," Hall says. "For Debbie, the community is her clinical arena."

Reed, who is a member of the research team in UK's Southeast Center for Agricultural Health and Injury Prevention (part of the Department of Preventive Medicine and Environmental Health), is continuing to work in the community on several new projects, including one aimed at preventing disabilities in farm youth. Reed and co-investigator Pamela Kidd will teach 720 ninth graders in public schools in Kentucky, Iowa and Mississippi the consequences of and ways to

prevent amputation, hearing loss, and long-term chemical exposure.

"Farming is the oldest occupation in the world. Man was given the responsibility to take care of the earth, and today it is our responsibility to take care of the farmers we've taken for granted for so long," Reed says. "Farming is an industry as well as a way of life, and my goal is to make it a healthy way of life." ❧

Preparing the Faculty of the Future

Leslee Gilbert, who just completed her doctorate in history at UK, credits getting her first faculty position to the knowledge and experience she gained through UK's Preparing Future Faculty (PFF) program.

"I would not have gotten the job that I did without the PFF initiative," she says. "The knowledge I received in both courses—College Teaching and Preparing Future Faculty—helped me secure the position at Prescott College (in Arizona). I consider myself lucky to have participated in such a valuable program."

PFF's goal is to prepare future faculty in a comprehensive way. The program introduces graduate students to the broad and complex realities of scholarly life and to the wide range of post-secondary institutions. PFF also helps graduate students develop the skills and knowledge necessary to compete more effectively in the academic job market.

There are about 3,600 post-secondary institutions in the United States, and fewer than 90 of them are Research I universities, according to Linda Kraus Worley, director of UK's Teaching and Learning Center and associate dean of Undergraduate Studies. PFF seeks to assist those graduate students who want to become faculty members, recognizing that many will probably seek positions at institutions quite different from UK, which is a Research I university.

These diverse institutions, such as com-

munity colleges, liberal arts and religiously affiliated colleges, along with regional and research universities, have different missions, values and cultures. Graduate students need further preparation beyond the traditional graduate courses to prepare for faculty life at one of these sister institutions,

school developed through participation in PFF. Having always attended large research universities, Gilbert says she did not have a really good idea of what college life was like at other post-secondary institutions.

During her first semester in the PFF initiative, she learned about the practices

and norms of faculty life at all of the major types of colleges and universities. She attended panel discussions made up of representatives from each major type of school and learned from their experiences, advice, and expectations for future faculty. "As I listened to their stories, I realized what I liked and did not like, and I emerged with a clearer idea of what I wanted to do," she says.

Gilbert also participated in a PFF practicum, during

which she visited a host institution. This practicum is an extended version of visits which are an integral part of the PFF course itself. On-campus visits vary, depending on the institution visited. Visits can include an individual shadowing a faculty member for half a day, or a group of graduate students on a one-day tour that would include attending faculty meetings.

According to Worley, "PFF helps graduate students reflect on their own value systems and talents. PFF helps them recognize the kind of institution that would be the best match."

After Gilbert visited Centre College in Danville, Kentucky, she says, "I began to



photo by Lee Thomas

"THE PREPARING FUTURE FACULTY PROGRAM HELPS GRADUATE STUDENTS LEARN ABOUT THE VARIETY OF INSTITUTIONS AVAILABLE AND TO THINK ABOUT THEIR OWN VALUE SYSTEMS AND TALENTS IN TERMS OF WHAT MIGHT BE THE BEST MATCH," SAYS LINDA WORLEY.

says Worley. More than one-third of the UK graduates who recently became faculty members responded to a survey by saying they had obtained their first faculty positions at liberal arts colleges.

Gilbert's first faculty position is at a liberal arts college. During the interview process, she was asked to share her thoughts on teaching. "Since I had participated in the PFF initiative, I was ready and able to articulate my goals and teach a practice class," she says.

Her interest in teaching at a liberal arts

WRITTEN BY
HEIDI BRIGHT PARALES

CONTINUED ON PAGE 22

think about how I could prepare myself to get a job at a liberal arts college."

Gilbert says one of the most valuable aspects of the program was the construction of a teaching portfolio. "As a graduate student in history at UK, I did not have independent teaching experience," she says. She learned how to use her experiences leading discussion sections to her advantage, with the assistance of Worley, Jeff Bieber, associate professor in educational policy studies and evaluation, and Bill Burke, associate director of the Teaching and Learning Center.

"After collecting paper assignments, in-class exercises, and test questions that I had amassed over the past four years, I was better able to articulate a teaching philosophy, complete with goals, applications, and assessment techniques. This portfolio proved invaluable on the job market since I was able to clearly and confidently express my teaching philosophy and provide concrete examples to support my position. Although I lacked independent teaching experience, I appeared knowledgeable and thoughtful to interviewers."

Gilbert also learned about current teaching strategies through PFF. "By reading articles and listening to discussions on various teaching techniques, I was better able to understand the dynamics of a classroom and construct my own innovative assignments to meet those conditions. The PFF professors helped me learn and think about my teaching as not something one just does, but rather as something that one experiments with and cultivates over a lifetime."

Through PFF, Gilbert learned how to research schools, evaluate their mission statements, and write a cover letter that wedded their needs with her qualifications. "I am confident that knowing that information

helped me to the next step of the interview process," she says. "Since I had listened to the guest panelists from the PFF course, I also knew what to expect from an on-campus interview. Additionally, I knew what to ask during the interview."

These job-search strategies were not part of graduate education at UK in the early 1990s. When Louis Swift, dean of Undergraduate Studies, saw a notice in 1993 about a grant that addressed the need to better prepare graduate students for a diverse array of faculty positions, he immediately recognized the necessity of such a program. "Applying for the grant simply seemed so obvious and the right thing to do," he recalls. "It was almost automatic."

Swift met with Dan Reedy, then dean of the Graduate School, and they developed a proposal. By 1994, UK was one of 17 research universities awarded a two-year grant. The \$10,000, combined with money contributed by Swift and Reedy, led to a course and subsequent positive response from the students who took it.

Swift recalls, "That first class was a real pleasure to teach. They were like youngsters hearing ideas for the first time, and they were very enthusiastic. In a sense, we knew we had a winner of a program because we were obviously meeting a need that had been around for a long time and never addressed."

After the first two years of this program, UK was awarded one of 15 \$60,000, three-year grants to continue the project. The current Phase II grant is under the direction of the Teaching and Learning Center, the Graduate School and Undergraduate Studies. PFF now consists of two seminars on teaching, a course on the roles and responsibilities of faculty, and a practicum, along with various research projects and area-specific mini-conferences.

The program has grown from 10 students in one course in 1994 to 40 in each course this past year. "We have filled every available space," says Worley of the voluntary program.

PFF has only just begun, according to Swift. "The real power of the program is in the students who are beginning to demand this kind of assistance," he says. "They know the job markets and want to be competitive."

"In one PFF class, about one-third of the participants came to realize they had to write more papers and publish more to prepare themselves. Another group realized they needed more teaching experience," says Worley. "The response becomes very individualized."

