

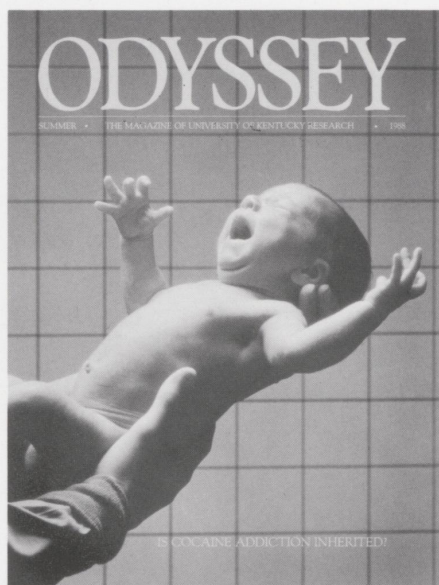
# ODYSSEY

SUMMER • THE MAGAZINE OF UNIVERSITY OF KENTUCKY RESEARCH • 1988



IS COCAINE ADDICTION INHERITED?





**T**he 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 to 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 Magazine, 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 Magazine 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

Volume VI, No. 2

## CONTENTS

University Archives  
Margaret I. King Library - North  
University of Kentucky  
Lexington, Kentucky 40506

|                                    |    |
|------------------------------------|----|
| Is Cocaine Addiction Inherited?    | 2  |
| The Feminization of Poverty        | 6  |
| Sensationalized Science            | 17 |
| When Subatomic Worlds Collide      | 21 |
| The Dissatisfaction Reaction       | 26 |
| On-Screen Hunt for a Silent Killer | 30 |
| Research Briefs                    | 35 |



Sensationalized Science, p. 17



The Dissatisfaction Reaction, p. 26



Research Briefs, p. 35

\* ODYSSEY is a magazine published by the University of Kentucky Research Foundation under the auspices of the Vice Chancellor for Research and the Dean of the Graduate School. Each issue of ODYSSEY describes only a few of the many University of Kentucky research projects underway in a variety of areas.

Requests for permission to reprint material and readers' comments regarding ODYSSEY are welcome and should be sent to the Editor, University of Kentucky Research Foundation, University of Kentucky, Lexington 40506-0057, Phone 606-257-8297.

The publication of ODYSSEY is not financed by state-appropriated funds.

**Editor:** Susan H. Donohew. **Asst. Editor:** Jeff Worley. **Designer:** Shear & Shear. **Publications Asst.:** Sharon J. Turner. **Contributing Writers:** Elizabeth Hansen, John Fritz, Laith Alkhoa. **Typesetting:** Maury Boyd & Associates.

**Credits:** photos on pp. 3 and 17 by Lee P. Thomas; photos on pp. 5, 11, 22, 25, 30, 31, and 32 by Ken Goad; photos on pp. 7, 18, 20, 24, 29, and 34 by Bill Wells; photo on p. 38 by John Ragland; photo on p. 35 by Linda Butler; cover photo by Comstock; back cover photo courtesy of Quantam Medical Systems Inc./The Waggener Group.

printed June, 1988



# IS COCAINE ADDICTION INHERITED?

by John Fritz

In the center of the steel arena, the white mouse pauses. He seems alert and calm, in no hurry. It seems clear, even to the mouse, that in this small, circular, screened-in place there is nowhere to go. Boredom is king in this tiny kingdom.

In an identical chamber directly above this one, another mouse seems to be clawing his way across the stable surface of the arena. Then suddenly runs two quick laps, pink feet out of sync with the determined body. Then he stops, skidding sideways, as if on ice. The mouse isn't on ice; he is on cocaine.

At the University of Kentucky, Dr. John M. Carney, associate professor of pharmacology, and Dr. Thomas W. Seale, associate professor of pediatrics at the University of Oklahoma, are experimenting with mice in order to determine the behavioral effects of cocaine. The researchers, who have been awarded a \$360,000 grant by the National Institute on Drug Abuse, are attempting to discover, by analyzing the behavior of laboratory mice, whether or not a person's potential to abuse a particular drug is genetically determined.

"It's well known that people respond differently to caffeine, a behavioral stimulant found in coffee and other beverages," Carney explains. "And we have found that the ability to respond to caffeine-like chemicals called methylxantines is genetically determined in mice."

