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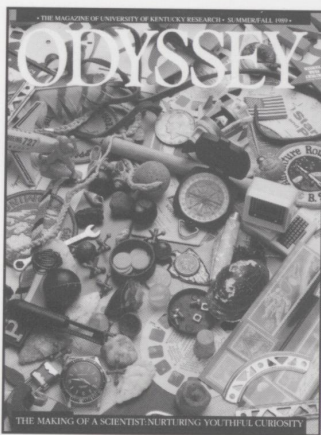
THE MAGAZINE OF UNIVERSITY OF KENTUCKY RESEARCH • SUMMER/FALL 1989 •

ODYSSEY

THE MAKING OF A SCIENTIST: NURTURING YOUTHFUL CURIOSITY

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The University of Kentucky, the Commonwealth's graduate education and research institution, exists to provide opportunities for the education, personal growth and development of individuals and to contribute to the improvement of society.

With this mission as its premise, one goal of the University 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. This research experience can offer them a significant advantage in their education while laying the foundation for future research and development. ODYSSEY, through articles about various research projects and graduate education programs, reflects the breadth of the University's search for new knowledge and the myriad of research endeavors underway. The progress that the University has made toward achieving its research mission and securing the extramural funds required to support these types of endeavors would have been impossible without the talents and dedication of our researchers.

The goal of ODYSSEY is to offer the reader the opportunity to share in some of the excitement, curiosity and creativity evident in the research underway at the University of Kentucky.

ODYSSEY

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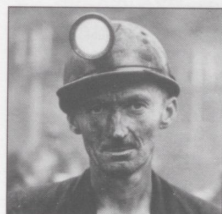
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THE MAKING OF A SCIENTIST:

Nurturing Youthful Curiosity

by Elizabeth Hansen

They studied egg survival and red blood cells. They developed membranes for releasing anti-cancer drugs. They studied nicotine and animal surgery. They built model bridges.

And in a sense, that's what all of the high school students and university undergraduates did this summer in various funded programs at the University of Kentucky—they built bridges that could take them into careers as scientists or engineers.

In an effort to identify and encourage potential scientists, the University of Kentucky has developed programs to encourage students to select undergraduate majors in scientific fields and to go on to graduate and professional schools. Funding for the programs comes from a variety of sources, including the National Science Foundation, the National Institutes of Health, the Department of Education and the University itself.

"We're in a phase in society where there aren't many people interested in the sciences. Most scientific disciplines are having to recruit. I hope it is just a phase," says Robert Dickson, a University Research Professor for 1988-89. Dickson coordinates an undergraduate research program in biochemistry funded by the department.

Because science classes build on each other, it is important for students considering scientific careers to make that decision early. "We want to give undergraduates a chance to see what research is like," says Dickson, an associate professor in the College of Medicine. "If they put off making a decision [about a scientific career], they may never decide to do it."

Like Dickson, Allan Butterfield, professor of chemistry and director of the Center of Membrane Sciences, is concerned about the shortage of scientists.

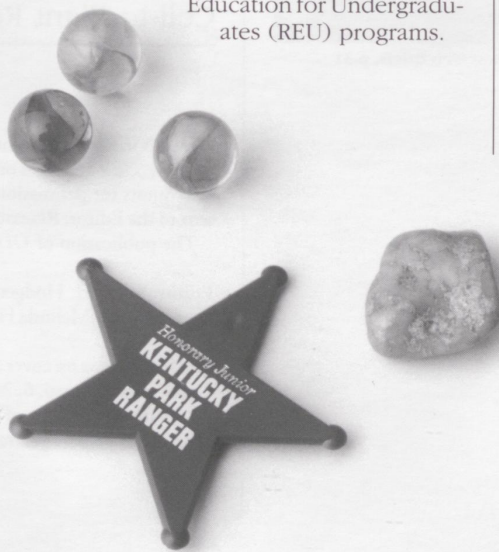
"There is such a shortage predicted in the next decade that it's frightening. We've got to encourage people to move into science and engineering in order to keep the United States competitive," Butterfield says.

The chemistry department has "a long tradition of undergraduate students performing research as a part of their education," Butterfield adds. He estimates he has worked with 40 to 45 undergraduate students on independent study projects in the 14 years he has been at UK.

The goals of undergraduate research in chemistry, according to Butterfield, "are to help undergraduates appreciate what research is, teach them how to do it well and, in the process, if the student is lucky and particularly hardworking, something good may come of it in terms of publication [in a professional journal]. But at the very least they are going to learn how to organize their thoughts, collect and assemble and evaluate data and make some conclusions. In today's marketplace, if people can't do that, they aren't going to be competitive."

Undergraduate research experiences differ in kind from work in laboratory classes, according to Dibakar Bhattacharyya, professor of chemical engineering. In a lab class, the outcome is already known. In the students' research projects, the results are unknown. Research teaches independence. "We [the professors] will guide them, but we expect them to think for themselves," he says.

Because of concern about the shortage of scientists nationwide, the National Science Foundation encourages students to consider graduate school through its Research Education for Undergraduates (REU) programs.



The University of Kentucky has two REU grants currently. One is in aquatic ecology and is directed by Philip Crowley, professor of biological sciences. The other, in the Center of Membrane Sciences, is directed by Leonidas Bachas, assistant professor of chemistry, with Butterfield, Michael Jay, associate professor of medical chemistry in the College of Pharmacy, Bhattacharyya and Kim Ward, assistant professor of chemical engineering, as co-principal investigators.

Unlike other REU programs, the UK programs are both restricted to students at colleges within about an hour's drive of Lexington, Bachas says. That's because the students not only spend eight weeks on campus during the summer doing research full time, but they are also required to return to campus on a regular basis during the fall semester for a series of seminars. In addition, they must write a paper about their research and present the paper at a professional meeting. The programs conclude with a banquet for the students, their parents and the students' faculty.

The 13 students in the membrane sciences program and the 10 in the aquatic ecology program come from the University of Kentucky, Transylvania University, Georgetown College, Morehead State University, Centre College, Eastern Kentucky University, Berea College and Kentucky State University. Students receive a \$2000 stipend for the eight-week program.

Last summer Lisa Cox, a senior zoology major from Lexington, shared a lab in the Multidisciplinary Research Lab building with Elaine Meng, a junior biology major from Maysville. The two did research on fat-head minnows, focusing on egg survival. This research is funded in part by the aquatic ecology REU grant.

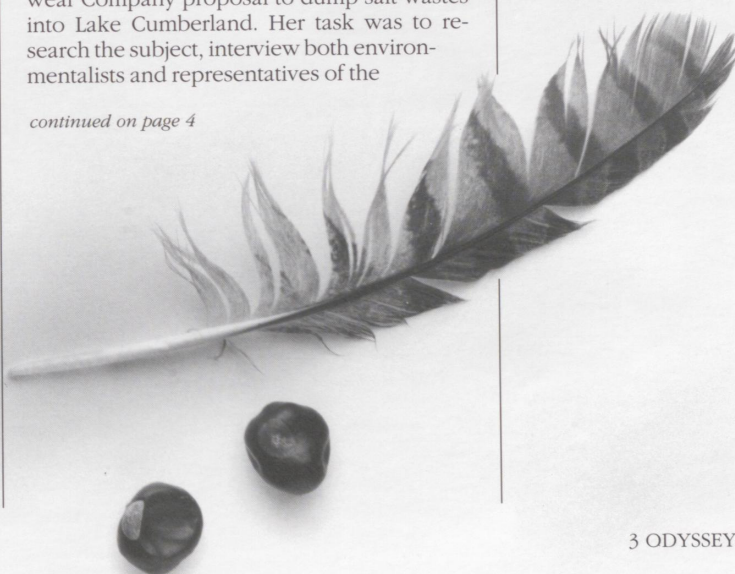
The project involved watching the behavior of the fish in an aquarium, counting the number of times one of them would rub its head against the top of a nest where hundreds of fish eggs clung to the glass. In order not to influence the fish or disturb its behavior, Cox studied its movements as recorded by a video camera, counting the times the fish rubbed against the eggs for 15 minutes every two hours, 24 hours a day, for about five days—the time it takes the eggs to hatch.



Eighteen students representing 16 Kentucky counties competed in pairs in a bridge-building contest. Jon Steckbeck and David Wade (middle row, far left), whose bridge supported the greatest weight, won.

Tonya Foreman of Danville, a senior at Centre College majoring in English and biology, wants to go to graduate school in bioethics or biology, or go to medical school; but she wants to make a career as a science writer for a lay audience. Her REU project combined her interests in writing and science. Her job was to conduct an evaluation of the Union Underwear Company proposal to dump salt wastes into Lake Cumberland. Her task was to research the subject, interview both environmentalists and representatives of the

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company and conduct a diversity study of fish from the creek where the waste is now dumped. Then she will judge whether the company should be allowed to dump the wastes into Lake Cumberland. Like the other REU students, she will report her findings to the Kentucky Academy of Science in the fall.

Students participating in the membrane sciences REU program are working in chemical engineering, chemistry, pharmacy, nutrition and psychology. Among them is Kelli Wickline, who worked in Ward's lab in chemical engineering as a part of the membrane sciences REU program. Wickline, along with Carl Baker and Leahan Roebuck, who is from Lexington, South Carolina, spent the summer studying red blood cell deformability. The three studied blood samples from patients with circulatory diseases to determine if the walls of the red blood cells had become rigid—less deformable—and therefore did not flow as easily. "I'm looking at this experience to introduce me to research," said Wickline, a chemical engineering junior from Elizabethtown. "I want to see if it's what I'm really interested in before I put in all the time of going to medical school."

This was not the first research experience for Baker, who received his degree in chemical engineering

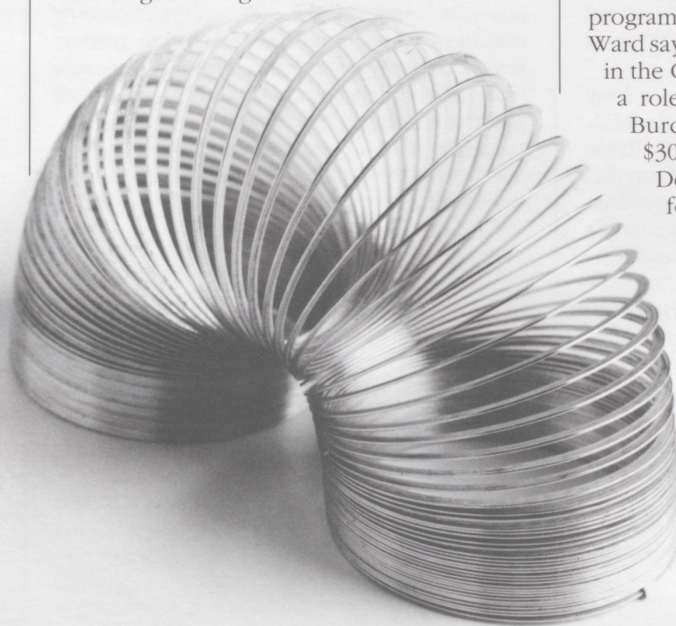
from UK in May of 1989. He began working on blood cell deformability during his senior year because "it seemed like a good project for a chemical engineer who is going on to medical school."

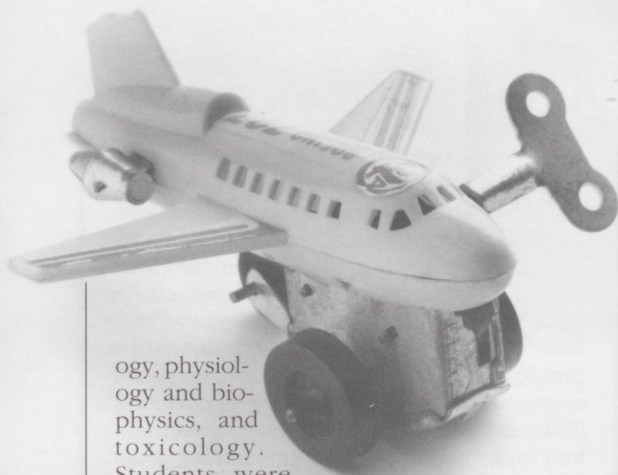
Also as a senior, Baker worked on a project to try to develop a radiotherapeutic drug to treat liver cancer. The goal was to attach a radioactive isotope to a tiny biodegradable particle that could be injected into the body and then would lodge at the site of the cancer. A paper Baker wrote based on the project won first place at the southern regional student competition of the American Institute of Chemical Engineers (AIChE). Baker, who is from Paducah, is to present the paper in November at the national meeting of AIChE.

Rebecca Burchett, a chemical engineering senior from Paintsville, also worked with Ward on developing membranes for controlled release of anti-cancer drugs. "I'm pulled toward both medical school and a Ph.D. I hope this summer will help me decide," Burchett said in early June. "I hope it will let me see if I'm willing to give up medical school for graduate school." If she had the time, she said, she would like to earn both a medical degree and a Ph.D. in chemical engineering and then do research.

Recruiting women students for graduate programs in engineering "takes a big effort," Ward says. As the only female faculty member in the College of Engineering, she serves as a role model for students like Wickline, Burchett and Roebuck. Ward has a \$300,000, three-year grant from the U.S. Department of Education to provide fellowships for women to pursue Ph.D.'s in chemical engineering. She would like to see some of her undergraduate researchers go on to graduate school under the POWERS-MS (Production of Women Engineering Role Models) fellowships.

For the first time this past summer, UK offered a summer program in the biological sciences for undergraduate minority students. Twenty-four students were selected to work on research projects in plant physiology, biochemistry and molecular biology.





ogy, physiology and biophysics, and toxicology. Students were matched to projects and professors based on individual interests.

"The goal of the program is to recruit outstanding minority students for professional and graduate schools," says Donald T. Frazier, director of the physiology and biophysics section of the program. The program is funded by the Department of Education. Since 1982 Frazier has also directed the Minority High School Student Research Apprentice Program, funded by the National Institutes of Health.