Gilbert says PFF now is an essential part of what makes UK a great place to do graduate work. "The Teaching and Learning Center has been a boon to my graduate career," she adds.

And the program will continue to help prepare more graduate students each year. The practicum side of PFF will expand to include working with teaching mentors, says Worley.

The future direction of PFF also includes integrating the PFF principles into academic programs throughout the university. "The next step is to make the principles of PFF part of the culture of the disciplines," says Worley. "We want the departments to take ownership." ■

GRADUATE ALUMNI ACHIEVEMENTS

WRITTEN BY
ALICIA P. GREGORY

PATRICIA C. BORNE,

M.S., Library Science, '89, is a communications consultant and executive principal with CEO Resources, a company involved in corporate training, executive consulting and organizational development. Borne's 15-year management and training career has targeted team building, organizational development, diversity, career planning, and positive dispute resolution. She has taught business, speech, writing, and group dynamics for more than 10 years at Northern Kentucky University, Thomas More College, and the University of Louisville. Borne published a communications guidebook, *Speak No Evil*, in 1995 and is editor of *Equity News Alert*, a statewide newsletter with a readership of more than 5,000.



WENDELL P. CROPPER,

M.S., Chemistry, '43, is a retired research supervisor of instrument development in computer and control services at Amoco. During his 37 years at Amoco, Cropper's work in process stream analysis and instrument development led to 16 U.S. patents, including a process that uses carbon dioxide as an internal monitor of sulfur concentration.

LARRY GATLIN,

Ph.D., Pharmacy, '81, is currently director of pharmaceutical and analytical development at Biogen Inc. in Cambridge, Massachusetts. Biogen is a biopharmaceutical company focusing on development of novel products for multiple sclerosis, inflammatory, respiratory, kidney and cardiovascular diseases, devel-

opmental biology and gene therapy. Previously, Gatlin worked as a research scientist at Genetech and the Upjohn Company, and he served as an officer in the U.S. Public Health Service. Gatlin joined Biogen in February 1998 after 10 years with Glaxo Wellcome, where he served as pharmaceuticals department head.

CAROL FANG,

M.S., Library Science, '68, is president of C&F Enterprises, a one-woman business Fang started as a hobby in 1976. Her "hobby" is now a \$30-million-a-year company with 350 employees in Newport News, Virginia, and Shanghai, China. The company supplies major department stores and other retailers with high-quality quilts, decorative needlepoint pillows, Christmas stockings, and table linens designed in Virginia and manufactured in China. C&F Enterprises produces custom designs for retailers and licensed products for Colonial Williamsburg, Coca-Cola and Disney. Fang, her husband Ching Seng "Frank" Fang, and their two sons, Edward and James, run the company.

WILLIAM BANKS,

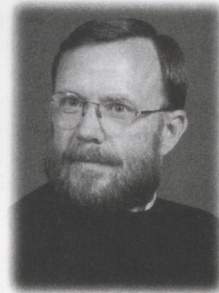
Ph.D., Education, '68, is a professor of African American Studies at the University of California, Berkeley. Banks also served as provost of undergraduate affairs at Berkeley and has been a fellow at the National Humanities Center at Research Triangle Park in North Carolina and the Center for the Advanced Study in the Behavioral Sciences at Stanford University. He



published a book in 1996 titled *Black Intellectuals: Race and Responsibility in American Life*, based on original interviews with prominent black artists and thinkers.

WILLIAM SWATOS JR.,

M.A., Sociology, '69, Ph.D. Sociology, '73, is executive officer of the Association for the Sociology of Religion and the Religious Research Association. Swatos received a 1997 John Templeton Foundation Exemplary Paper in Humility Theology award from Pine Forge Press for his chapter "Globalization and Religious Fundamentalism" published in *Illuminating Social Life* (Pine Forge Press, 1997). The award is presented for published works that address the benefits of a constructive relationship between religion and the sciences. Swatos also served as editor-in-chief of the *Encyclopedia of Religion and Society*, which was published in January 1998.



WANDA DURRETT BIGHAM,

Ph.D., Education, '78, is president of Huntingdon College in Montgomery, Alabama. Bigham served as president of Marycrest College in Davenport, Iowa, and worked in administrative positions at Emerson College in Boston and at Morehead State University in Kentucky. Bigham was co-chair from 1987 to 1992 of the Quad Cities Vision for the Future, a community strategic planning and action committee. She has been an active member in professional organizations including the American Council on

continued on page 24

GRADUATE ALUMNI ACHIEVEMENTS

Education, the American Association of Higher Education, the National Council of Educational Opportunity Associations, and the International Association of University Presidents.

ROSALYNNE VALLEY PRICE,

M.A., Elementary Education, '74, is manager of diversity for Cox Enterprises Inc. in Atlanta, Georgia, a media company that encompasses newspaper, direct mail and book publishing, as well as television and cable programming. As diversity manager, Price focuses on recruitment and retention strategies, communications materials and training programs. Previously, she was director of performance technology for Equifax Inc., also in Atlanta, where she held several positions in human resources development and training. In addition to her UK degree, Price has a Ph.D. in instructional technology from Georgia State University.

WILLIAM CLARK SPRAGENS,

M.A., Political Science, '53, is chairman of Spragens and Darnes Associates, a communications and policy research firm in Herndon, Virginia. Spragens was a professor at Bowling Green State University in Ohio and has written six books. He is working on a new book, *White House Press Secretaries (1981-1998): The Press Office Enters the Age of the Internet*, for which he has interviewed Marlin Fitzwater, Larry Speakes, and Judy Woodruff of CNN. Spragens has served as associate editor of *Presidential Studies Quarterly* since 1990 and was a writer for the Democratic National Committee in 1978.

CHARLES S. "TED" OLSON,

M.A., English, '91, is an assistant professor of English and Appalachian Studies at Union College in Barbourville, Kentucky. Olson worked as a park ranger at Blue

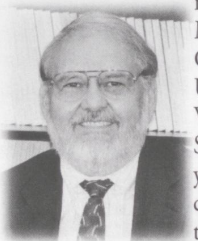
Ridge Parkway, Great Smoky Mountains National Park, and has written several



books, including *Blue Ridge Folklife* (1998) and *So Far: Poems* (1994), as well as articles, essays, poems, and reviews for a number of periodicals. Olson, who sings and plays banjo, guitar, dulcimer, and harmonica, also performs traditional folk songs and stories at festivals across the southeastern United States. Olson is listed in *Who's Who in the South and Southwest*, and *Who's Who in Entertainment*.

WILLIAM E. SEALE,

M.S., Agricultural Economics, '69, Ph.D. Agricultural Economics, '75, is chair of the finance department of the School of Business and Public



Management at George Washington University, in Washington, D.C. Seale served a five-year term as commissioner on the Commodity Futures Trading Commission, as a government relations vice president for a New York futures exchange, and as a senior legislative assistant to U.S. Senator Walter D. Huddleston. He is on the board of directors of the National Futures Association (the self-regulatory organization of the U.S. futures industry) and the New York Cotton Exchange. Seale's current research interests center on price volatility and its relationship to market efficiency.