In order to isolate the "genetic determinates" of sensitivity to cocaine, the researchers are developing what are called "congeneic" strains of mice, mice which have been bred to possess selected genes. Carney explains that congeneic strains

are obtained by continual in-breeding of the mice until the offspring differ from the parents by only one gene.

"In our thinking about this research, we wanted to use a system capable of producing statistically significant, reliable, and 'robust' results—mice that either like cocaine or mice that don't like it, but not animals in between those two extremes," Carney says. "Mice seemed to be just the right species—they are well mapped genetically and have a short life-span."

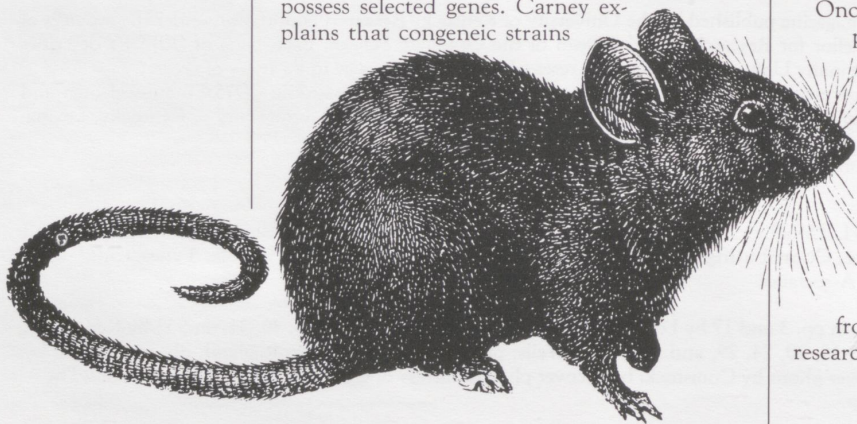
In their research, Carney and Seale are comparing the locomotor activity of drug-free mice to that of mice who have been given cocaine. Also, the researchers will compare the behaviors of drug-free mice taught to operate a device, such as pushing a button for a reward, to the behavior of cocaine-injected mice operating the same device.

Teaching mice to operate a button for a reward is fairly simple. To start the training, the researchers code the type of mouse into the computer located on top of a structure resembling an ordinary chest-of-drawers. The chest is divided into three rows of six smaller areas, each containing what the researchers call a thirst chamber.

The thirst chamber is a one-square-foot plexiglas cubicle with a food trough and a tiny water faucet. As the mouse is placed gently into the cubicle, the chest door is closed to shut out any exterior light. The mouse sees only a small red light above the tiny water faucet which, along with the food trough, is wired to the nearby computer.

Once the mouse is in the room, the computer drops a food pellet into the trough, once every minute. Instinctively she eats the food until she becomes so thirsty that she searches for the water and learns where it is. Every time she puts her mouth on the water faucet, the computer records the drink taken; when cocaine is put in the drinking water, the number of drinks the mouse takes increases.

If, in their analyses of mice that differ from one another by only one gene, the researchers find that the animal's desire for





drugs is genetically determined—if such an “evil gene” does exist—can we predict which people are at risk of chronic cocaine addiction?

According to Dr. Charles A. Dackis, a cocaine-addiction treatment expert at Fair Oaks Hospital in Summit, New Jersey, the predisposition to feel euphoric after taking cocaine seems to be innately etched into everyone’s brain. Cocaine causes a transient increase in concentrations of two neurotransmitters and a decrease in serotonin concentrations. These three neurotransmitter systems are like different phone companies: they all

make connections between the brain’s neurons, but each system provides a characteristic service all its own.

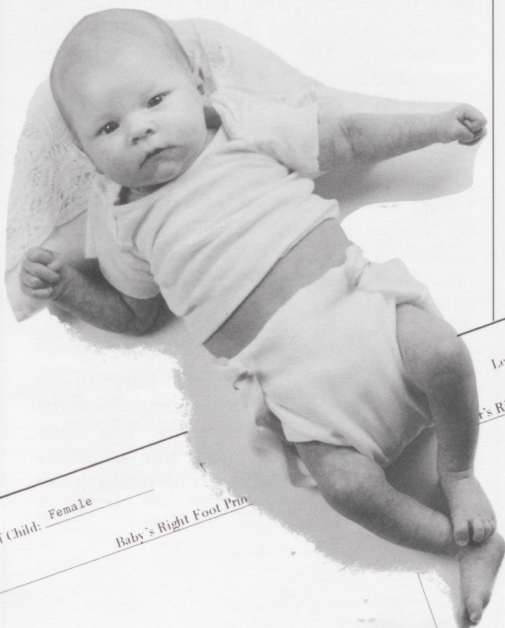
“The key to understanding cocaine addiction is best explained by how cocaine affects DA neurons—the likely heritable component of cocaine craving,” Carney explains.