Minority students with high potential for continuing their education are selected from Fayette and surrounding counties. Most are juniors or seniors, although a ninth grader participated this year. They are matched with faculty members throughout the College of Medicine based on individual interests. The students work in labs assisting with research and at the end of eight weeks prepare a written report on their experience. Each is paid \$1,000.

Though many of the minority apprentices go on to college elsewhere—Harvard, Yale, Princeton, and Emory, for example—some students, including George T. Brown, choose UK.

"When I first started high school, I didn't know what I wanted to do. I thought about being a business major," Brown said. Then between his junior and senior years at Bryan Station High School in Lexington, Brown was chosen to participate in the 1985 minority high

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Appalachian Teens Get Hands-On Scientific Training



The Appalachian Explorers Program encourages ninth-grade students to take part in lab projects and field projects.

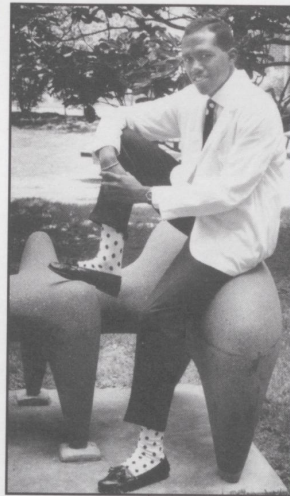
For two weeks in June of this year, 22 ninth graders from Appalachia experienced first-hand the rigors and rewards of being a scientist. The program, sponsored by the University of Kentucky and funded by the National Science Foundation, is aimed at getting more students interested in studying science.

The Appalachian Explorers—10 boys and 12 girls from West Virginia and the Appalachian regions of Kentucky, Tennessee and Virginia—developed their own ecosystems, visited a strip mine, learned about predator-prey relationships, studied the formation of natural bridges, and camped two nights in the forest, among other activities.

The project is a lot of fun, project organizers say, but it also sets important groundwork for a group of gifted kids from an often-maligned region of the country. "There's a lot of focusing on how poor the schools there are," says Jane Bagby of UK's Appalachian Center. "But there are many, many bright students in Appalachia." "We give them information on scholarships while they're here," she adds. "And we talk about their heritage, help them to be proud of being Appalachian."

At the same time, the program teaches the teenagers about "natural resources and the wise use of them," says co-director Truman Stevens.

George T. Brown was a minority high school research apprentice in 1985 and 1986 at UK, working on studies of hypertension, cardiology and nicotine. He is currently beginning dental school at the University.



school research apprentice program in UK's College of Medicine. Brown was paid to work in a laboratory that summer, assisting with a hypertension study and a cardiology study involving experiments with cats. He began thinking about science as a career and was chosen for the program again during the summer of 1986. His role in a study of the effects of nicotine on rats was to monitor the rats' blood pressure, which required him to put a blood-pressure cuff on the rats' tails. "After the second year, I knew science was what I wanted to do," Brown said.

He enrolled at UK in the fall of 1986 as a biology major and continued to work as a technician on the nicotine study of rats. This fall [1989] he begins dental school at UK while completing requirements for his bachelor's degree in biology, which he will receive next May. He credits his research experience as one of the factors in his admission to dental school.

Another program for minority high school students operates in the College of Pharmacy. "High school students, unless their parents are faculty members, do not get much exposure to what research is all about," says Jay, who directs the program. The five participants this summer were involved in all aspects of pharmaceutical research, from animal surgery to enzyme assays, Jay says. Four of the five were among the six students who took part in the program during its first year of operation in 1988. The students are paid \$1500 for eight weeks' work, Jay explains, with faculty members who work with the students paying half the stipend from their own research funds.

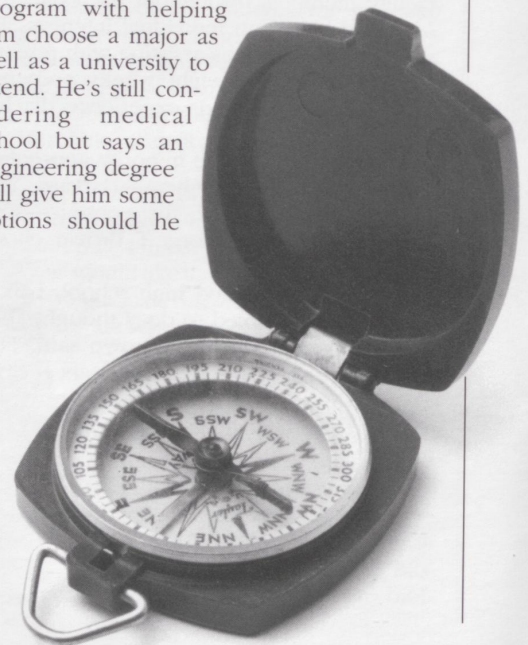
While the minority apprentice programs accept students living within commuting distance of UK, Engineering Ahead, a Young Scholars Program funded by the National Science Foundation, brings high school juniors from across the state to Lexington for two weeks to expose them to careers in engineering.

"A primary goal is to get the students interested in engineering as a career," says Cindy

Iten, student affairs coordinator for the College of Engineering and project director. An underlying goal is to recruit students for UK's program. Twenty students were selected for the program in 1988 and in 1989.

During their two weeks on campus, participants learn about branches of engineering. "They have heard of chemical, civil, electrical and mechanical engineering," Iten says, "but they have a limited idea about what these areas involve. They have never heard of materials engineering, and agricultural and mining engineering are easily misconstrued."

Tim Meade had not considered engineering as a college major until his counselor at Virgie High School in Pike County told him about UK's Engineering Ahead program for high school juniors. Though he wanted to attend medical school, he applied for the program and was accepted. During his two-week stay at UK during the summer of 1988, Meade met a physician who had used an undergraduate degree in chemical engineering as a route to medical school. This fall Meade will enroll at UK as a chemical engineering major. He credits the Engineering Ahead program with helping him choose a major as well as a university to attend. He's still considering medical school but says an engineering degree will give him some options should he



decide medicine is not for him.

Like Meade, through the program several students have discovered that a degree in engineering can lead them to medical school. Others, like Kelly Brown, a student at Pleasure Ridge Park High School in Louisville, knew they wanted to go into engineering but not which specific discipline. "The program made me decide to go into civil engineering," said Brown, who will enroll at UK this fall.

Do undergraduates have enough research opportunities?

"UK does a pretty adequate job of involving undergraduates in research," Dickson says. "If someone is dying to do research, they can find someone to work with them."

Ann Marie Hemmer, a UK biology major from Boone County who worked in Dickson's lab, agrees. "There is so much research to be done; the opportunities are out there for undergraduates," she says.

Crowley believes UK should do more. "The University needs to get more involved in getting undergraduates into research by committing some of its own limited funds to programs," Crowley says, adding that there will continue to be outside funding available for undergraduate research programs.

An advantage of undergraduate research experience is that it makes students more competitive for graduate and professional

schools, Crowley says. It also gives students a realistic view of what research is all about—both the hard work and the fun, Bachas adds.

Dan Finn, a biology major at Centre College who did research on ion selective electrodes through the Department of Chemistry, says he was surprised by the responsibility the students are given and sees benefits for both students and faculty members. "It helps both sides. We get a lot of experience and the professors get work done they need done," Finn says.

After participating in the programs, some students decide research is not for them. Learning that before embarking on a research career can also be a valuable lesson.

Some of the research projects students undertake do not pan out. "My attitude is that if something really productive comes out of [a project], great. That's gravy," Jay says. "The important thing is what the students experience, what they do learn." ♦



MAKING A GO OF IT ON THE FARM

by Gary Pierce

Dick Robertson is continuing the family tradition set by six generations of men before him: he is working the 260-acre farm in Bath County, Kentucky. But a new tradition may be in the making. Robertson is the only one of four brothers to follow his father into the farming business. And in order to make a go of it, Dick Robertson holds down a second job at a Mt. Sterling tobacco warehouse.

This "coping strategy" is fairly common, according to University of Kentucky researchers Janet Bokemeier and Lorraine Garkovich, who have been studying the changing nature of Kentucky farm families as they react to economic stress and changes in the farm business. What they have found is that farm families are finding new ways to deal with old problems while sometimes relying on old values and faiths to see them through new difficulties.

The days of the self-sufficient farm are all but gone. Instead of growing their own food and living strictly off the land as in the past, contemporary farmers are meeting their financial needs by earning "off-farm" income. "They find themselves in this kind of a dual role, as both employee and employer," says Bokemeier, an associate professor of sociology. "How they adjust to that situation at a household level is interesting. They have to decide whether it makes sense for them to go out and take a job and then bring in someone else to make up their time on the farm, whether it's the farm husband or the farm wife or sometimes even the farm children."

Thirty-eight percent of Kentucky farm men and nearly 46 percent of farm women are also employed off the farm. Over all, one-third of Kentucky farm families have adopted a work strategy whereby the husband or wife, or both, enter the off-farm labor force. According to Bokemeier, off-farm work was the most commonly occurring strategy employed to

cope with the decreasing profitability of farming.

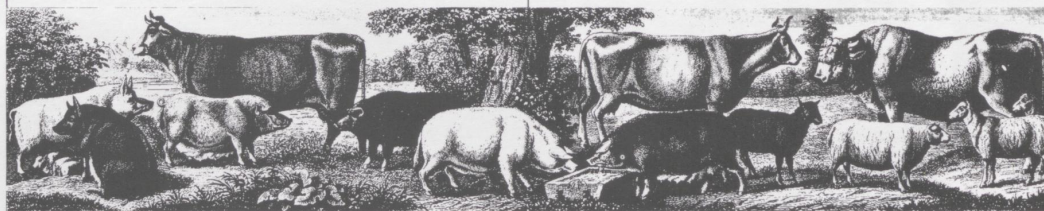
This strategy has become a definite trend among "small-scale farmers," according to Don Shurley, an associate professor of agriculture economics at the University of Kentucky. He and research associate Kurt Stephenson, in a study of small- and part-time farmers in the state, found that of the 75,900 farmers in Kentucky whose land generates less than \$40,000 a year, about 45,500 of these farm operators hold down other jobs (this figure excludes other farm members who work off

Thirty-eight percent of Kentucky farm men and nearly 46 percent of farm women are also employed off the farm.

the farm). More than 80 percent of those part-time farmers work more than 200 days a year at other jobs, Shurley says, and 65 percent work at least 40 hours a week off the farm.

"The farm cannot be considered the primary source of income," he says. "They need that off-farm job to help support the farm." The decision to take off-farm work is fraught with a myriad of strategies and concerns for the farm family. First it must be decided which family member has the most marketable skills for off-farm labor. Vivian Razor, whose husband Bob is a farmer, says she doubts whether her family could make it without the extra income from her job and his second one. "I'm going to be teaching as long as he's farming," she says. Bob Razor, 30, is co-owner of the 125-acre Farmacy Farm, five miles north of Morehead. He also sells fences, his off-farm job.

Another concern involves replacing this



time on the farm, assuming the family can afford to pay for hired labor and that such labor is available. In areas offering manufacturing jobs, casual farm labor is especially difficult to find. "You have a situation where people are working in factories for eight or ten dollars an hour," says Garkovich, an associate professor of sociology, "and they sure don't want to spend their weekends picking crops for four dollars an hour. In addition, there's the question of a benefits package. Even if the farmer can pay a competitive wage, he can't offer medical benefits as well. You're better off flipping burgers for minimum wage where you can still get those benefits."

What makes this situation all the more difficult is the nature of farming itself, Bokemeier says. Not only is farming governed by the ravages of nature, price controls and the structure of global economy in a simultaneous way that few, if any, other enterprises must face, but the nature of the work is centered around the task, not the time clock. "What happens is that when you try to get temporary laborers," Bokemeier says, "they come in with the expectation that it will be like an hourly job. But in farming, you work until the task is done regardless of the time, so when you bring to farming the attitudes of wage work, farming just doesn't stack up very well."

The second most commonly occurring strategy for coping with financial difficulties was expansion, Bokemeier says, but that choice is again complicated by economic restrictions. "If their strategy is to rely on unpaid family laborers or some kind of cooperative neighborhood arrangement," she says, "that puts an economic ceiling on how much they can expand. And there are real economic repercussions for that, so they find that they have to work off the farm. But then they no longer



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Janet Bokemeier

have the family labor there, so it becomes a sort of vicious cycle."

To cope with that cycle, Garkovich says, "they sometimes decide to bite the bullet and spend more than they think they should to buy themselves one good laborer, and set up a benefits package to make it worthwhile. The flip side is that they may go more mechanized, expand in that direction. If you expand in a way that requires more hired labor, it doesn't cost as much to do. But if you choose path B and go more mechanized, you can expand in such a way that you have a much higher output but still operate essentially with one person. Initially the cost is much higher, but in the long run that was the only sure way to be able to increase the size of their operation."

Both Bokemeier and Garkovich believe that

Farmers are finding themselves in a dual role, as both employee and employer. They have to decide whether it makes sense for them to go out and take a job and then bring in someone else to make up their time on the farm.

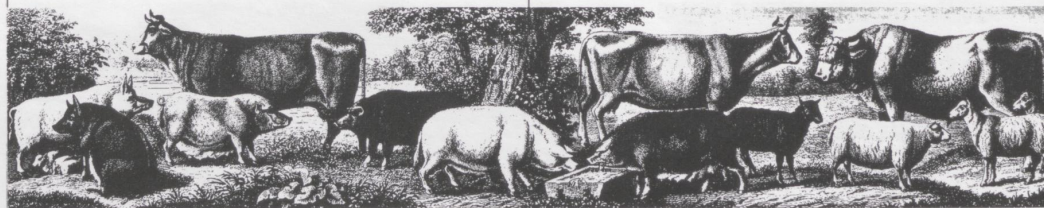
farming is in some ways much like other family-run businesses, but that there are concerns unique to farming which make it discernibly different. The question of how similar farming is to other family enterprises is a debatable issue in sociology, but Bokemeier

points out some distinctions that seem fairly clear-cut. "The farmer's lifestyle is very much influenced by the economic development of the local community," she says. "How far they have to travel for staples, groceries and things, is important. But how far they have to travel for spare parts is critical. If all the implement dealers have moved out, you could spend three or four hours downtime getting a part replaced. You have to actually stop the farm."