SANDRA J. HIGGS,

M.S.W., Social Work, '92, is a psychotherapist in private practice in Lexington, Kentucky. She works with children, teens and adults, and is a writer and speaker on issues including adoption and infertility, and grief and loss. Higgs has written articles and presented workshops on forgiveness as a recovery tool and does work as a trauma debriefer for crisis intervention.



SARAH C. NEWBY (FORMERLY CLARK),

M.A., Education, '65, is a primary teacher in the Fayette County Public School System. Newby, from Nicholasville, Kentucky, taught for more than five years at Douglass School and 32 years at Mary Todd Elementary School. She has been nominated several times for Ashland Achievement Awards and Outstanding Teachers of the United States. Newby was voted one of Fayette County's Outstanding Teachers in 1991.

DAVID LIVINGSTON,

M.A., Music, '52, received the Artist Award from Kentucky Governor Paul Patton as part of the 1997 Governor's Awards in the Arts. Livingston has been a music educator and professional musician for more than 50 years. Originally from Corbin, Kentucky, Livingston served in the U.S. Air Force as a member of the 4th Air Force Band. He served as band director for Harlan, Lee and Franklin counties, and later as director of bands at Western Kentucky University. Livingston's com-

GRADUATE ALUMNI ACHIEVEMENTS

positions have been performed by symphonies in Kentucky, Ohio, Michigan, and Oklahoma. He has played professionally with Doc Severinsen, Dave Brubeck, Edgar Haze, and Paul Desmond, and has toured overseas twice with the Billy Vaughn Orchestra. He currently plays in local and regional ensembles including the Lost River Cave Band in Bowling Green, Kentucky.

CARL H. ERNST,

Ph.D., Zoology, '69, holds a position as distinguished university faculty member in biology at George Mason University in Fairfax, Virginia. Ernst has been a fellow of the Herpetologist's League since 1971 and has served as a research fellow in the division of amphibians and reptiles at the Smithsonian Institution since 1972.

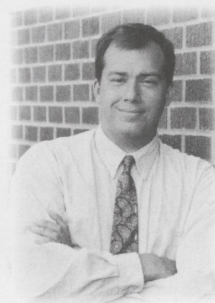


Ernst has published six books and 170 journal articles. He was associate editor for the journal *Biotropica* (1976-1982), editor of the turtle section of the *Catalogue of American Amphibians and Reptiles* (1977-1992), and served as director of the doctoral program in environmental science/public policy at George Mason University between 1986 and 1991.

JAMES WALLER,

Ph.D., Experimental Psychology, '88, is now a psychology professor at Whitworth College in Spokane, Washington. In his nine years at Whitworth, Waller has received the Dean's Award for Outstanding Junior Faculty Achievement in Teaching and Research (1993) and the Teaching Excellence Award (1996). In January 1996, Waller led an innovative month-

long cross-country study tour titled "Prejudice across America." The tour drew national media coverage and recently was cited as one of the "Promising Practices to Promote Racial Reconciliation" by President Clinton's Initiative on Race. An account of the 1996 and 1998 tours forms the context for his recently released book titled *Face to Face: The Changing State of Racism across America*.



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KIOSK

WANG RECEIVES \$195,000 TOXICOLOGY AWARD

It's a novel approach: cloning genes that could be used to shut down mutations that initiate cancer. UK's Zhigang Wang, assistant professor in the Graduate Center for Toxicology, is proposing to do just that with funding from one of the top awards in his field. Wang is one of four researchers in the country to receive a 1998 Burroughs Wellcome Fund New Investigator Award in Toxicology.

"I was very excited about this award for two reasons: one is that they recognized the importance of our work and offered support, but more important is the prestige and reputation of this nationally competitive award," Wang says. "This award is recognition of the quality of research we are doing at UK."

The \$195,000 New Investigator Award spans three years and is intended to encourage the development of talented young scientists who will bring new ways of thinking and novel experimental approaches to toxicology.

Wang says his approach is to look at the fundamental causes of cancer. Wang and his colleagues study how DNA damage, caused by radiation or chemical carcinogens, turns into

cancer-causing mutations in humans.

"For cancer to initiate and develop from a benign tumor to a late-stage cancer that spreads through the body, mutations must occur," Wang says. His goal is to understand the basic mechanism of how mutation happens by identifying and cloning the genes required for generating mutations after the human body is exposed to carcinogens. "The idea is once we find these genes and find ways to suppress them, we could take away that building block for cancer," he says.

Wang believes the genes, or the proteins they encode, may be used as therapeutic "targets" to stop cancer-causing processes. "Identifying these genes offers us an opportunity to design a new strategy for cancer prevention and suppression. This is really a brand new idea in the field," Wang says.

A native of China, Wang completed undergraduate work at East China Normal University, and received his Ph.D. at the University of Texas at Austin. He completed postdoctoral training at Stanford University and the University of Texas Southwestern Medical Center at Dallas. Wang joined the UK faculty in February 1996.

"We recruited Zhigang from one of the top DNA repair labs in the country," says Mary Vore, director of the Graduate Center on Toxicology. "This award reflects well on his ability and demonstrates the committee's belief that the University of Kentucky is a supportive and nur-

turing research environment in which he will succeed."

Other Burroughs Wellcome Fund award recipients included researchers at the Baylor College of Medicine, Rockefeller University and Northwestern University.

—Alicia P. Gregory



Zhigang Wang

photo by Lee Thomas

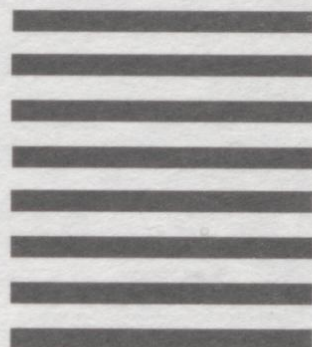
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COLLEGE OF MEDICINE, NURSING RANKED HIGHLY BY U.S. NEWS & WORLD REPORT

A national news magazine ranked the University of Kentucky College of Medicine in the top 20 primary-care medical schools and the College of Nursing in the top 50 nursing master's programs in the country. The College of Medicine ranked 20th and the College of Nursing ranked 48th on the list which appeared in the March 2, 1998, issue of *U.S. News & World Report*.

The rankings were based on surveys of deans, faculty and administrators of accredited graduate programs. The medical school rankings also included statistical indicators like research grants, student test scores, and student placement in primary-care residencies.

"The College of Medicine's 20th ranking represents our historic, long-term and current emphasis on primary care and community medicine," says Emery Wilson, the medical school dean. "The reputation of our faculty and the quality of our students are building prestige for UK with our peers across the country."

"At the same time UK is ranked in the top-20 primary care programs, we now rank 30th in the country in National Institutes of Health research funding among public institutions," James Holsinger Jr., medical center chancellor, says. Wilson and Holsinger say future success is vitally tied to the possibility that Congress will double the funding for the NIH in the next five years. "We could see even greater success if we look for ways to link medical center and Lexington campus researchers together to pursue new NIH funds," Holsinger says.