Cocaine stimulates the brain’s “euphoria center” by causing an initial increase in DA concentrations. The euphoria is very short-lived, perhaps only 30 to 40 minutes, but extremely intense. Soon, the drug user has learned this response: put cocaine in, feel on top of the world. In an effort to continue stimulating the dopamine-fueled euphoria center, a cocaine user may become a chronic addict, Carney adds.

The typical addict’s frequent use of cocaine causes—in contrast to the initial increase in DA concentration—net decreases in all three neurotransmitters. These decreases result in cocaine’s unpleasurable effects: agitation, anorexia, anxiety, depression, hostility, hyperactivity, infertility, insomnia, irritability and psychoses. Within perhaps only two weeks,

continued on page 4

**T**he possible genetic link to the known neurochemical effects of cocaine is the DA receptor.



Sex of Child: Female

Length: 21"

Baby's Right Thumb Print

Baby's Right Foot Print

**ADDICTED TO COCAINE**

This certifies that Tracy Kawanna Loess  
Imogene Katherine Wymer  
 was born to Imogene Katherine Wymer  
 in University Hospital, University of Kentucky, Lexington, Kentucky  
 at 12:03 o'clock, P M. on Wednesday  
 the 30th day of March 19 88

*Emmett Lincoln Beattie*  
 Signature of Attending Physician



**W**ithin about two weeks the brain's DA supply is empty. The addict's euphoria ceases despite desperate efforts to prime the DA-fueled euphoria center by taking more and more cocaine.

the brain's DA supply is empty. The addict's euphoria ceases despite desperate efforts to prime the DA-fueled euphoria center by taking more and more cocaine.

The possible genetic link to the known neurochemical effects of cocaine is the DA receptor, a protein which the body makes according to instructions located on a gene. Carney hopes his experiments in mice will indicate whether this theoretical genetic link influences whether one becomes addicted to cocaine and related stimulants.

"This is important because behavior has a relation to brain function. Hypothermia, increased heart rate and hypertension are controlled unconsciously by the autonomic nervous system, which is controlled by the central nervous system. If we cannot demonstrate a robust behavioral effect in some mice, we want to know whether they are also missing the peripheral nervous system response-capacity to cocaine as well as the CNS response-capacity to cocaine," explains Carney.

The researchers are also studying the subjective, or discriminative, effects of various stimulants. If another drug is substituted for cocaine, does the animal respond to it as though it is cocaine? To find out whether a mouse can discriminate between a substitute drug and cocaine, the scientists are using a technique called place preference assay (PPA). According to Seale, "PPA has never before been used in genetic exploration. In PPA, a mouse learns to associate a particular environment with her response to a specific drug."

The PPA studies take place in a six-inch by fourteen-inch plywood box that looks something like a crude doll house without a roof. Inside the box are two small rooms (one jet black, the other white) joined by a narrow gray hall. The rooms are constructed differently: the ebony room has a wire screen floor with small woodchip bedding; the white room has only large cedar woodchip bedding.

In this experiment, the mouse is injected with cocaine and placed in the white room. The tiny hallway door is shut so that during

this phase of training the mouse is conditioned to associate cocaine's euphoric feelings with the white room. "After the mice come to associate feelings of euphoria with the white room, they spend more time there even when they are drug free. The positive reinforcing environment of a drug will cause the mice to seek out that environment," explains Seale. "By their behavior, the mice are telling us whether they like the drug."

Carney and Seale will also determine if the biochemical responses of these mice to cocaine are predictive of their behavioral responses to cocaine. To do this, the scientists will measure body temperature, heart rate and blood pressure of drug-free and drug-injected mice who are known to differ genetically in the way they respond to cocaine.