The seasonality of farming also makes it different from other family businesses. "When the peppers are ready," Garkovich says, "you can't sit and interview 30 people over the course of five days to find the ones who are capable and willing to do the work. By that time, your crop is ruined."

Even if a farmer has successfully invested in higher-tech equipment in hopes of a long-run return on the investment, the unique characteristics of farming can often undermine carefully made long-range plans. Add to this dilemma the matter of crop price controls and the farmer's outlook becomes even bleaker. "The lack of control over your market causes farmers some extraordinary problems," Bokemeier says. "If you run a drug store and utilities go up, you can mark up your paper towels or whatever. Farmers can't do that. If the price of fertilizer goes up, they can't mark up what they'll get for their soybeans. They have very little control over price setting. And they have very little control over the global marketplace. The grain market these days is Minneapolis, New Orleans, France and Hong Kong. It's a world market."

All of this paints a bleak picture for the family farm, and the farmers themselves are divided when it comes to solutions to their problems. Bokemeier notes that while many farmers recognized the limits of their own lack of education and argued that beginning farmers simply must have a college education,



WORKING TO PREVENT
FARM-RELATED
INJURIES AND DEATHS

Many farmers recognize the limits of their own lack of education and argue that beginning farmers simply must have a college education. Many others still hold the opinion that these new-fangled methods and advanced technologies have caused agriculture's problems in the first place.

many others still hold the opinion that these new-fangled methods and advanced technologies have caused agriculture's problems in the first place. Such differences of opinion seem right in line with how farmers view themselves these days.

Garkovich says that one of the questions they asked the farmers was how they think non-farmers view farmers. "The results were interesting," she says. "They see themselves as losing a lot of status and respect in the last ten to twenty years. They see a loss of political influence, not only at the national and state level, but even at the community level. Twenty or thirty years ago, farmers were community leaders. But because of the pace of farming now, young farmers just don't have the time to get involved."

Many of the aspects of farm life which once made it worthwhile are vanishing. The family bonds forged out of the daily necessities of the farm operation are loosening as one or more household members enter into off-farm labor. The neighborliness which once existed among farm families is gradually disappearing as fewer and fewer young persons are taking up the occupation, leaving all ages of farmers with a diminishing pool of peers. Garkovich notes that even the pressures of farming are increasingly similar to those of other occupations. "When you have extremely high debt-

to-asset ratios," she says, "you can't afford to have a bad year."

Despite the dismal portrait of farming painted by their findings, Bokemeier and Garkovich are both impressed by the resiliency of the family farmer. Garkovich notes that no matter how many horror stories the farmers spun about their situation, they usually managed to see some humor on the horizon. Bokemeier says that other coping strategies included a sense of tradition and faith. "Clearly, faith in God was important," she says. "Faith in the land was another important mechanism: 'The land will take care of me. It's been in my family for a hundred years and it'll take care of me.' There's also something we call 'mastery,' a sort of survival instinct. 'I'm a good manager, I've grown up with agriculture, I've grown up with this farm. I can handle it. I can survive.'" ♦



Lorraine Garkovich



WORKING TO PREVENT FARM-RELATED INJURIES AND DEATHS

by Jeff Worley

Last June a Pembroke, Kentucky man, Lee Raymond Young, 42, was run over by a tractor on a farm. He suffered an injury to his ankle and complained of chest pains. He was released from Jennie Stuart Medical Center the next morning after being admitted for 24-hour observation.

A few days later at a farm near the Kentucky/Virginia border, a 41-year-old man was fixing a fence by himself in a field next to his home. He apparently laid his 12-gauge shotgun along one section of the fence. The gun fell and discharged, and the man was struck in the back right shoulder. He died twelve hours later at a local hospital.

One week after this fatal accident, a five-year-old Lewisport boy was riding on a tractor with his father. The man backed up and then went forward. The boy fell off and into the path of the implement the tractor was towing. The boy died instantly.

Twenty-two Kentuckians lost their lives in farm-related accidents during the first six months of 1989, according to Kentucky Farm Bureau's latest farm-fatality survey report. Fourteen of the 22 fell victim to tractors or other farm machinery, while four others drowned in farm ponds. Wood cutting, lightning and livestock accounted for the other deaths.

The six-month total of 22 was higher than the number during the same period last year

when 19 Kentuckians died as a result of farm-related accidents. But according to David Finney, Farm Bureau safety director, the 1989 figure is equal to the average fatality rate for that period over the past seven years.

Farm-related accidents and deaths occur in Kentucky with "maddening regularity," according to Lorann Stallones, an associate professor in the Department of Preventative Medicine and Environmental Health at the University of Kentucky. And what makes many of these accidents doubly tragic, she says, is that they could have been prevented.

"In reading death certificates for this study, I would get terribly angry," Stallones says. "I would read one after the other where the 'immediate cause' was something that could have been prevented from happening—'tractor rolled over on steep incline,' for instance. This accident didn't have to happen—you just don't drive a tractor up a steep incline. Or at least you have a roll bar on the tractor. That's a reasonable precaution to take."

In her current project, funded by the Centers for Environmental Health and Injury Control, Centers for Disease Control, Stallones is cataloguing the types of fatal and non-fatal farm-related injuries in Kentucky. The primary goal of the project, she says, is to determine what kinds of prevention strategies would be most effective in reducing the severity of the injuries or preventing them altogether. She points out that the focus of the study is important because farming is a unique enterprise: the home and workplace are combined, the work varies a great deal by season and climate, and most workers are self-taught and solely responsible for their own safety.



"A lot of attention has been focused recently on the issue of injury control," Stallones says. "But few analytical studies are designed to lead to improved prevention programs." In her study of non-fatal injuries, she is using data obtained from a survey of Kentucky farms conducted during 1978. A random sample of farms was surveyed reflecting the variety of agricultural practices in the state. The final sample included 1,972 farms in Kentucky.

"Larry Piercy, an agricultural safety specialist in the Department of Agricultural Engineering here, was responsible for getting this earlier survey done. He's a tremendous resource in this area because he's been very well trained in accident investigation," Stallones says.

In undertaking this project, which began in April of 1987, Stallones decided to collect information about farm-related deaths in Kentucky by reviewing actual death certificates rather than by the more common method of reviewing computer tapes. "The problem with reviewing tapes," Stallones says, "is that around 10 percent of the fatal injuries that occur to farmers occur on highways and that would be coded as a highway death, not a farm-related death. So you miss all those. I was concerned with getting a good count."

In order to get accurate information, Stallones hired research assistant Celia Stipanowich to go to Frankfort and hand-search records of every death related to accidental causes between 1979 and 1985. "She went into the vaults looking for any mention of 'farm,' 'farm produce,' 'farmer,' or 'farm occupation'—anything that would lead us to think it was a farm-related death. She pulled those, brought them back, and we created a new file incorporating our more detailed information with the information on the computer tape at Kentucky Vital Statistics."

Stallones found that a total of 486 unintentional farm-related deaths occurred among Kentucky residents between 1979 and 1985. Of these, 26 were women. Almost half of the deaths involved farm equipment, primarily tractors. Smoke inhalation and drowning were the second and third leading causes. Stallones

found that of the male farm population in Kentucky, two age groups were particularly at risk—those under 25 and over 65. "These older men are at very high risk because their strength isn't what it used to be, their sight isn't, their hearing isn't," Stallones says. "They continue to work at what most of us consider retirement age."

She adds that these men work with equipment that requires the power and ability to concentrate, which they may no longer have. "I think it's important for family members to recognize that there may be some activities that their father or grandfather should not be doing." Nearly 31 percent of males who died in farm-related accidents between 1979 and 1985 were over 65.

“These older [farmers] are at very high risk because their strength isn't what it used to be, their sight isn't, their hearing isn't.”

The other end of the age spectrum is also at high risk. In the six-year period surveyed, 57 farm children under the age of 15 died from farm-related injuries. Stallones found that farm machinery was, by far, the leading cause of death for both boys and girls in Kentucky. Stallones says studies have shown that children at an early age begin riding on tractors driven by parents or grandparents and begin to operate tractors when they are able to move the gas throttle, usually by the time they are 10 years old. By age 14 children are typically involved in chores using tractors, including some field work. Nearly 32 percent of boys and 39 percent of girls died by falling from or being crushed by farm machinery.

Firearms were involved in over 13 percent of deaths among boys, but no girls were killed by accidental shooting. Motor vehicles were

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WORKING TO PREVENT FARM-RELATED INJURIES AND DEATHS

Between 1979 and 1985 farm machinery was, by far, the leading cause of death for both boys and girls in Kentucky.

listed as the external cause of death for 23 percent of the girls and for nine percent of boys included in the study.

"Drowning was another leading cause," Stallones says. "We found that by ages 10-14, children on farms were more likely to die from drowning in farm ponds than from accidents involving farm machinery. In this age group, no girls died as a result of exposure to machinery and only 18 percent of boys did. These statistics on drowning are significant—and represent a significant problem. It's not being addressed in the literature on drowning because most studies are being done in urban areas. The recommendations for reducing drowning deaths in urban areas don't apply—

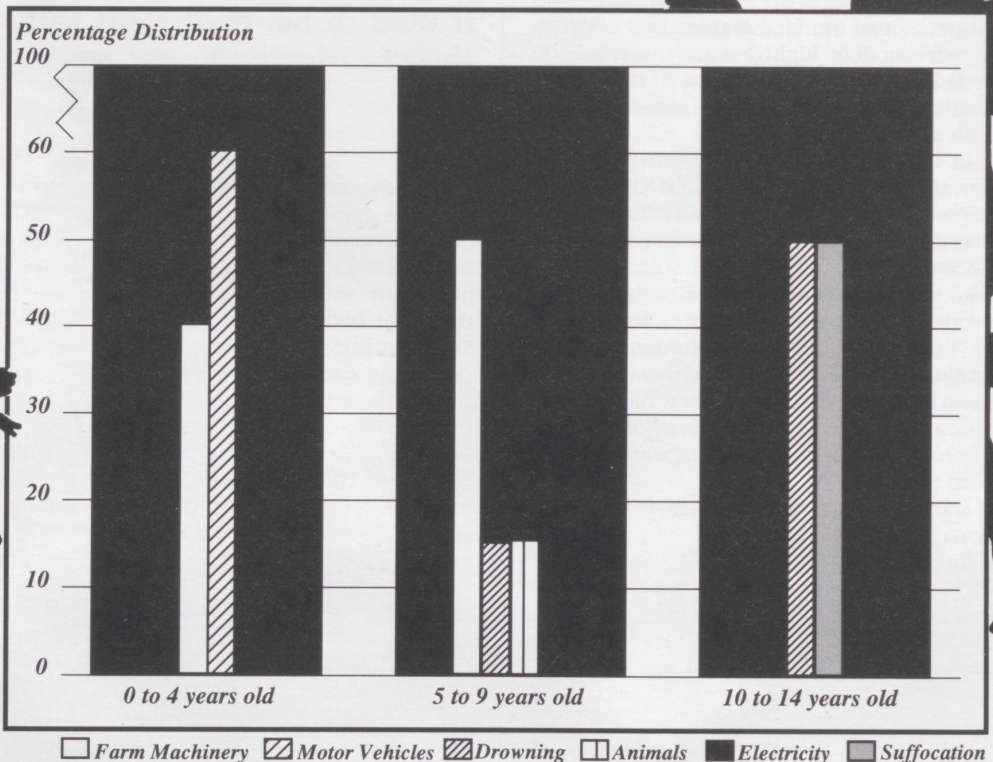
you aren't going to put an eight-foot fence around a farm pond.

"A child drives a tractor into a farm pond and drowns. A child rides a horse into a pond, falls off and drowns. We need to recognize that ponds are dangerous places for farm kids."

What prevention strategies would Stallones suggest? "It might sound simplistic, but you can teach them to swim and you don't let them wander around by themselves until they do know how to swim. Also, it's important to teach them to not swim alone."

Prevention, Stallones says, is often a matter of common sense. "If you don't take a four-year-old on a tractor, he won't fall off and get

FEMALE FARM CHILDREN INJURY DEATHS BY EXTERNAL CAUSE / 1979-1985



A BURGEONING BUSINESS

run over by the equipment being dragged behind—it's very simple. If you do take a child on a tractor, you're putting him at risk. Parents need to know what their responsibility is in this situation."

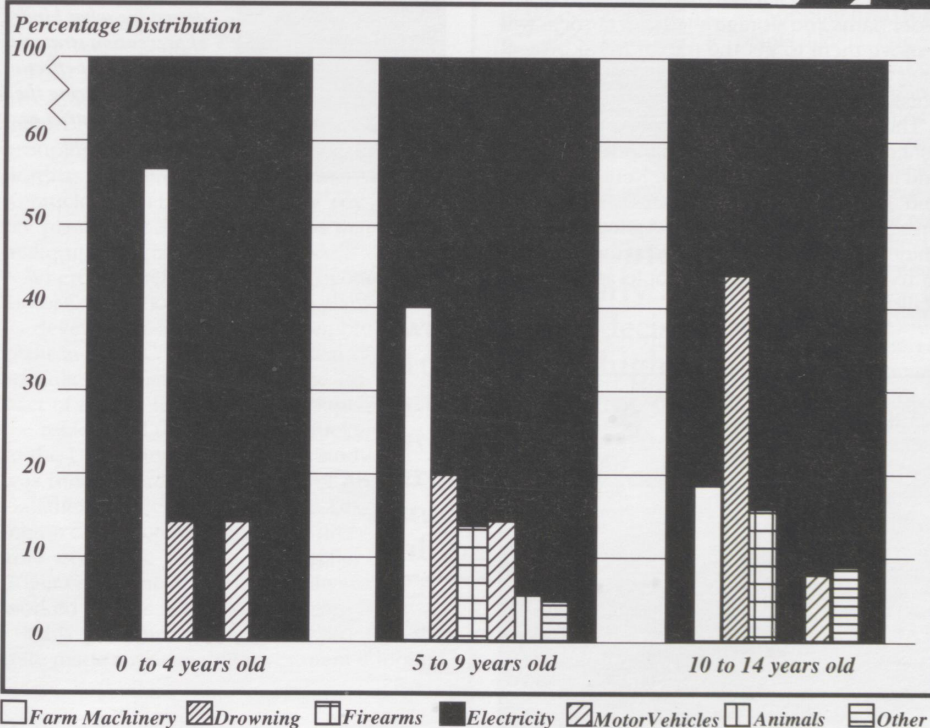
She adds that accident rates for children under four are unacceptably high and unnecessary. "This was, for me, the biggest surprise in doing the research. I was outraged by this."