Holsinger also believes the College of Nursing is poised to move into the top 20. "Although this ranking was based on the reputation of the master's program, our nursing doctoral program is sending out great students who have won national and international awards for their dissertations," Holsinger says. "Seeding those kinds of graduates into other colleges of nursing around the country is obviously going to have a marked impact on how we are perceived."

"In light of the fact that there are 340 master's programs eligible for ranking, our 48th rank puts us in the top 14 percent of MSN programs in the United States," Carol Williams, dean of the College of Nursing, says. "This is an important tribute to our faculty and students who have worked so hard to advance the quality of our nursing programs."

—Alicia P. Gregory

1998-1999 UNIVERSITY RESEARCH PROFESSORS

Two faculty members were named University Research Professors for 1998-99 by the UK Board of Trustees. They are Joseph Chappell, agronomy, and Peter Eklund, physics.

Chappell studies the mechanisms plants use to defend themselves against microbial attack. He is currently working to understand how plants turn on defense genes that produce antibiotic agents. He is also focusing on redesigning the enzymes responsible for synthesizing these antibiotics with the goal of generating novel antibiotic-like compounds for possible human medicinal application.

The professorship will allow Chappell to fund the continuing research of two postdoctoral students in his laboratory as well as support a new program. "I'm going to offer stipends of \$2,500 to two students in the College of Education to work with me to develop an outreach effort to area high schools dealing with DNA science," he says. Chappell currently brings loaner lab equipment to high schools and community colleges three times each semester. "My goal is for these education students to get a feel for how opportunities to use specialized equipment for

DNA science might be integrated into standard science curriculum," he says. Chappell has taught at UK since 1985.

Eklund has studied the properties and potential applications of "buckyballs," a family of all-carbon molecules whose discovery achieved notoriety in 1996 when Richard Smalley from Rice University won a Nobel Prize for their discovery. More recently, Eklund has helped to develop a new, very long form of the molecules called nanotubes [see also, article titled "Thinking Big by Thinking Small," p. 13]. "The ideal structure of a nanotube can be thought of as a hexagonal network of carbon atoms rolled up into a seamless tube," Eklund says.

Because nanotubes have unusual strength and high electrical/thermal conductivity, scientists and industry are eager to mass produce them in order to explore applications ranging from new building materials to cellular-level drug delivery devices. During his year as a research professor, Eklund will continue work to "scale-up" nanotube production through his transition-metal-catalyzed hot carbon plasma process, explore new cata-

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ARTS AND THE KENTUCKY ECONOMY

lysts, conduct fundamental optical and transport experiments, and test applications including nanotube-polymer composites, Li ion batteries, and macroscopic filaments with nanotube additives. The professorship will allow Eklund to purchase new research equipment and provide support to a postdoctoral student working in his laboratory. Eklund has taught at UK since 1977.

The research professorships were established in 1977 to recognize outstanding researchers and encourage further scholarly research. Recipients use the \$30,000 award to cover their expenses and teaching duties so that they may devote themselves to full-time research for a year.

—Alicia P. Gregory



The arts in Kentucky have given us pleasure, made us laugh, made us cry and made us think. The arts have also enriched us in a literal sense—adding millions of dollars to the state's economy.

The economic impact of arts organizations alone in Kentucky was \$22 million in worker earnings and 1,324 jobs in the state last year, according to a recent report published by the Center for Business and Economic Research at the University of Kentucky. The economic impact of the arts due to arts spending, arts donations, and spending at restaurants, hotels, and shopping near arts events was estimated to be \$41.5 million in worker income and 2,400 full-time jobs in the last year.

"The arts are essential to the economic development

of the state, not only through direct dollars into the economy but also because the arts are a value-added incentive for drawing new businesses and professionals to the state," says Gerri Combs, director of the Kentucky Arts Council which, with the Kentucky Center for the Arts in Louisville, sponsored this UK study.

The survey also asked households about their willingness to donate money in order to increase the number of arts performances, or to avoid a decrease. The results suggest that the average Kentucky household would be willing to pay \$7.38 to increase the number of arts performances by 25 percent. Though this may not seem like a large amount, it suggests that all Kentucky households would be will-

ing to pay \$10.9 million to fund a 25 percent expansion in arts performances, in addition to purchasing tickets to those performances. The average Kentucky household spent \$104 attending arts performances and events in the last year and donated \$48.73 to arts organizations.

"I was surprised by the numbers relating to the value of the arts to Kentuckians, how much they would give to keep or increase the arts and the numbers relating to volunteerism," Combs says. The survey found that Kentucky households on average donated 6.93 hours in the last year to arts organizations.

"And the arts are beneficial to Kentuckians in ways other than economical," says Tim King, vice president of the Kentucky Center for the Arts. "The wide, diversified array of offerings, some mainstream and some not, help to dispel certain perceptions about the provincial nature of the commonwealth by people who don't live here. The arts help tremendously in dispelling that myth."

"The arts are extremely

MATHEMATICS DEPARTMENT ATTRACTING TOP POSTDOCTORAL FELLOWS

important in the education of our children and to the general livability of the state," Combs adds. "Another benefit is the documentation and continuation of our heritage."

"We wanted to fund this study because we saw it as an opportunity to get a real handle on what's going on in the state, especially in light of the fact that there have been many new centers—in Owensboro, Prestonsburg, Madisonville and Ashland, for example—since the inception of the Kentucky Center for the Arts," King says. A total of 77 arts organizations returned surveys.

"One of the reasons for focusing on the regional arts centers," Combs adds, "is their potential for spurring economic development in rural areas through their ability to bring in the arts from outside the state, their potential in educating our youth through the arts, and their leadership skills in the arena of social issues—at-risk youth, crime prevention, and keeping kids in school."

—Jeff Worley

Two postdoctoral mathematicians have selected the University of Kentucky as their choice for continuing research on National Science Foundation fellowships.

Choosing UK is a strong endorsement of the university's standing as a research university and the respect accorded its faculty, says Peter Perry, UK mathematics professor. "Typically, NSF postdoctoral fellows go to such places as Stanford, Berkeley or MIT. Applicants name a proposed institution and postdoctoral adviser as part of the application. The applications are judged not only on the applicant's research record, but also on the fit between the proposed research, the adviser and the institution."

The two fellows are Ruth Gornet, an assistant professor at Texas Tech University, and Edward C. Taylor, who previously held a postdoctoral fellowship at the University of Michigan. Both chose to work with Perry and Peter Hislop, chair of the UK mathematics department. Gornet earned her doctorate at the University of Washington in St. Louis, and Taylor is a doctoral graduate of the State Uni-

versity of New York at Stony Brook.

Last year, 30 NSF Mathematical Sciences Postdoctoral Research Fellowships were awarded. Both Taylor's fellowship and Gornet's NSF grant, called a POWRE grant (Professional Opportunities for Women in Research and Education), were reviewed by a panel of leading scientists.