Based on the information collected and analyzed, Stallones has suggested three different approaches to intervention which would be likely to reduce the severity of injury or prevent it: 1) education only; 2) education and equipment modification; and 3) equipment

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“If you do take a child on a tractor, you’re putting him at risk. Parents need to know what their responsibility is in this situation.”

MALE FARM CHILDREN INJURY DEATHS BY EXTERNAL CAUSE / 1979-1985



modification only.

"Education only" represents situations where injuries can be prevented by changing an individual's attitude and behavior. One obstacle to this approach, Stallones admits, is an endemic attitude that "accidents happen." "We have a tendency to look at accidents as 'acts of God,' something we can't do anything about. And until people change that attitude, our means of reaching them are limited. We can tell someone, 'Don't walk onto the thin ice of a farm pond,'—we can talk about the danger but can't do much else."

In the case of accidental shootings, education and equipment modification are suggested. Parents can be told to keep firearms under lock and key, and a rifle or shotgun partially disassembled if possible. An example of "equipment modification only" would be the roll-over protective structures (ROPS) on all new tractors.

"One practical problem with these roll bars," Stallones explains, "is that they make it impossible for some tractors to fit under the doors of older barns and storage sheds, so farmers will remove them to get the tractor in, to protect their investment rather than leave the tractor outside."

These various prevention strategies are published in newspapers throughout Kentucky and in news releases from the Kentucky Farm and Home Safety Council. "We also make presentations at the annual Agricultural Machinery Show in Louisville and at the State Fair to try to get to as many people as we can," Stallones adds. ♦



“ We have a tendency to look at accidents as ‘acts of God,’ something we can’t do anything about. And until people change that attitude, our means of reaching them are limited. ”



In Lorann Stallones' project nearly 2,000 Kentucky farms are included. The primary goal of the project is to determine what kinds of prevention strategies would be most effective in either reducing the severity of injuries or preventing them altogether.

A BURGEONING BUSINESS:

Kentucky's Automotive Supplier Industry

by Jeff Worley

In the past 30 years no phrase in the English language has undergone more of a dramatic metamorphosis than "Made in Japan."

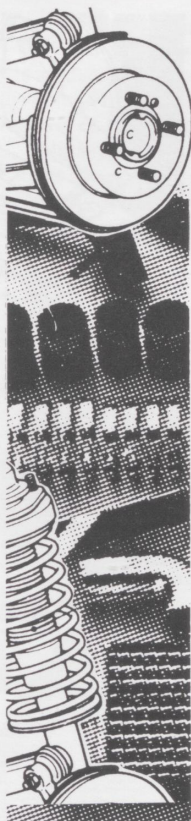
In the 1950s the imprint "Made in Japan" was the hallmark of the cheap, the shoddy. Then in the 1970s, seemingly overnight, we found ourselves admiring the neat fit and logic of the Toyota engine, the car's precise interior details that, taken together, made us think: quality.

As demand for Japanese-manufactured products rose in the United States, Japanese companies began making inroads into the American marketplace. In Kentucky, the Mazak Corporation began manufacturing machine tools in Florence in 1974. Within the next 15 years, 52 other manufacturing companies located in Kentucky, employing over 15,000 people with a total investment of \$2.5 billion.

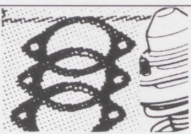
The escalation of direct Japanese industrial investment has recently led to the development of the Japanese "auto alley," a rough grouping of automotive plants located as far north as Michigan and as far south as Alabama. Kentucky, with the Scott County Toyota plant, is one of the six states that make up this configuration.

When in December 1985 the Toyota Motor Corporation announced its plans to develop an automobile assembly plant in Scott County, a great deal of speculation began regarding the impact of such a facility on the county, the region and the state of Kentucky. At the University of Kentucky a study was funded through the office of Art Gallaher, then chancellor of the Lexington campus, to determine the probable economic impact. Researchers Roger Calantone and Brinton Milward worked on this initial study.

"This preliminary study showed that the state made a reasonable investment if looked



These new industries require highly skilled workers. The decision by a 16-year-old high school student whether or not to stay in school has tremendous economic implications for the future of the state.



at over a ten-year period of time instead of in the short-term," Calantone says. "One of our main findings was that it was the automotive supplier industries that made Toyota a good deal here."

After the governor's office in Frankfort received the results of this study, the state then funded Calantone and Milward to find out what the effects on the supplier industry would be. "As construction of the Toyota plant proceeded, numerous automotive suppliers announced that they would be locating plants in the region," Calantone, a professor of marketing, says. "Kentucky was fast becoming a major player in the automotive manufacturing and supply industry."

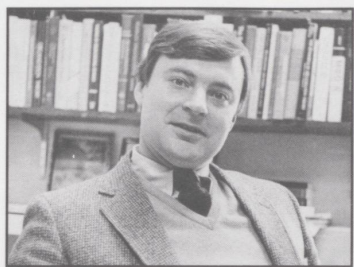
The purpose of this second project was to explore past, present and future trends in the automotive supply industry, to find out how the new supplier network would enhance the economic welfare of the state, and to determine whether or not Kentucky was getting its fair share of supplier plants as a result of Toyota.

"Supplier firms tend to surround automotive plants like a huge spider web," Calantone says. "We wanted to see how many of these were actually going to land in Kentucky." Calantone explains that Japanese plants are usually located on large interstates so that suppliers may easily locate no more than a day's drive away.

In their research Milward, who now heads the public policy program at the University of Arizona, and Calantone were joined by Heidi Newman and Lucinda Zoe. Newman has an MBA degree from UK and Zoe is a research associate in the University's Center for Business and Economic Research. "Lucinda was able to get extensive information about the automobile industry," Calantone says. "She's a very significant resource in doing these kinds of studies—she even got some government reports that aren't in print yet."

The researchers used every source they could, according to Calantone—newspapers, magazines, internal reports, government reports and memos. "People told us things

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*Brint Milward
now heads the
public policy
program at the
University of
Arizona.*

that weren't in the public domain and we corroborated whatever we could. We also interviewed executives at the Smyrna, Tennessee plant and at the joint GM-Toyota plant in Fremont, California."

One thing that became absolutely clear from their study, he says, is how difficult it is to discover what is occurring in the automotive parts industry. There is, as yet, no systematic information collected on the supplier industry. This lack of information was also considered a problem by all the state government officials interviewed.

One goal of the researchers was to be able to forecast the size of the supplier industry as time went on. This goal, Calantone says, was impossible to achieve. "We spent a lot of time talking to Washington and found that they just didn't have the type of data they said they were going to collect. And the Japanese automotive companies themselves are generally very secretive about what they are doing. They just don't have the same attitude toward the press and the public that American companies tend to have."

He says that such secrecy is one of several differences between U.S. and Japanese corporations. The nature of Japanese business is that executives tend to deal with companies on a long-term basis, in a close-knit set of relationships generally thought of as unusual by corporate America. Japanese businesses extend credit to their suppliers, send engineers to work with their suppliers and try to keep their relationship constant over a long period of time.

Another attitude difference is reflected on the assembly lines of U.S. and Japanese automobile plants. Calantone says that "five years ago if a worker in a U.S. plant stopped the assembly line to point out a problem, he was castigated; a worker in a Japanese plant was rewarded. Two years ago this was only relatively true—Ford began adopting some of these Japanese processes in some of their plants, Ford being the most internationalized American auto maker." (The Ford Motor Company is also Kentucky's first automobile manufacturer. The plant began operation in 1913 in Louisville, turning out twelve Model T's a day.)



In U.S. auto plants today, a new sense of responsibility for the product has gained popularity, he says, one in which quality control is done on the assembly line rather than after the product is built. "So instead of rolling off a new car and having 15 guys in white coats jump all over it with micrometers—the usual picture we have of quality control—it extends back into the assembly and fabrication process. This is a hallmark of the manufacturing process the Japanese have popularized."

In breaking the system down and focusing on its "component parts," Calantone says that there is now a stronger emphasis on the role of the workers and the role of the parts suppliers. "We've learned a few new 'rules for reality,'" he adds.

Some American parts suppliers, fearful of the increased competition in their established market and anticipating insurmountable barriers to entry into the new market created by Japanese automakers, have formed joint ventures with their Japanese competitors. In an article titled "Joint Ventures as a Strategy for Competition," published in *The Japanese Competition: Phase 2*, Vladimir Pucik characterizes this current trend as frequently a "desperate attempt on the part of American manufacturers to find a way around their competitive disadvantage."

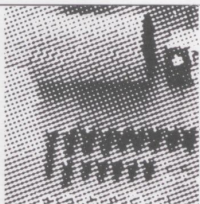
He goes on to say that these joint ventures are purely defensive in nature. American firms, he says, are seeking these ventures because the once very cost-competitive U.S. supplier industry is now running even with or behind

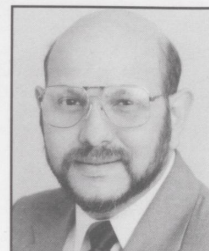
the Japanese. U.S. industry has lost much of its technological edge, and that Japanese "partners" will offer access to the new Japanese automakers. Pucik adds that a belief has emerged that it is more advantageous

“The bedrock attitude of ‘If it isn’t made here, we don’t want it’ has been shaken. Lots of people think now that it’s good to get ideas from other places, good to diversify the economy.”

to join your rivals than fight them.

Calantone says that if joint ventures between U.S. and Japanese auto suppliers don't work out, the problem may come from the





Roger Calantone is a professor of marketing at UK.

American company not realizing the different strategic agendas. "American companies are good at getting in there and cracking open a market, then exploiting it—in a business sense. They're good at achieving financial goals quickly. The Japanese go into the venture from the point of view of technology transfer—they want to learn how to do something and dominate the market in the long run."

He illustrates the problem with an analogy: "It's like a marriage where the woman gets married because she wants to improve her financial situation, and the man gets married because he wants a family and a smoothly-run household. A relationship such as this will sooner or later play itself out."

In their report, *Kentucky's Automotive Supplier Industry: Trends and Implications*, the UK researchers concluded that Kentucky is doing quite well in attracting auto suppliers where few existed before. Recent investment and employment estimates have indicated a significant boom in Kentucky's automotive supplier industry. In 1985, only 9,753 jobs were attributed to the state's whole category of automotive supply. Since Toyota's plant announcement, however, 4,586 additional jobs have been brought into the automotive supplier category. (This category excludes truck parts and industrial processes or other goods for cars and trucks.)

"Toyota has been a much bigger event for Kentucky economically than anyone thought when the agreement was first made," says Calantone. "It has affected many more communities than just Scott County."

The manufacturing industries now moving into Kentucky provide jobs with higher pay levels, but they also require highly skilled workers. "If Kentucky is going to be successful in attracting and keeping new industry," Calantone says, "we have to have an educated work force. Auto suppliers and auto manufacturers have no use for high school dropouts."

He goes on to say that a major constraint in attracting more auto suppliers is the state's large number of high school dropouts. Only 51% of Kentuckians hold high school degrees—the lowest percentage of high school graduates in the United States. Calantone says that "the most important economic development decision made in the state occurs when

a 16-year-old high school student decides whether or not to stay in school." On average, a high school graduate earns \$20,000 a year versus \$13,500 for a dropout with one to three years of high school.

He says beyond its economic impact, Toyota's presence has had a further effect in causing a change of attitude among many people who initially resented the foreign competition. "Another result of Toyota is that the cultural clock has ticked forward one more tick. People are a little more accepting now of a corporation that comes into their community. The bedrock attitude of 'If it isn't made here, we don't want it' has been shaken. Lots of people think now that it's good to get ideas from other places, good to diversify the economy."

Calantone adds that Kentucky is becoming more cosmopolitan, and as it changes, people are becoming more sophisticated in their view of the world. "We're in a global economy now; we have to become more culturally cosmopolitan."

The report, published by the Center for Business and Economic Research, also points out that Kentucky is in a unique position to take advantage of Japanese investment. Kentucky is located at the geographic center of auto alley, is easily accessible and is a prime location for a wide variety of research, educational forums, and seminars where people from government, industry and labor can meet to discuss research problems and issues related to the changing automotive industry.

In this unique position, Kentucky could also become a centralized information source for economic analysis of the automotive supplier market. A major policy recommendation from the researchers' report is that a systematic method be developed for tracking the growth in Japanese direct investment in the United States, specifically in the auto alley.

"We need a database tracking system that would compile information about Japanese investment in the six states of the emerging auto alley," Calantone says. "Then policymakers would have information on location, incentives, products, ownership and estimated employment so they can make informed decisions concerning Japanese investment in Kentucky." ♦

“If Kentucky is going to be successful in attracting and keeping new industry, we have to have an educated work force. Auto suppliers and auto manufacturers have no use for high school dropouts.”