When asked why she chose to come to UK, Gornet says, "Perry is certainly well respected in the field, and someone I'd met frequently at conferences. My intention for the 18 months I am on leave was to go where I could focus intensely on my research and work closely with experts related to my field. As an added payoff, I'm also geographically closer to my family."

She adds that her research projects at UK are a natural continuation of her current projects, along with projects that would be enhanced by the expertise of the UK mathematics department.

Perry says it is important for a research institution to have excellent young scholars doing research. "One of the distinguishing features of top-20 research depart-

ments is a constant stream of talented young scientists who visit and work with senior faculty. Having Ruth and Ed at UK stimulates our own research, keeps us current, and exposes UK students to their work."

Both Gornet and Taylor are working in the area of pure mathematics. Pure mathematics research forms the base from which direct application to technology springs. According to Gornet, "There have been almost no areas of mathematics that weren't, eventually, put to good use in the 'real world.'"

Their area of specialty is spectral geometry. According to Perry, their work is related to the mathematical theory that underlies areas such as medical imaging, damage detection in structures, and seismic techniques for oil exploration.

Spectral geometry involves using an external probe to create an image of what's inside something that one cannot directly observe. For example, ultrasound imaging can be used to determine some features about a growing fetus.

Although Gornet and Taylor are working on different projects, both use

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DIGGING INTO THE PAST

"group theory," a language mathematicians use for talking about geometric patterns, in their research. Group theory helps researchers identify the similarities and the differences in the properties of an object being studied.

—Heidi Bright Paraless

As the Declaration of Independence was being signed in Philadelphia, many of the earliest Euro-Americans began settling Kentucky under the protection of Fort Logan. This frontier fort, a significant early gateway to the settlement of the West, is now being excavated by a team of volunteers and professional archaeologists under the direction of Kim McBride, co-director of the Ken-

what is now Stanford, the small fort served as a safe haven for settlers and as a base for scouting further into what is now Kentucky. Through this and other forts, settlement of the area became possible.

"This area was a very important one in the early settlement of this region by Euro-Americans," says McBride.

Physical descriptions of individual forts from this era are rare, and few physical

drawings exist, though

documents do provide detail on militia and scouting. Archaeological excavations are necessary to fully

understand the size, appearance, location, and occupational history of these forts. While locating these sites is a first step toward their preservation, full-scale excavations are needed to understand variations in the physical structure of these forts. Archaeology also helps us identify and understand the materials early settlers used for their forts and homes.

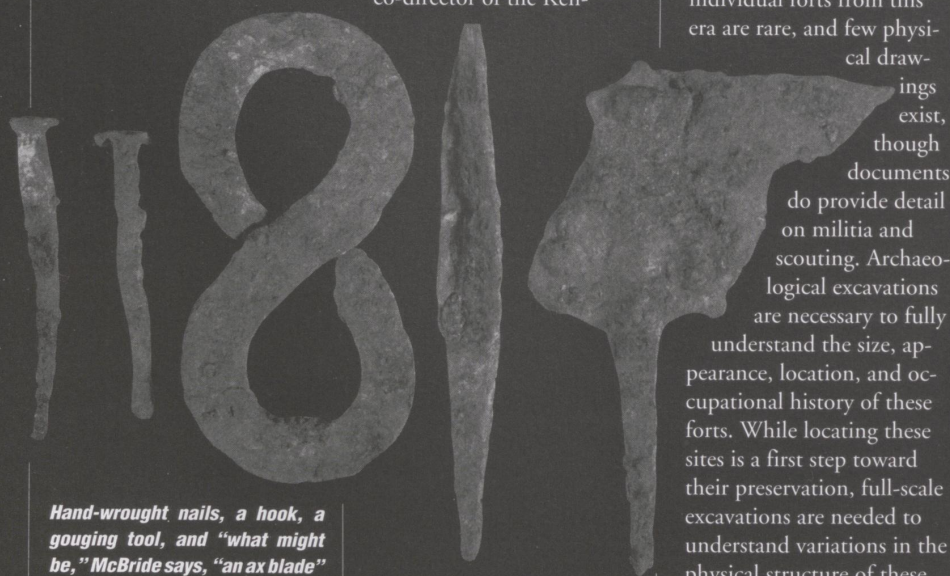
Written accounts about Logan's fort tell that the fort site, near a spring, was cho-

sen in 1775. Construction was completed in 1777. Sometimes up to 19 single men lived in the fort, along with seven families. When danger from Indians brewed, settlers were called back into the fort for protection.

In 1777, Daniel Boone warned the inhabitants of the fort about a coming siege by Indians. According to a written account of the attack, William Hudson was killed and scalped. He was buried inside the fort.

Discovery of the remains of a scalped man is perhaps the most significant archaeological find from this fort. McBride says, "I always have mixed feelings when we find human remains, which need to be treated with respect, but the burial helped verify that we were excavating within the fort. And, of course, we have learned much from it."

According to research done by Clyde N. Bunch, a member of the Logan's Fort Foundation, the log fort was 90 feet by 150 feet, and gates—located at the east and west ends—were raised and lowered by leather thongs. Two blockhouses were built on each end of the south side, with three cabins between them. A blockhouse, built on the northwest corner, was adjoined by four



Hand-wrought nails, a hook, a gouging tool, and "what might be," McBride says, "an ax blade"

tucky Archaeological Survey (a joint undertaking of the anthropology department and the Kentucky Heritage Council).

Located in Lincoln County on the edge of

UK PART OF NATIONWIDE STUDY TO EXPLORE PROMISING NEW DRUG FOR STROKE

cabins. A conventional cabin, situated on the northeast corner, is thought to be the one built by Benjamin Logan.

According to McBride, "The focus of our project has been to help verify the exact location of the fort, to help provide details about its physical construction, internal layout, and material culture, and to assist the local civic groups who have committed themselves to seeing this important site recognized."

The site was difficult to excavate because it has been reused many times. By 1780, most of the families had permanently left the fort, according to McBride.

"Documents suggest a possible house there in 1820, probably another house by the 1850s, and the one standing today. An additional complication was that the L & N railroad put a track through the site in the 1860s.

"One of the goals of the unit excavation was to open up the investigation to the public," says McBride. During a period of 12 days, professional archaeologists and hundreds of volunteers helped excavate the fort. Most of what they found could be dated to the late

18th and early 19th centuries, says McBride.

"Not only are we trying to understand the past, we are trying to get the public to touch and understand the past," says M. Jay Stottman, who received his master's degree from UK and is now on the staff of the Kentucky Archaeological Survey. "Archaeology makes history and the process of understanding tangible, which provides more than just facts. It creates experiences and memories that will become history," he adds.

The ultimate goal of the Logan's Fort Foundation and the Daughters of the American Revolution is to accurately reconstruct the fort.

"We have been working with the schools this spring, in constructing a model of the site, based on both the documentary and archaeological evidence," says McBride.

—Heidi Bright Paraless

Fort Logan Web site:
www.logansfort.org

Physical anthropology of skeleton excavated at Fort Logan:
funnelweb.utcc.utk.edu/~herrmann/Logan/LOGANS.htm

Stroke, the third leading cause of death in the United States, claims over half a million new victims each year and kills one third of these. Often the survivors are left paralyzed or unable to talk. They can no longer return to work or take care of themselves.

Now, however, a new treatment for stroke may help to reverse these statistics. In a recent nationwide study, a promising new medicine called citicoline was found to protect the brain from catastrophic damage after a stroke. Citicoline is made by the body and is a building block of cell membranes. A drug version was made for the study by Interneuron Pharmaceuticals in Lexington, Massachusetts.

The University of Kentucky Medical Center was one of 21 centers that participated in this study of 259 stroke patients. The patients were split up into four groups: three dosage groups (500, 1,000, and 2,000 milligrams of citicoline) and one group that was given a placebo. The drugs were administered for six weeks.

"The results of this study are very exciting, very promising," says Creed Pettigrew, a UK professor of neurology and head of the UK study. "In this study citicoline appeared to limit the size of a stroke, speed up recovery and improve victims' mental functioning."

Pettigrew explains that each of the centers that participated had a trained examiner assess a stroke patient exactly one week after admission to the hospital, then again at three, six and 12 weeks. Twenty-five different cognitive functions were measured, including tests of a patient's intellectual abilities—concentration, memory and attention span. The citicoline patients scored 20 percent to 30 percent higher than the placebo group.

"We were pleased with what we saw," Pettigrew says. "Five of the 25 cognitive measures were dramatically helped by citicoline. As long as people took the drug, their cognitive performance got better in these five categories; once they stopped taking the drug, their performance scores dropped."

Of major importance in the study, he says, is the finding that citicoline appears to help injured membranes repair themselves, which limits cell death and paves the way for the brain to repair damaged circuits or create new ones to restore functions lost in the stroke. Brain tissue repair was measured

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CLEANING UP KENTUCKY'S WATERWAYS

at UK noninvasively, through use of magnetic resonance equipment.

"We can measure the volume of injured brain tissue this way," Pettigrew says. "And shrinkage of this volume correlates positively with people getting better faster. They can get back to work more quickly and stand a much better chance of taking care of themselves."

In addition to obvious health benefits, there is also the consideration of cost. Stroke often results in long hospital stays. "If a drug such as citicoline turns out to be as effective as we think it will, this could save billions of dollars annually in hospital and insurance costs," Pettigrew says.

Interneuron Pharmaceuticals has asked the U.S. Food and Drug Administration to approve citicoline as a drug that may be prescribed for stroke patients. "We hope the FDA will approve citicoline, though that approval, for now, is on hold," Pettigrew says.

—Jeff Worley

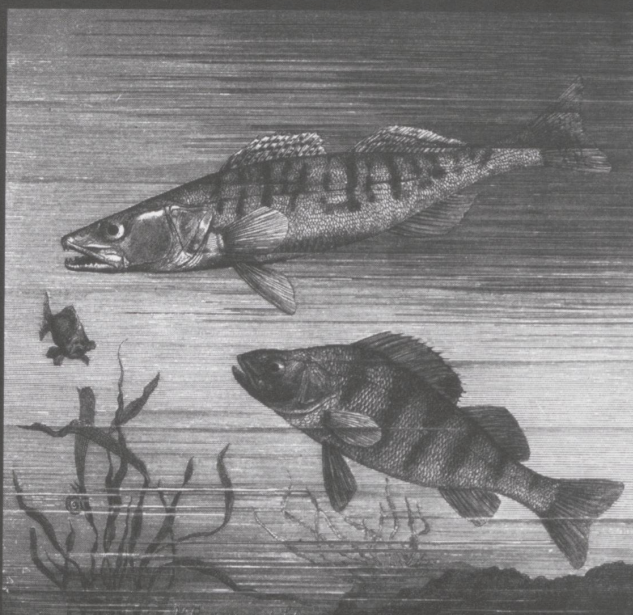
The fish are back and the water is cleaner in Taylorsville Lake, 30 miles west of Lexington, thanks to recent efforts of University of Kentucky agricultural extension agents, in partnership with state and federal agencies, working with farmers along the Salt River.

About five years ago, there were practically no fish in Taylorsville Lake and in the Salt River, which fed the lake. The fish were getting sick, the levels of oxygen in the water were low, and phosphorous levels were high. These levels led to the production of too much blue-green algae, which produces toxins, according to Terry Hutchens, UK agricultural extension agent for water quality. "The bass stocked in Taylorsville Lake would not reproduce," he says.

Extension agents began working jointly with agricultural agencies, farmers, schools and the general public through demonstrations and educational programs to encourage the use of better ecological practices. Called Best Management Practices (BMPs), these modern methods prevent unnecessary soil erosion and water pollution, says Curtis Absher, UK's assistant director for agricultural extension.

Jack Godbey, a part-time farmer in Boyle County, learned about BMPs a few years ago from an extension agent, and also had heard about the fish dying in Taylorsville Lake. Godbey invited Hutchens to survey his 190-acre cow/calf operation and to work out a management plan.

The plan involved digging a new pond, repairing an old pond and putting up several thousand feet of fence to keep his



cattle out of the creek that ran through his property. This way, he provided his cattle with an alternative water supply and kept them out of the stream, resulting in a more even distribution of waste. He also began a seven-pasture rotational grazing program.

Along with implementing the plan to meet the requirements of the relatively new Kentucky Agriculture Water Quality Act, Godbey says he wanted to keep a step ahead of any potential national Environmental Protection

Agency regulations and to improve the quality of his family farm, which he might pass along to his two sons.

The entire project cost about \$13,000, including labor, but Godbey had to contribute only about 40 percent of the price tag since he worked with the agents. Godbey says the benefits now include improved water availability without jeopardizing the quality of the creek water that runs through his farm and empties into the Salt River. He also "runs 50-60 head of cattle," about as many as before.

Godbey's new BMPs prevent pollution of public water, bringing him in line with new state requirements, according to Absher, since farmers are now required to develop and implement an agriculture water quality plan.

The concept of BMPs has been around in Kentucky for about 20 years, according to Jeff Stringer, assistant professor of forestry at UK. However, BMPs have been actively implemented only during the past five to 10 years.

Most BMPs have been developed and researched in the coastal states, which have different land variables than

Kentucky, which has deep slopes, a limestone subsurface and underground water conduits, says Hutchens.

Because of the differing land characteristics in Kentucky, there is plenty of opportunity for new research specific to implementing BMPs in this state, says Absher. Some research projects are already under way at UK, such as research on nutrient recycling within a pasture system, waste management for wetlands, and waste and its associated bacteria moving from buffered areas into streams.

—Heidi Bright Parales

UK'S GLASSBLOWER COMBINES ART WITH SCIENCE

Jeff Babbitt, in a basement room of the chemistry-physics building, turns a mysterious-looking glass object on the glassblowing lathe, sweat beading on his forehead from the constant tongue of orange-blue flame that heats the glass.