WHEN TEENAGERS BECOME PARENTS

by Jeff Worley

"I 'll just put it on this stack here," said Thomas Arcury, taking the pocket-size recorder I offered. "That should elevate the mike enough to pick up both Sara and me."

The print-out, one of several mounds rising from the small conference table, was a foot and a half high. "These are just some of the statistics we've been running," Sara Quandt said, indicating other such bundles in the room. "We'll be analyzing dozens of these before we're finished."

Quandt, an associate professor of anthropology, and Arcury, research coordinator in the Center for Developmental Change at the University of Kentucky, are currently examining the major predictors of parenthood among American adolescents and the physical and social well-being of these parents and their children. The 18-month study is being funded by the Office of Adolescent Pregnancy Programs in the Public Health Service.

The researchers are basing their study on data collected since 1979 by the Center for Human Resources Research at Ohio State University. Twelve thousand youths (6,000 males and 6,000 females) age 14 to 21 in 1979 have been interviewed yearly. Though this study is primarily a survey of labor market experience, there is extensive data on fertility, adolescent parenthood, educational experience and other variables which Quandt and Arcury are interested in.

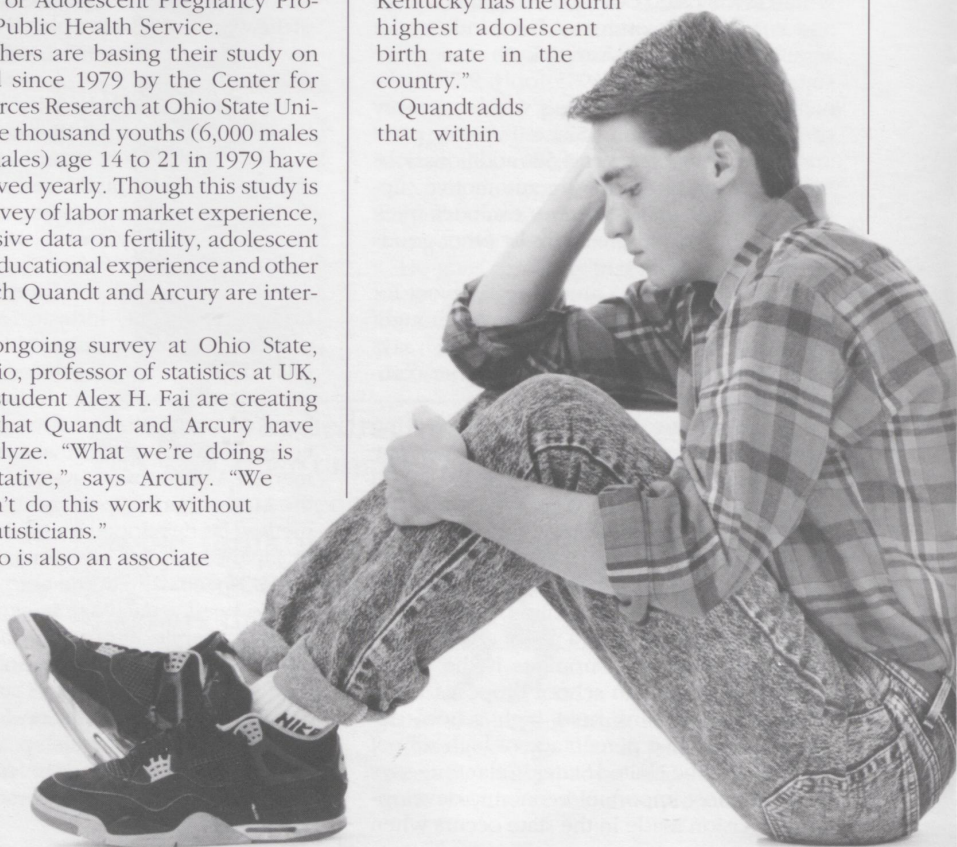
From this ongoing survey at Ohio State, Richard Kryscio, professor of statistics at UK, and doctoral student Alex H. Fai are creating the data set that Quandt and Arcury have begun to analyze. "What we're doing is highly quantitative," says Arcury. "We simply couldn't do this work without the help of statisticians."

Quandt, who is also an associate

professor of nutrition and food science at UK, conducted research at Michigan State on weight-gain and dietary patterns of pregnant women. This work, and her more recent interest in nutritional patterns in rural areas [see related article, "Lunch in the Mines," on p. 31], led her into this project. "My general areas of interest as a physical anthropologist are reproduction and medical issues that have to do with reproduction," Quandt says. Arcury has focused his research in two general areas—rural household and family in the United States, and demography.

"One of the reasons we were interested in conducting this study," Arcury says, "is that adolescent fertility has been seen for a long time as a social problem. But we know almost nothing about teenagers having babies in rural areas. And in Kentucky this problem—if it is a problem—is particularly critical: Kentucky has the fourth highest adolescent birth rate in the country."

Quandt adds that within



Kentucky has the fourth highest adolescent birth rate in the country.

the "life course perspective," it is argued by some social scientists that behavior which places an individual out of phase with peers will have consequences throughout the person's life. In the case of adolescent parenthood, bearing a child too early has been associated with leaving school early, the inability to find a satisfactory job, poor parenting practices, and reduced health and nutritional status of the child.

Arcury believes that becoming an adult in this country is more problematic for 18- and 19-year-olds than it was 50 years ago. "The path to adulthood is more regimented now than in the past," he says. "Back then you left high school, worked for awhile, went back to school, left again, got married, had kids, then went back to school. Being a high school graduate at 28 was okay." He adds

that with the formalization of education programs and the military drafts came an inflexibility in the system. "A 22-year-old in high school today is considered an oddity."

At this stage in their work, the researchers are examining the age at which adolescents become sexually active, when the women surveyed become pregnant, and when they

become parents. "What we've found so far," Quandt says, "is that there are differences among whites, blacks, and his-

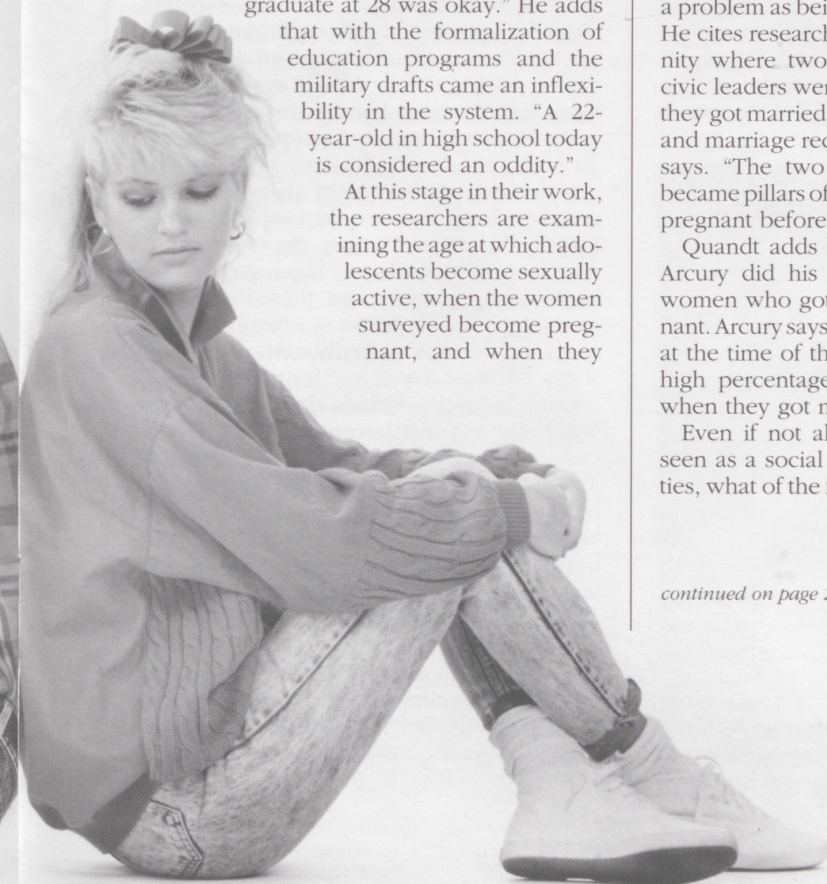
panics in these rates. There are also rural/urban differences: about the same percentage of women become pregnant in rural and urban areas at every age. However, a higher percentage of rural women give birth." "The indication is," Arcury adds, "that the rural women surveyed probably have fewer abortions, and tend more often to be married when the child is born."

"Our hypothesis is that being an adolescent mother in a rural community has fewer long-term ramifications than being an adolescent mother in an urban community because these rural mothers tend to marry," Arcury says. "Being pregnant before marriage isn't as much a problem as being a parent before marriage." He cites research he did in one rural community where two women who later became civic leaders were six months pregnant when they got married. "I looked at the birth records and marriage records, so I know this," Arcury says. "The two are older adults now and became pillars of the community despite being pregnant before they were married."

Quandt adds that in the rural area where Arcury did his work, 30 to 40 percent of women who got married were already pregnant. Arcury says that historical research shows at the time of the founding of our country a high percentage of women were pregnant when they got married.

Even if not all adolescent childbearing is seen as a social problem in these communities, what of the fact that so many babies born

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to teenage mothers are born premature or smaller than normal?

"If you look at 18- or 19-year-olds who are having babies, especially in urban areas of the country," Quandt says, "they may well be single mothers who have lower incomes, less access to good medical care, and less access to a healthy diet. So they give birth to babies that are smaller and at risk. This has nothing to do with the mother's age—biologically, late adolescence is an ideal time to have children." She adds that when many people think of the risk of adolescent pregnancy they think of 14- and 15-year-olds, many of whom do have biological problems with pregnancy. Since these teenagers are still growing, the infant is competing with the mother's body for nutrients.

Quandt and Arcury have recently completed one part of their study on adolescent sexuality and parenthood and are in the process of writing an article which focuses on one of the hypotheses they have tested. One hypothesis—that rural adolescents are more

likely than urban adolescents to become sexually active at any given age—has proven to be false.

"We've found that that's not true," Arcury says. "Basically, whites in rural and urban areas become sexually active at pretty much the same rate. Rural blacks become sexually active a little bit earlier than urban blacks, and, urban hispanics a bit earlier than rural hispanics."

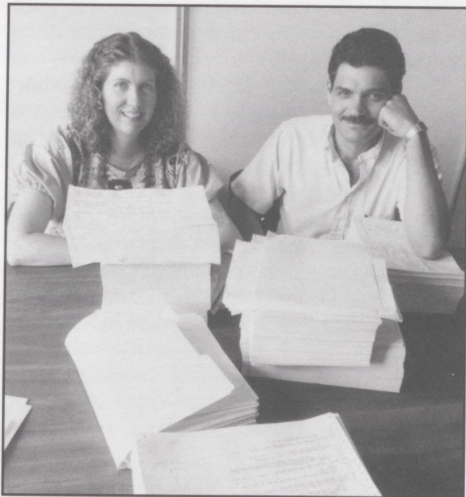
In their analysis the researchers are focusing on the indicators, or predictors, of adolescent sexual behavior. "Basically some of the best predictors of who becomes sexually active at any given age are what you can call 'deviant behavior' or 'adult behavior,'" Arcury says. "Drug and alcohol use are good predictors."

"If you're drinking, for example—an adult behavior—then becoming sexually active is another adult behavior," Quandt explains. "Some people would call this deviant behavior, but it's not deviant if you're an adult—you smoke a cigarette or take a drink because that's part of the cultural norm of being an adult. Many adolescents are simply doing it at an earlier age."

In looking at one set of statistics the researchers have available, results of the Armed Services Vocational Battery, they have determined another predictor. "The survey participants who do better on these tests—and therefore probably better in school—are less likely to become sexually active," Quandt states. "At least this is true for white males."

Other indicators include church attendance and birth year. Adolescents of any religious denomination who attend church regularly are less prone to become sexually active. And because people are becoming sexually active at earlier ages, what Arcury terms a "secular trend," those born in 1957, for example, were less likely to have become sexually active at any given age than those born in 1963.

"And then there's another variable that's called 'co-habit': All adolescents who live with an adult of the opposite sex or get married are extremely likely to be sexually active," Arcury



Sara Quandt and Thomas Arcury are analyzing data from an Ohio State University ongoing survey studying 12,000 males and females between ages 14 to 21 in 1979. The participants have been interviewed yearly.

says, allowing a slight smile to form. "It's a real good predictor at every age."

In attempting to determine "well-being" of adolescents who have children, the next step in their project, the researchers are interested in an ongoing study by Frank Furstenburg of a group of urban women in Baltimore. Furstenburg concludes that the results of being an adolescent mother in the short-term appear to be extremely negative for all these teenagers, invoking stereotypes of the poverty-stricken drop-out. However, many by age 35 had completed high school and had limited their family size. "That's what we want to focus on," Quandt says. "Are the life stories the same for all the women and men who become adolescent parents, or are they following different routes?"

The researchers admit that analyzing the fertility behavior data from this survey is a tremendous undertaking. The information they are sifting through is contained on eight computer tapes; the "Key-Word Index" by itself fills three large three-hole binders. One concern Arcury and Quandt have had from the beginning, of course, is the reliability of the data they are using.

"There are problems of accuracy in any kind of data that a scientist collects," Quandt says. "These data were collected in face-to-face interviews by interviewers asking extremely sensitive questions—about drug use, sexual practice. They were trained to deal with these questions and to be sensitive to the surroundings. Was there anybody else in the room, for example, when the teenager was being asked these questions?"

Arcury adds that repetition is built-in to the interviews as a check on truthfulness. "Those interviewed are asked the same questions every year: 'At what age did you first experience sexual intercourse?' And we have found in some of the data the phenomenon of the self-rejuvenating virgin. But the people that maintain these data sets compare responses from year to year and re-code for dishonesty or 'forgetfulness.'"