"This is a rotary evaporation condensing unit," he explains, "which is used to distill high-boiling solvents. One of the hose connections broke off, so I need to put a new one on." This is a routine job for Babbitt, the chemistry department's resident glassblower. He builds or repairs from 1,000 to 2,000 pieces of glasswork a year for UK faculty.

"About 75 percent of my work is for researchers in chemistry and physics," says Babbitt, who came to UK from the University of Michigan in 1989, "though I do get requests from other departments, too." The typical equipment he builds or repairs includes vacuum manifolds, rotary evaporation traps, Schlenk flasks, and solvent distillation heads.

Babbitt starts his various jobs with straight tubing and fitting which he buys from suppliers, but he does all the tricky—and sometimes dangerous—work himself. Sitting at his workbench beside what looks like a welder's torch erupting with blue flame, Babbitt holds up a foot-long cylinder with four valves attached to it. "This is a vacuum manifold system," he says. "For someone in the chemistry department here to buy something like this from a catalog would cost anywhere from \$300 to \$500. I can make this for the cost of material, and there's no labor cost involved since I work at the university. So this piece ends up costing about \$120."

A vacuum manifold system falls into the category of "standard requests," but Babbitt also gets quite a few requests for pieces that are highly specialized and unique. Researchers often come to him with a rough drawing of what they need, and Babbitt will take it from there.

"In planning sessions like this, you have to be a lot more than a glassblower," he explains. "You need to know a little bit about metallurgy, you need to know some chemistry and stress factors of the material because you'll be working with very precise measurements. Glassblowing is a fine line between being an artist and being a mechanical engineer."

An essential part of the job, Babbitt says, is the mental preparation necessary before he blows the first breath into a

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pocket of molten glass. He says he builds the object four or five times in his head before he actually sits down to work, and tries to imagine every possible thing that could go wrong. "Once you've started and gotten the glass hot, you can't stop until you're done. You can't go off and talk on the phone for a while."

And there's the added pressure of nearing completion on a job when something unexpectedly breaks. "Things don't always work out. My theory on glassblowing is that things never go wrong until you're almost finished with the job. You can have 12 hours in a piece and—pop!—something breaks and you have to start all over again."

Jack Selengue, a professor in UK's chemistry department, says Babbitt is indispensable to him and many of his colleagues. "Jeff has built virtually all of our vacuum lines and Schlenkware. He is able to build to our exact specifications, and often helps us design our apparatus. Jeff has modified many pieces of standard bench-top glassware, such as quartz cells for spectroscopy, with glass joints or stopcocks for inert atmosphere use. He even custom-builds our Dewar

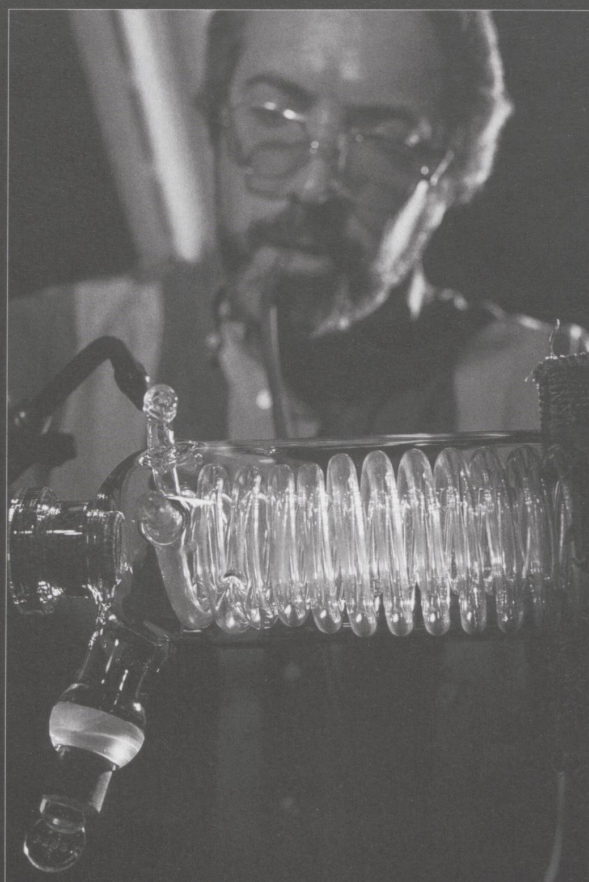


photo by Lee Thomas

flasks (silvered 'thermos' bottles)."

Selengue adds that Babbitt is one of the top scientific glassblowers in the United States and that a major benefit of having him in the department is saving time. "Commercial glassware can take over a week to receive, even when it's in stock. Custom glassware can take months. Jeff can help us out quickly, sometimes the same day in emergency situations. He can also do on-the-spot repairs, seal glass sample tubes and do many other small jobs which we just couldn't get done without an on-site glassblower."

Babbitt has been a glassblower for over 20 years and learned, as many glassblowers have learned, from his father. "I grew up in Ann Arbor, Michigan, where my father worked as a glassblower, so I've been around it all my life," Babbitt says. "I started doing a little work with Dad when I was in junior high school and ended up doing my more formal apprenticeship in the chemistry department at the University of Michigan."

"Was I surprised my son went into glassblowing? Well, yes, I guess I was at first," says Babbitt's father Joel from his shop, Blue Dot

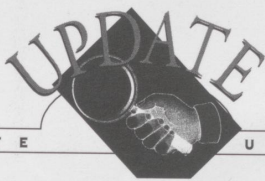
Limited Inc., in Lexington, South Carolina. "I didn't know he was that interested until one day after high school he announced that he really wanted to get into it." Joel Babbitt says that Jeff "progressed very rapidly" in the art and seemed to have a natural talent for glassblowing.

When asked whether the son had reached the father's level of proficiency as a glassblower (Joel has invested over 40 years in the trade), Joel unhesitatingly says, "Oh, yes. Yes, indeed."

As rewarding as this work is, it's not without its dangers. Jeff Babbitt says that he's been both burnt and cut several times.

"I almost cut my finger off once," he says, adding that he had to have immediate microsurgery to sew the nerve back together after a "scoring accident" with a piece of tubing. And along the line of accidents Babbitt lists one final talent a glassblower needs to be successful—agility. "You learn to move real quickly when hot glass is coming at you."

—Jeff Worley



WRITTEN BY
LEATHA KENDRICK

U P D A T E U P D A T E U P D A T E

U P D A T E U P D A T E U P D A T E

ROCK FENCES OF THE BLUEGRASS STILL IN JEOPARDY

As a student traveling through Kentucky on the way back to his native Minnesota, Karl Raitz says he was swept off his feet by the Bluegrass. Raitz, who now serves as the chairman of UK's geography department, took a visiting professorship in geography at the University of Kentucky in 1970 and never left. Eventually, his work focused on how the most extensive collection of quarried rock fences still standing in the United States came to be built.