Quandt admits that there are some problem-

“The indication is that the rural women surveyed probably have fewer abortions and tend more often to be married when the child is born.”

atic areas in the data set. "The data generated from males' responses about parenting are probably not the best. Some of them lie about this and some don't know if they've parented a child. The data are better for females because they have a much harder time concealing parenthood," she says.

Quandt adds that the interviewers have done an extremely credible job of building rapport, a fact borne out by the statistics. In the "worst year," 92.5 percent of the original 12,000 people were interviewed. The "non-interview rate" has generally been less than five percent. "That's one of the reasons why we've invested so much into this data base," Arcury says. "The surveyors have been very successful."

Once all of the data on adolescent fertility have been analyzed, what then?

"One thing we'll be able to do at that point," Quandt says, "is to develop some intervention strategies. If you can make a profile of youths who will probably become pregnant, you can tailor programs to that audience." Arcury adds that if the outcomes are different between rural and urban adolescents, each group needs certain types of programs to deal with teenage pregnancy.

That stage of the research, though, is still "a distant light at the end of a tunnel," Arcury says. Looking at the formidable stacks of paper around them, he adds that he and Quandt just hope to finish the project before their children become teenagers. ♦

SCIENCE PROGRAM STRENGTHENING RESEARCH IN KENTUCKY

by Jeff Worley

Christine and Michael Barton came from Centre College in Danville to study the adaptive behavior of fish in a stream's headwaters. Bruce Mattingly came from Morehead State University to research the neuro-behavioral effects of stimulant drugs on rats. And Karen and Richard Hackney came from Western Kentucky University to study nebulae and the birth of stars.

These five researchers, and sixteen others from Kentucky universities and colleges, have come to the campuses of the University of Kentucky and the University of Louisville during the summer months as part of the Kentucky EPSCoR Visiting Scholars Program. EPSCoR (Experimental Program to Stimulate Competitive Research) was initiated by the National Science Foundation in 1986 to increase the quality of science and engineering research in the state, and to improve the ability of scientists and engineers in the commonwealth to compete successfully for federal research funds.

"The Regional Universities Visiting Scholars Program was established in 1987 to provide opportunities for faculty at Kentucky's regional public universities and private colleges and universities to work with researchers at the state's two doctorate-granting institutions," says Leonard Peters, EPSCoR project director. The program provides up to two months of support. The award, typically \$10,000, can be used as summer salary, to purchase supplies and equipment, and to support students as research assistants.

"EPSCoR considers proposals for support of research in any field of science normally supported by NSF," Peters says. The research areas supported during the first three years of the Visiting Scholars Program include biology, physics, astronomy, psychology, economics, mathematics, computer science and geology. So far, all of the state's regional universities and four of the state's private colleges and universities have been represented.

In discussing the genesis of the

Visiting Scholars Program, Peters says that an article sent to him by Henry Barschall, professor of physics at the University of Wisconsin, set the wheels in motion. Barschall is a member of the National Academy of Sciences and serves on the Kentucky EPSCoR External Advisory Panel. "We were already working on a proposal," Peters says. "Barschall knew we were trying to pull regional universities into a unified program where their researchers would work with researchers at UK or at U of L. And someone at one of Wisconsin's regional universities was collaborating with someone at Madison, so we took that idea and molded it to our special circumstances. We also have to credit Wimberly Royster for a lot of the initial thinking and planning." Dr. Royster is Vice President for Research and Graduate Studies at UK.

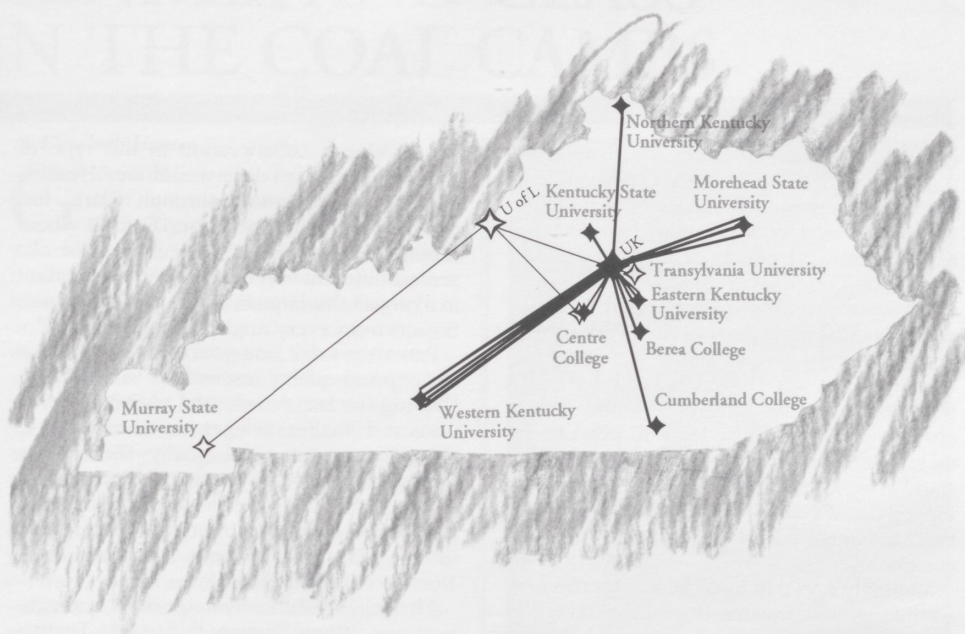
Solicitation of proposals for the program begins in October each year. Letters and application forms are mailed to the presidents, grants officers, and EPSCoR coordinators at Kentucky's six regional universities and to the presidents of Kentucky's 17 private colleges and universities. Faculty members at UK and the U of L are informed of the program through their respective grants bulletins. The deadline for proposals is February 1 prior to the summer of participation.

"The Proposal Review Panel evaluates proposals on the basis of the demonstrated competence of the researcher and the technical soundness of the proposed research," Peters says. In addition to these criteria, proposals are reviewed as to the likelihood that summer support will strengthen the overall competitiveness of the researcher and that the collaboration with the host faculty member or members will continue beyond the summer. The Proposal Review Panel consists of faculty members from UK, the University of Louisville and some members of the EPSCoR committee.

During the first summer of the program [1987], Christine and



Leonard K. Peters,
EPSCoR Project Director



All of the state's regional universities and four of the state's private colleges and universities have been represented so far in the Visiting Scholars Program.



Michael Barton from Centre College came to the UK campus to study the adaptations of fish under changing ecological conditions. Working with researchers Philip Crowley, Andrew Sih, and Craig Sargent, the Bartons utilized the simulated stream conditions set up in UK's Aquatic Research Facility.

"We were interested in looking at how fish we call 'aquatic grazers' adapt to dramatic changes in their environment," says Michael Barton, an associate professor of biology. "Studying the fish in simulated stream conditions—a system of tanks and troughs and pools—is one way to do this. The research we did here complemented our field work."

Barton says that one immediate benefit of the program has been their continued association with the UK researchers. "And last year UK was awarded, through NSF, an REU [Research Experiences for Undergraduates] grant, which has now been funded for an additional

three years." The grant, Barton explains, provides room, board, and a stipend to ten undergraduates each year from Kentucky colleges and universities to do research in aquatic ecology during the summer and fall. [See article titled "The Making of a Scientist," p.2.]

"Aside from this being a terrific idea exchange," says Crowley, a UK professor of biology, "it's also good from a teaching standpoint. We get very talented students from around Kentucky, and Chris and Mike are extremely adept at working with them." Crowley adds that he gets a lot of satisfaction from interacting with other researchers with similar interests, saying "there's always a pay-off."

During the first year of the Visiting Scholar's Program, Bruce Mattingly, professor of psy-



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chology at Morehead State University, also traveled to UK to begin collaborative efforts. Mattingly, working with Michael Bardo in the UK Department of Psychology, studied the neuro-behavioral effects of the chronic administration of drugs. In their work with rats, the researchers used a drug called L-Dopa, which is commonly used to treat Parkinson's disease.

"Chronic use of L-dopa has subtle, long-term effects," Mattingly says. "We know that chronic cocaine use also leads to side effects that don't appear for awhile. If we can understand the mechanisms operating with prolonged use of L-dopa, we may be able to relate these to human side-effects caused by chronic cocaine use."

Mattingly says that in addition to learning a technique to measure dopamine receptor binding, the affinity of the drug to bind with specific areas in the brain, he has benefited from continuing to work with Bardo. Their work has "turned into four or five projects," Mattingly says. In the year following his initial collaboration with Bardo, Mattingly published three journal articles and presented seven papers.

Bardo, an associate professor, agrees that a primary benefit of the program has been a continuing long-term collaboration with Mattingly. "Our project, which is still ongoing, is quite productive. One obvious benefit of working with Bruce is that he brings new ideas into our lab. The program is a very useful way to foster communication and to consolidate different skills across the state."

From the Department of Physics and Astronomy at Western Kentucky University, Karen and Richard Hackney came to UK in the summer of 1988. Though the researchers have access at WKU to a 24-inch telescope, the largest in the state, Richard Hackney says they lack a "critical mass" of scientists at Western. "Our purpose in coming," Hackney says, "was to start a collaboration with Frank Clark. We're interested in the study of very young stars and needed to write a software program for later analysis of photometer measurements." Hackney defines "young stars" as stars that range in age from one year to several hundred thousand years.

"It's tremendously useful," Hackney states,

"to develop a collaboration in this type of work. You just can't do as well alone." He adds that the collaboration, through Clark, has extended to South America and Europe, where researchers looking at these stars have observed different wavelengths. "It's important in a project this large in scope to look at these objects from every angle of the spectrum."

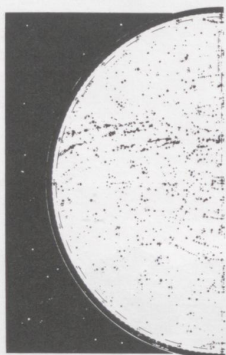
Peters says that one goal of the program is to keep top-quality researchers in Kentucky. "During the last decade, the regional institutions and smaller colleges have been able to attract some very good faculty. We want to provide them the opportunity to continue a research program." Peters adds that such a program is especially important for younger faculty. "We want to keep these people in Kentucky if at all possible."

The primary difficulty Peters sees is a logistical one. "We truly want this to be a face-to-face relationship during the summertime," Peters says, "and in some cases it just hasn't been that easy for someone with family commitments to pick up and spend 2 1/2 months at UK." He says that the program has so far been lenient in its interpretation of this type of interaction between researchers. "Some people will come to UK for a week, return home for a week, then come back to the campus for a week," Peters says. "Others are close enough to commute daily."

The Visiting Scholars Program has been judged a success by both the Kentucky EPSCoR Committee and the Kentucky EPSCoR External Advisory Panel, and Peters believes the program can be expanded if there are more applicants. "We've been able to select very high-quality projects, but we could enlarge the program considerably if the applicant pool is there."

"The Visiting Scholars Program has achieved national attention," says Royster. "It has been highly successful in a number of ways and in the long-term will enhance academic programs at the regional institutions."

One measure of the program's success is that it has served as a model for similar programs being proposed or developed in other EPSCoR states, including Idaho, Arkansas, and North Dakota. ♦



GENDER AND CLASS IN THE COAL CAMPS

by Elizabeth Hansen

Glenna Horne Graves, a doctoral student in history at the University of Kentucky, contrasts two images of Appalachian women in the introduction to her dissertation proposal. Graves, who teaches history at Lexington Community College, first quotes Alpha Brackstone, the young wife and mother in James Still's novel *River of Earth*, as she despairs at her husband's decision to move the family back to the coal camp:

"I allus had a mind to live on a hill, not sunk in a holler where fog and dust is damping and blacking. I was raised to like a lonesome place. Can't get used to a mess of womenfolks in and out, borrowing a dab and pinch of this and that, never paying back. Men tromping sut on the floors, forever talking brash."

Then Graves quotes a folk song of the southern West Virginia coalfields:

*"Where did you get that pretty
little dress?*

That hat you wear so fine?"

*"Got my dress from a railroad man,
Hat from a man in the mine."*

According to Graves, neither image accurately reflects the complexity of Appalachian women who lived in the coal camps.

"The story of women in the coal camps has not been told," says Graves.

The two most common stereotypical images are of the "sturdy, strong mountain woman" and the "not-too-bright, promiscuous sweet young thing," Graves says. Neither image is accurate.

"We know very little about the lives of women in the coalfields," says Ron Eller, director of UK's Appalachian Center and Graves's dissertation director. "Almost all of the research that has been done on Appalachia in general, and the coalfields in particular, has focused on the perspective of the lives of men, especially the miners themselves as they went below ground."

A major reason for Graves's project is to gain a better understanding of what happened to women as they moved from the farm into an industrial work setting, particularly in the coal camps of Appalachia and Eastern Kentucky, Eller says.

Graves has discovered that her findings are



Mrs. Leanore Miller, widow of a miner, with a picture of her husband. She said, "There's more widows and orphans in this holler than men at work." Four Mile, Bell County, Kentucky.



Gary, McDowell County, West Virginia

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Glenna Horne Graves, a native of Sugar Grove, Virginia, is a doctoral student in history.



Widow of a miner. Gilliam, McDowell County, West Virginia

not so much about women in the coal camps as about gender differences. Because women have been ignored in most histories of the coal camps, adding women's stories and experiences to the account changes the overall story, Graves says.

Graves's research is based on interviews she conducted with 60 people (two thirds of them women and a third of them men) who lived in coal camps between 1900 and 1940. Most of these people were at Auxier in Floyd County or Van Lear in Johnson County. Her interviews are part of a larger coal mining oral-history project begun by the Appalachian Center in

1985. She is also using 40 other interviews that do not deal specifically with gender, and she still wants to do 30 additional interviews. Her research is funded by the Kentucky Oral History Commission.

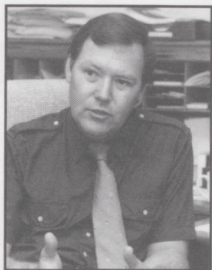
Graves has found major differences between men and women in the camps in terms of relationships between social classes and races. She has also found class differences in educational opportunities for women as well as differences between the first generation of women to move to the coal fields and later generations. The picture of family life that is emerging from her research both refutes and confirms some of the stereotypes about coal-camp families.

What Graves has not found is a monolithic image of mountain people. According to Eller, "One of the important things that we've come to understand about Appalachia is the diversity of experiences." The sons and daughters of the management and village merchant classes had different experiences than working-class people such as coal miners or mill workers. And the experiences of working-class people were different from those of rural, farm-oriented people.

Graves's interviews show that there was almost no contact between women from the miners' families and women from management families in the coal camps. "Though men and boys of all classes could get together in the coal camps and play sports," Graves says, "women and girls of varying social classes didn't seem to have that much contact."

There were sharp material differences between the two classes in terms of housing, clothing, what the children took to school for lunch and what children got for Christmas. Men and women viewed that disparity differently. "Men recognized the differences, but there was hardly any resentment. There wasn't

These photographs were taken by Russell Lee in 1946 as part of a federal survey of health conditions in the U.S. bituminous coal industry. At the time of the survey the coal industry was under government control on orders of President Harry S. Truman, who took the action in order to end a 59-day strike by the United Mine Workers of America. As part of the unique agreement between the government and the union, the survey was undertaken to document the working and living conditions then prevalent in the industry. Lee took more than 4,000 photographs in 12 states for this survey. Forty-six of these photographs were displayed at UK's Rasdall Gallery in 1978 in an exhibition titled "Coalfield Life," and are used here as a courtesy of UK Special Collections.



Ron Eller is director of UK's Appalachian Center and an associate professor of history.

the bitterness I heard from women when they talked about the same thing," Graves says. From working-class women Graves heard comments such as "I guess they [women from the management class] thought they were better than us—well, they weren't!"

Although their lives were separate above ground, "under the hill" black men and white men worked together. But black women and white women in the camps had almost no contact. Even when Van Lear had 900 white families and only five black families, there was no interaction, Graves says. From her interviews the only connection she found was the occasional mention of little white girls sitting outside the black church on Wednesday nights and Sunday mornings and listening to the singing.

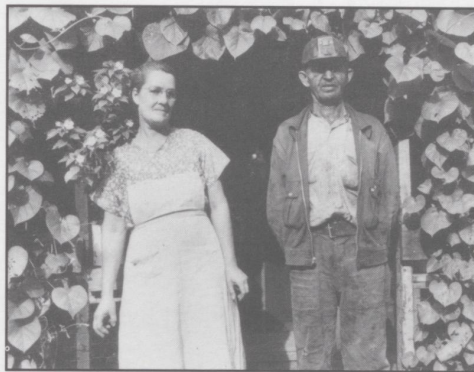
Graves describes the lives of black women in the coal camps as "very, very marginal." She plans to do more interviews focusing on black families in the camps.

Education and employment opportunities were different for the daughters of coal miners and for the daughters of management. Most people Graves interviewed had not gone to high school even though education was valued. Many boys quit school in eighth or ninth grade to work in the mines. Often, working-class girls dropped out of school to work for awhile, and then at 18 or 19 they married coal miners.

One management-class woman from McRoberts, whose 1940 graduating class comprised only nine students, said she thought people didn't go to high school because they didn't want to. She also described a high school social life that sounds much like today's—with class trips, rings and yearbooks. Graves says the working-class women she interviewed said they didn't go to high school because they did not have the money for nice clothes, the outings and the extras.

Working-class girls also dropped out of school to care for sick relatives. "Any calamity in the family fell right on the shoulders of the oldest daughter," Graves says. Daughters of the management class had fewer responsibilities at home.

For those children of miners who were able to go on to high school or for more education such as nurse's training, Graves found that the person who got an education was strongly



Mr. and Mrs. Tudor Circo on their front porch. Raven, Tazewell County, West Virginia.

obligated to send wages back to the camp so that a younger brother or sister could also be educated.

In addition to inequities in educational opportunities, there were differences in employment opportunities in the coal mines. The good jobs in the company store went to the daughters of management, not the daughters of miners. The first and second generations of women in the coalfields were in a particularly vulnerable financial position because there was almost no opportunity for women to earn wages. With the move from the farm to the coalfields, many women became dependent on men for income and were in constant danger of losing access to those wages.

The women in the first generation who moved into the coal camps were closely tied to the family back on the farm. They were "women-oriented," identifying much more closely with female relatives than male ones. In the camps they and their children tended to "stick close to home," Graves says.

"Women in the next generation had much less contact with the farm, the rural community. Kids tended to run wild; the camps were very unstructured," Graves says. She reports that women took turns watching each other's children. Instead of turning to a female relative on the farm or to the oldest daughter for support if they were upset, second-generation women turned to their husbands.

Life was harder for the second generation off the farm. They were less secure and more burdened with the problems that came from

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A working-class culture emerged in the coal camps—one that became more “immediately-oriented.” Rather than planning ahead and growing a garden, people became more dependent on the company store for food.

the congested living conditions and different lifestyle in the camps, Eller says. As a working-class culture emerged in the camps, people became more “immediately-oriented,” Graves says. For example, rather than planning ahead and growing a garden, people became more dependent on the company store, buying processed food rather than producing their own, Eller adds.

The definition of respectability shifted with each generation, Graves says. Women from the first generation described themselves as “backward” in what they knew about the “facts of life” when they married. For them, “backward” had a positive connotation, meaning chaste. As being educated and “up with the times” became more valued, the definition of respectability changed so that when women from the third generation talked about being “dumb” about the facts of life, the connotation is negative.

The routine of day-to-day life in the coal camps was linked to the mines. One of Graves’s sources recalled watching for the tram car to come out across the ridge before putting her bread in the oven to bake for supper. Because of the coal dust, women hung out their wash after the coal train ran in the morning and took their wash down before the train ran in the afternoon.

Graves describes domestic life as “orderly,” with women sending cake, not just cold biscuits, in their husband’s lunchpail and taking pride in how white their husband’s clothes were despite the coal dust.

Graves has found evidence that families were basically egalitarian in the coal camps. “I know some studies of coal camps say the men are in the mines and they don’t come up except for one day of sunshine on Sunday. But the men I studied seemed to be involved in family life,” Graves says. “I know of examples of men who fed the babies, of men getting up and fixing breakfast for the family.”

Despite this sense of equality, day-to-day life for families in the coal fields was “tenuous,” Graves says. “These families weren’t living in poverty, but if any major calamity befell the family, it would shatter them.”

“It was a very hard life,” she says.

With fewer responsibilities than on the farm, many of the women were bored, as

evidenced by comments such as “we lived for the movies.” One of the males interviewed, when asked if women in the camps were bored, told Graves: “Well, I reckon if they had time to be bored, they were bored.”

People who could look backward, who could mix the rural life and the coal camp life, seemed to be the happiest, Graves says. “If they could keep their hogs and a big garden, not just for the food but for the linkages of doing that, if they could visit people out of the coal camps, they did the best . . . There was never the security that allowed them to breathe easily.”

“A word that characterizes life in the coal fields, now as in the past, is ‘uncertainty,’” Eller says. “You are uncertain about the future, you are uncertain about whether your husband is going to make it up out of the mine, you’re uncertain about whether the company is going to operate in the future and whether you are going to have a house. You are uncertain about so much.”

Perhaps a symptom of the hard life and uncertainty in the camps was the large amount of drinking reported, but even the drinking was orderly rather than abusive, Graves says. Twenty of Graves’s 60 interviews include references to drinking “and 15 of these mentioned drinking more than a pint a day,” she says. Men left home to drink, gathering someplace in the camp. The drinking was usually jovial and relaxed, not loud and angry, Graves says. She does not find evidence of women drinking much until the late 1930’s.

Although life in the camps was hard, these people were not victims, Graves says.

Eller adds: “One of the images that exists is of coal communities, like ghettos, being oppressive places to live. Despite the limited conditions and restrictions, people made a meaningful life for themselves . . . They were not ground down by their conditions. That demonstrates an awful lot of cultural strength and adaptability. Those are important counters to what our dominant image is.”◆

RESEARCH BRIEFS



Lunch in the Mines

The diet of workers in agriculture and industry has recently drawn increasing attention. In the summer of 1987, two University of Kentucky researchers began a study of eating habits in a different workplace—the depths of a coal mine. This pilot study, sponsored by the Institute of Mining and Minerals Research's BRASH (Behavioral Research Aspects of Safety and Health) group, was

aimed at finding out whether or not the diet of the average coal miner included the recommended amounts of nutrients needed to provide energy and aid in tissue repair. The BRASH project was headed by Sara Quandt.

"The three main goals were to identify the nutritional constraints the underground work environment places on miners, to document actual

food-consumption patterns in the mine and in the home, and to analyze how work and home environments shape the eating habits of miners," says Quandt, an associate professor in the departments of anthropology and nutrition and food science. Special attention was paid to the intake of vitamins A and C, and nutrients which the body can convert into energy.

A total of 91 miners, 89 men and two women, took part in the study. They ranged in age from 20 to 59, with an average of 10 years' experience in the mines. Data were collected through surveys and by informal observation and interviewing.

Three mine sites in Eastern Kentucky were studied. All were of the type known as "low coal," with mine ceilings ranging from 22 to 44 inches. The lateral work space is less restricted—usually about 20 feet wide—but the low ceilings force miners to spend most of their shift in the prone position. This posture may affect the way bones in the miners' bodies harden.

Due to the hazards of coal mining, especially the damage that coal dust can do to the lungs, the intake of nutrients such as vitamins A and C is very important to miners. These vitamins aid in maintaining the tissues that line the bronchial tubes. "Masks are provided to protect miners from airborne coal dust," Quandt says, "but the miners don't wear them all the time because they're uncomfortable." In light of these factors, the need for sufficient amounts of vitamins A and C, as well as Vitamin D and calcium for bone mineralization, is clear.

The diets of the miners included traditional foods such as cornbread, ham, and beans—typical in the Appalachian region—as well as canned goods, snack items, and other processed foods. The study found that the more meals the miners ate at home, the more likely their diets complied with recommended levels of nutrition. The diet in the mine was found to be less likely to comply, as it generally consisted of processed foods with no milk and few fresh fruits or vegetables.

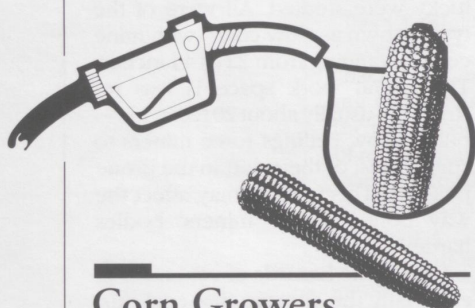
The difference in nutritional value
continued on page 32

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between the home diet and the diet in the mine can be explained, Quandt says, "by the convenience of using packaged foods as opposed to fresh foods in the packed lunches the miners must carry with them. For miners whose shifts require them to miss meals with their families—particularly the evening meal—the likelihood of consuming recommended levels of nutrition is especially low."

The results of this BRASH pilot study have prompted Hoffman LaRoche, Inc. to fund a more extensive study of the nutritional status of coal miners.

—Melinda Higgins



Corn Growers Stalking New Market Possibility

Research into new uses for corn could mean extra markets for perhaps hundreds of millions of bushels of corn, according to Morris Bitzer, extension grains specialist with the UK College of Agriculture.

The technology now exists to make plastic bags, using six to eight percent cornstarch, that will decompose in about 18 months. The technology also works for plastic jugs such as the kind used in marketing milk, Bitzer says. The jugs decompose in six to eight months.

The plastic bag and jug market represents a \$3 billion a year market, according to Jeff Gain, chief executive officer of the National Corn Growers Association. "If we just get 10 percent of that market for a bag or jug using six percent cornstarch, that's 100 million bushels per year," Gain says. "Think what it would be if we got half the

market!"

Since the new product is environmentally superior to the non-degradable kind and is cost-competitive, such projections are not unreasonable, he adds.

The bag business could be just the beginning for new markets in the plastics field. Gain says research in carbohydrate chemistry has shown that "you can produce anything from corn that you can from a barrel of oil."

Other research is directed at these possible new uses for corn:

- A de-icer. A cornstarch-based de-icer melts ice as quickly as salt but without the damage often caused by salt.

- A sweetener. A process of using a corn sugar, fructose, already accounts for more than half of the sweetener market.

- The coal industry. A new process for cleaning toxins from coal and from the air where coal is burned shows promise of economic feasibility.

- Gasoline. Ethanol, a corn alcohol used in producing fuel, is already the largest non-food or feed use for corn; continuing research could expand this market.

—Jerry Robbins

Crimes of the Heart: UK Researchers Follow New Clues to the Development of Alzheimer's

A recent study by UK researchers D. Larry Sparks, John Hunsaker, Stephen Scheff, and William Markesbery indicates that coronary artery disease may be related to the development of a key form of abnormality associated with Alzheimer's Disease (AD).

This abnormality is called a senile plaque. Senile plaques, which are thought to relate to brain-cell loss, are observed so frequently in the brains of the victims of AD that their pres-

ence at autopsy is often used to confirm the diagnosis of AD. The relationship between plaques and dementia is not perfect but it is strong—not everyone who has senile plaques develops dementia, but plaques are almost always observed in the brains of those with dementia.

The study compared the number of senile plaques in the brains of individuals with and without severe coronary artery disease to the number of plaques in the brains of confirmed Alzheimer's victims. As expected, all 17 of the AD victims had large numbers of plaques and only two of the 21 non-coronary artery disease subjects had plaques. Fifteen of the 21 subjects who had died of coronary artery disease, however, had plaques. If similar findings are confirmed by other studies, the results suggest that coronary artery disease may be linked to the development of senile plaques. This study opens up a promising new avenue of research into the causes of Alzheimer's Disease.