Eight years ago Karl Raitz' work on rock fences in Kentucky was instrumental in debunking the myth that these fences were built by slaves before the Civil War. The myth of the fences' construction, like many myths, was partly true. Raitz's investigation traced the real origins of the fences to the work of Irish stonemasons who immigrated into the Bluegrass in the early to mid-19th century. These masons passed the craft along to slaves who became master artisans themselves and further passed the craft on to other black artisans, giving rise to the popular labeling of the rock fences as "slave walls."

When the detective work of Raitz and his co-researcher, Carolyn Murray-Wooley, an architectural historian, was detailed in a 1990 *ODYSSEY* article, their goal was very specific: to provide the Kentucky Heritage Council with a detailed historical context statement that would become the basis for nomination of large segments of rural property for historic preservation status. Their book, *Rock Fences of the Bluegrass*, was published by the University of Kentucky Press in 1992.

"The book had a huge impact on public awareness of the history of the fences," Raitz says. "Unfortunately, this awareness and appreciation have not translated into methods of preservation."

Though Raitz and Murray-Wooley were successful in discovering the context for the rock fences—how, why and by whom they were built—what ended up being preserved was not the fences themselves, but the secrets of their construction. The most visible legacy of their work is the Dry Stone Masonry Conservancy, a group dedicated to preserving and promulgating this art.

The existence of the conservancy has had a diverse and far-reaching impact, despite the small staff (two full-time and one part-time) and lack of consistent funding. For example, when the Kentucky Transportation Cabinet and the Kentucky Heritage Council set up a program to train mortar-masons to build dry-laid fences for the relocation of the historic fences on Paris Pike, Murray-Wooley was asked to organize it. And the work that began with *Rock Fences of the Bluegrass* has reached far past the confines of Kentucky.

A connection made in the course of Raitz' and Murray-Wooley's



IN A 1990 PHOTO, CAROLYN MURRAY-WOOLEY AND KARL RAITZ EXAMINE A ROCK FENCE A FEW MILES NORTHEAST OF LEXINGTON

photo by Ken Goad

research has become crucial in the renewal of dry-stone masonry. That connection is Richard Tufnell. Tufnell (a British stonemason who lives in southern Scotland), along with Raitz, Murray-Wooley, and a few others form the board of the Dry Stone Masonry Conservancy. Tufnell has provided the on-site expertise in building, repairing and restoring dry stone structures.

As part of the conservancy's mission, for the past three years Tufnell has presented workshops on dry-stone masonry around the United States and has found a ready audience for his teaching. Dry-stone

masonry is art as much as craft. Stones must be selected by shape to fit snugly and securely together. Raitz gets excited when he describes what lies behind the craft. "You have to be able to look at a pile of stone and pick up the one that's mostly likely to fit. You can't stand there all afternoon and fiddle with one or two stones," he says.

In 1990 Raitz's ultimate goal was that his documentation of the origin and significance of the rock fences would aid rural landowners in defending their property against construction projects, such as road building and other development. Raitz estimates that 95 percent of the fences that once existed around Lexington are already gone. Now, when asked if he feels there is any hope of preserving what's left, he says, "Not in the long run. When I came here in 1970, I thought there had to be a way of doing this, but it does not seem to have happened."

Despite some small successes (notably the preservation of fences along Paris Pike), preservation itself has become increasingly controversial as development accelerates around Lexington.

"Fayette and Scott counties do have ordinances to prevent removal of rock fences in public rights-of-way," Murray-Wooley points out. "However, region-wide legislation is needed, which would have to be enacted by the General Assembly."

Around Lexington, as in most other areas of the country, the landscape reveals less and less of the culture which once shaped it. As rock fences, spring houses, and other structures disappear, the countryside has become more homogeneous, less distinctive, stripped of its history.

"Growth Destroys Bluegrass Forever" says a bumper sticker popular with some motorists around Lexington. "You know, that bumper sticker is true," says Raitz. "And it doesn't make any difference how many times you stand up in an audience and say that this is the only place on the face of the earth that is like this."

ODYSSEY

RESEARCH OUTREACH

The University of Kentucky's research goal is to conduct programs of basic and applied research which support graduate and professional education, provide for the advancement of knowledge, and seek solutions for the acute problems of society.

The university's research mission also acts as a magnet for attracting top graduate students who want to participate in nationally competitive research projects. *ODYSSEY*, through articles about various research projects and graduate research programs, reflects the breadth of the university's search for new knowledge and the myriad of research endeavors under way.

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ODYSSEY is not just a magazine — it is a resource which serves as the basis for some very important outreach activities. The articles appearing in *ODYSSEY* are rewritten — in a briefer format — for a newspaper column titled "UK Science & You." This column is sent to every newspaper in Kentucky and is a regular feature of many of the weekly papers. Through these columns we reach a potential audience of 1.4 million readers—letting them know how UK research impacts their daily lives.

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PARTING SHOTS

"Why is it that our memory is good enough to retain the least triviality that happens to us, and yet not good enough to recollect how often we have told it to the same person?"

—*Francois La Rochefoucauld, French writer and moralist (1613-1680)*

"How to live to be 100? Get to be 99. Then be very careful."

—*attributed to George Burns (1896-1996)*

"The secret of staying young is to live honestly, eat slowly, and lie about your age."

—*Lucille Ball, actress and comedian (1911-1989)*

"The longer I live the more I see that I am never wrong about anything, and that all the pains I have so humbly taken to verify my notions have only wasted my time."

—*George Bernard Shaw, British author and socialist (1856-1950)*

"Old age is like a plane flying through a storm. Once you are aboard there is nothing you can do."

—*Golda Meir, former Prime Minister of Israel (1898-1978)*

"I am not young enough to know everything."

—*Oscar Wilde, Irish writer (1854-1900)*

"I am in the prime of senility."

—*Joel Chandler Harris, American writer (1848-1908)*

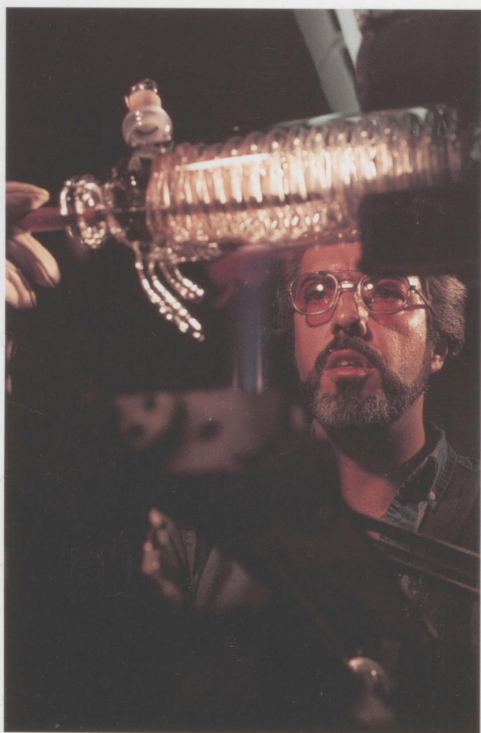
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