•••••

The Center on Aging was recently awarded over \$2 million in a grant from the National Institute on Aging. This grant will fund three research projects over the next five years. These projects are part of the Center's coordinated effort to determine mechanisms involved in the development of Alzheimer's Disease.

Symposium on Smoking and Atherosclerosis

The University of Kentucky's Tobacco and Health Institute will present an international symposium on tobacco smoking and atherosclerosis from December 11 to 13, 1989 at the Hyatt Regency Hotel in Lexington.

"This symposium will assemble authorities from around the world," says John Diana, director of the Tobacco and Health Research Institute at UK. "We plan to have 40 speakers

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at the three-day event, half of whom are from the international scientific community."

The primary purpose of the symposium is to focus on the role of cigarette smoking in the origination and development of atherosclerosis, the build-up of fatty deposits in larger arteries. Atherosclerosis is the principal underlying cause of cardiovascular and cerebrovascular disease in people of the western world. Cigarette smoking has been implicated as a promoter of the atherosclerotic process, but the mechanisms are unknown.

"This will be a great opportunity for researchers from all over the world to come together in this important area of study," Diana says.

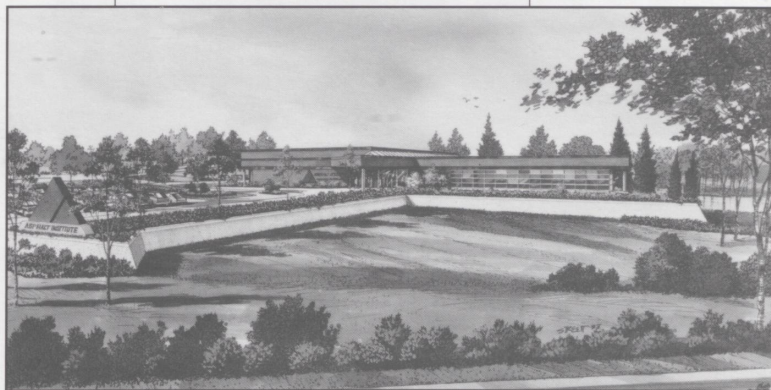
More information about the Symposium can be obtained by calling or writing:

Tobacco & Health Atherosclerosis
204 Frazee Hall
University of Kentucky
Lexington, KY 40506-0031
(606) 257-5151

Asphalt Institute Moving to Kentucky

The Asphalt Institute will soon be moving its international headquarters from College Park, Maryland to Kentucky. The new state-of-the-art facility, now under construction, will be located near the University of Kentucky's Spindletop Research Center on Iron Works Pike.

The Institute's research laboratories and national executive offices will incorporate 17,210 square feet of space. The construction of the new facilities began in the spring of 1989, with completion scheduled for late fall of this year.



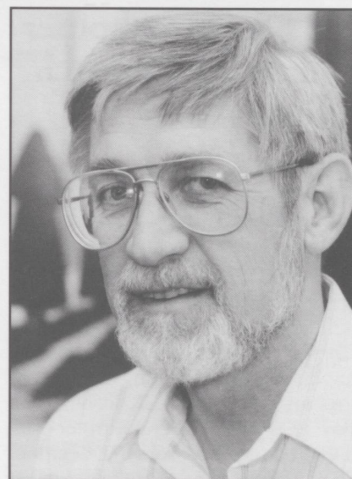
Spanish Professor Awarded National Humanities Center Fellowship

John J. Allen, chairman of the Department of Spanish and Italian at UK, has been selected as a Senior Research Fellow by the National Humanities Center. Allen, a member of the UK faculty since 1983, is one of only 37 researchers appointed for the 1989-90 academic year.

These fellowships provide for a year's residence at the National Humanities Center in Research Triangle Park, North Carolina. The Center is a private institute for advanced study in the liberal arts.

"I was very pleased to be selected," Allen says. "Especially since, to the best of my knowledge, this is the only fully Hispanic topic being funded." While at the Humanities Center, Allen plans to continue his study of Spanish *Corral* playhouses of the 16th and 17th centuries, research that will allow him to complete a book on these open-air theaters of Spain's "Golden Age."

Allen explains that the remains of one of these theaters was recently discovered in the Spanish city of Alcalá de Henares, which has invited him to come in October to join a panel of experts advising the city on how to



John J. Allen

proceed with restoration of the theater. He will be working with experts on the Globe from England and several Spanish architects and archaeologists. Allen points out that this project coincides with the reconstruction of the Globe Theatre in London.

"It's nice," he adds, "to have such 'real-world' impact."

When he returns to North Carolina in November, Allen may have a few more answers to the question of how Golden Age plays were performed. "The staging of Spanish drama is an interesting problem," he says, "because there's no tradition of how to act these plays. That continues to be an ongoing problem for Spanish acting companies."

RESEARCH BRIEFS

UK's Supercomputer Enhancing Research Efforts

The University of Kentucky is emerging as a nationally recognized center for computational sciences, according to UK President David Roselle. "Central to the institution's strategy," Roselle says, "is the establishment of strong computing resources that will position it among the top universities in computing nationally."

As an initial step, UK installed an IBM 3090-300E supercomputer with three vector processors in December 1987, and a few months later replaced its IBM 3081 mainframe with a more powerful IBM 3084-Q96 mainframe. To coordinate scientific and engineering efforts requiring supercomputer computations, UK established the Center for Computational Sciences.

Appropriate use of technology, according to Roselle, is emerging as the educational issue of the late 20th century. "Technology is affecting education and its costs more and more," says Roselle. "Faculty need to incorporate exciting developments, such as supercomputing, into the learning environment. We are just as happy to see students working at workstations as studying with books."

A strong advocate for free computer access, Roselle admits that not charging for central-processor cycles is a difficult burden for administrators. "But so is discouraging computer use," he adds. "I would worry much more if I had a big computer that was not being used."

(Sources for Research Briefs include *IMMR Highlights*, The University of Kentucky College of Agriculture *NEWS*, *Sounding Board* and IBM Academic Information Systems *Application Brief*.)

How Advanced Students Use the UK Supercomputer

The CCS and the IBM 3090 are providing graduate students and post-doctoral candidates with opportunities to conduct research in a wide range of applications.

Eric Durbin, a graduate student in computer science, is developing an expert system for an IBM PS/2 Model 80 designed to aid physicians in the selection of appropriate interventions for heart-attack patients.

Terry Turner, a post-doctoral researcher in psychology, is trying to characterize learning in neural networks. His simulations will lead to techniques for modeling cognitive processes and for understanding the development of emotions.

Karin Bennett, a doctoral candidate in mathematics, is improving software for solving two-point boundary value problems in ordinary differential equations which arise in fluid mechanics and other engineering calculations. She is also working on optimizing the programs to exploit the vector and parallel facilities of the IBM 3090.

Rick Saylor, a doctoral candidate in chemical engineering, conducted numerical simulations of the transport, chemistry, and removal of atmospheric pollutants. His ultimate goal is to develop a reliable numerical model that policy makers can use to simulate acid rain and test emissions reduction strategies.

Jack Rossen, a doctoral candidate in anthropology, is using the IBM 3090 supercomputer to catalog the exact locations of excavation finds from the Monte Verde archaeological site in Chile. The dig, part of which dates back 33,000 years, is considered the most complete Ice Age site ever excavated. Statistical manipulation of the data will define many activities which occurred there.



RESEARCH

Results

Collins Perfecting Soybean Cell-to-Plant Regeneration System

Glenn Collins, a cellular geneticist in the University of Kentucky's College of Agriculture, doesn't like to oversell the current state of genetic engineering.

"Everything we've done so far has been done with a club and a stick," Collins says. "We know a lot about genetics in a gross way, in an end-product way, but as far as understanding the pathways by which genes exert their effects, we are just about blatantly ignorant."

If what Collins has recently accomplished with his research into soybean regeneration in tissue culture is any measure, the scientific community could use a healthy dose of Collins' brand of ignorance.

In his 23 years at UK, Collins has shifted his focus from tobacco breeding to cellular genetics. He has been working on the somatic cell genetics of soybeans and other crops, including tobacco, clover and corn, since 1978.

In an article titled "Acres of Soybeans in a Test Tube" in the Spring 1985 issue of *ODYSSEY*, Collins talked about the importance of soybeans as an extremely important oil and protein source worldwide and as a major food crop for humans and animals:

"The soybean is a Cinderella crop because it is a relatively new crop which has such outstanding characteristics as high-protein content, good food and feed value, and it is just ready to be utilized. Interest has been strong, the markets strong, and it has replaced other crops in the production cycle, especially in the Midwest."

At this stage of his research, four



Glenn Collins

years ago, Collins and his colleagues were within months of perfecting the soybean cell-to-plant regeneration system so that the quality of the seed—and the oil and protein it contains—could be improved. How far has his research come since then?

"We now have in place a very efficient regeneration system so that we can introduce tissue from an immature seed of a soybean into a Petri dish or test tube and we can manipulate that tissue using hormones and chemical components. We can regenerate plants, we can root them, we can carry them back to the greenhouse. So what we have is a complete system for tissue culture of soybean, taking it from the normal plant or seed back to the plant in the greenhouse which can produce seed in the breeding cycle. We are to the point with the transformation system for soybean, using *Agrobacterium* (microscopic bacteria which live in the soil), where we are routinely introducing genes into soybean."

What Collins calls "routine" is a process by which soybeans, predicted to become an increasingly important food crop by many agricultural experts, can be genetically altered to grow into a more disease-resistant, higher-protein and perhaps even better-tasting end-product. In short, science should soon be able to improve upon nature.

This is the sort of research that can raise the ire of those who see genetic manipulation as a realm into which only God should venture. Rather than arguing that philosophical point, Collins pragmatically points out that "much of what we wind up doing in genetics is mimicking nature," discovering man-made methods of accomplishing what nature might manage over decades or centuries of evolution.

In the case of soybean, what Collins and his colleagues hope to accomplish includes developing a more virus-resistant plant, but that's only the beginning. "We're very interested in a gene called the desaturase gene," he says, "which could alter the lipid or fatty acid composition of soybean oil. The goal is to develop a soybean oil which is much more stable, which has a longer shelf-life, and is more nutritious."

The work of Collins and his colleagues has advanced to the point of introducing foreign genes into soybean which have expressed themselves in the resulting plant. "The first of these genes of economic importance is what we call the zein gene, an important protein component. This gene encodes for a protein which has a higher methionine content. The amino acid methionine is deficient in soybean, so this 'protein boost' is very important from a dietary standpoint."

Collins is exploring several methods of regeneration. One approach is

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to develop a system that would yield plants from a single-cell origin, so that genetic transformation would occur uniformly. A related method involves regeneration of soybean from protoplasts, cells produced by enzymatically removing the cell wall. The result is a spherical cell bounded by only a thin membrane which offers minimal resistance to the transferred genes.

One alternate approach is the use of microprojectiles. In this biolistic method, the transferred genes are "shot in" to the cell as if fired from the barrel of a gun. This approach offers a better chance of delivering genes to different plant species and different tissues in order to induce transformation with the specifically desired gene. Plans have already been made to acquire a microprojectile apparatus at UK, which would eliminate the downtime involved in sharing such devices at other institutions.

According to Collins, much of what we now know about genetic engineering is involved with beginning and end processes; we are still largely in the dark about the actual pathways by which biological processes are carried out. In an effort to begin to map these pathways, Collins has introduced into soybean a gene, B-glucuronidase, also referred to as GUS. "We can use it as a marker," he says, "to tell us into which cells and which tissues the genes of interest have been transferred."

As to the possibilities of genetic engineering, Collins says "there's no limit to putting a gene into another organism because there's no sexual barrier, there's no crossability barrier. Theoretically, we can put the right controlling elements with the gene from any organism and put it into a plant and it will function, it will express. We may have to do a lot of manipulation, of course, but theoretically it's possible."

Collins cautions though against the tendency to see genetic engineering as the real and present harbinger of a brave new transformed world of perfect plants. "The most significant impact of molecular biology," Collins says, "is not going to be transferring

individual genes to influence specific traits. It's going to be our ability to understand and dissect the biology and the biochemistry and the mechanisms of organisms' operation and control at the cellular and molecular level." Much of the excitement for Collins manifests itself not in the creation of some startling new mutant plant, but rather in the mapping out of how genes exert their control in nature and the understanding of the ways in which scientists can work with nature to continually improve upon what we have already been given.

"The most important next step for the plant scientist is to be able to control the expression of any gene, of genes that are already present in the plants, to be able to influence the time a gene is expressed," Collins says. "Rather than it being expressed at the seedling level, make it express during seed-development. If we have a gene already that offers moderate resistance to a disease, can we use recombinant DNA to cause that gene to be expressed at an earlier level to fend off that disease? Can we make the gene express itself at a much higher level so that it might offer full resis-

tance?"

This step-by-step process generates more than enough excitement to keep Collins enthusiastic about using cellular and molecular biology tools in modern plant genetic research. "Everybody gets hung up on transferring their favorite gene into their favorite organism," Collins says, admitting "that is an exciting potential because the world is opened up to any organism source for a gene transfer. But before you know what gene to transfer from another organism into a soybean plant, you have to know the biochemical pathway leading to a specific trait. And right now we're pretty much ignorant about the basic biochemistry and metabolic pathways of many important traits in plants."

Collins is optimistic when it comes to the future of his research. "We feel like the work in soybean is moving along extremely well. We feel we're still one of the leading laboratories in terms of soybean regeneration and transformation advances." ♦

—Gary Pierce



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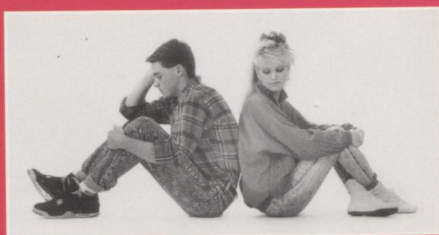
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