"The basic tenet we're pursuing is the concept that drugs of abuse produce their rewarding or reinforcing effects by interacting with particular unique components of the nervous system called receptors; and these receptors are unique for each of the drugs that are abused. In this sense we will test to see if heroin abuse is mediated by a receptor system which is different from alcoholism which is different from cocaine reinforcement," says Carney.

The heritability of an animal's sensitivity to other stimulant drugs is being compared to the heritability of cocaine-sensitivity. The scientists have already determined that sensitivity to cocaine is a trait distinct from sensitivity to

“After the mice come to associate feelings of euphoria with the white room, they spend more time there even when they are drug free.”



amphetamine (also an abused stimulant drug). Their initial evaluation of certain strains of mice suggests that there may be a simple dominant inheritance of the animal's sensitivity to the stimulants tested. "We are identifying and will ultimately isolate the genes that are associated with cocaine, amphetamine and related behavioral stimulants. This will take perhaps three years because the isolation of genes requires selective breeding of mice that are genetically complex. We're trying to develop mice strains that either like or do not like each particular drug being tested. Such mice would be a very specialized tool to help understand why some animals like a certain drug and others don't. We could also learn what parts of the brain are important for the basic neurobiology of reward systems," says Carney.

One of Carney's dreams is that he will be able to extend this research to humans, "to build a bridge between the animal laboratory and the human condition," says Carney. By isolating abuse liability in animals, the scientists can then use this information to understand how and why certain individuals may be at higher risk to abuse certain drugs as compared to others.

Some possible practical applications of the research into the behavioral genetics of cocaine and related compounds include targeting "high-risk" individuals for education about drug abuse, increasing our overall understanding of drug addiction, developing a test for risk of one's potential to abuse drugs, and developing specific treatments for drug abuse. ■

“Heroin abuse is mediated by a receptor system which is different from alcoholism which is different from cocaine reinforcement.”



John M. Carney, Pharmacology



# THE FEMINIZATION OF POVERTY IN KENTUCKY

by Jeff Worley

Her high school diploma hangs in its frame from the living room wall of her apartment. She is attractive and friendly, early-twenties. She works 40 hours a week as a bank teller and is, according to her boss, "extremely competent." She is divorced with two children and is paying for child care so that she can work full-time. She is living in poverty.

The fact that nearly one in five Kentucky women live in poverty, many because they are underpaid or lack adequate child support, is one of the findings published in *Women and Pov-*

*erty in Kentucky*, a 96-page report resulting from a study by Ms. Carol Straus and Ms. Lucinda Zoe, research associates in the University of Kentucky Center for Business and Economic Research. "For years a lot of people have suspected that economic hardship is a day-to-day reality for many Kentucky women," says Zoe. "Through our research and analysis, our worst fears have been confirmed.

"When we first started talking to the Kentucky Commission on Women, the agency that funded this project, one of the first things that came up was this term 'feminization of





“ Sometimes when I’d come across some particularly outrageous . . . case study, I would jump up from my desk and go running through the Center saying, ‘Will you look at this!’ ”

poverty,’ which,” Zoe says, “refers to the concentration of poverty in America among women and their dependent children. It’s a term that’s been tossed around for the past ten years. And occasionally someone will come on TV and say the feminization of poverty is a myth, it’s not true anymore—that incomes have gone up and women are making out just fine. But we suspected this wasn’t true.”

“The problem was, you don’t really know until you make a systematic attempt to find out,” Straus says. So our mission was to discover to what degree this is a problem for women in Kentucky. This attempt to systematically analyze and summarize the economic problems of women for a particular state is unusual, Straus adds, since most analyses of women’s economic circumstances have been national in scope.



Lucinda Zoe, Business and Economic Research



Initially, the Commission wanted the researchers to do a comprehensive study covering child-support enforcement, alimony, teenage pregnancy, the economical impact of divorce, child care, access to insurance, retirement pensions, and wanted complete statistics on the situation of poverty in Kentucky. Realizing that “you can take any one of those subjects and explode it into a full study,” as Zoe puts it, the researchers decided to cover each of these issues in terms of a massive literature review.

Zoe, who has a master’s degree in library science, spent eight months systematically gathering information about these issues from major studies and reports done by the U.S. Bureau of the Census, the Department of Commerce and other economic institutes around the country. Although she admits that

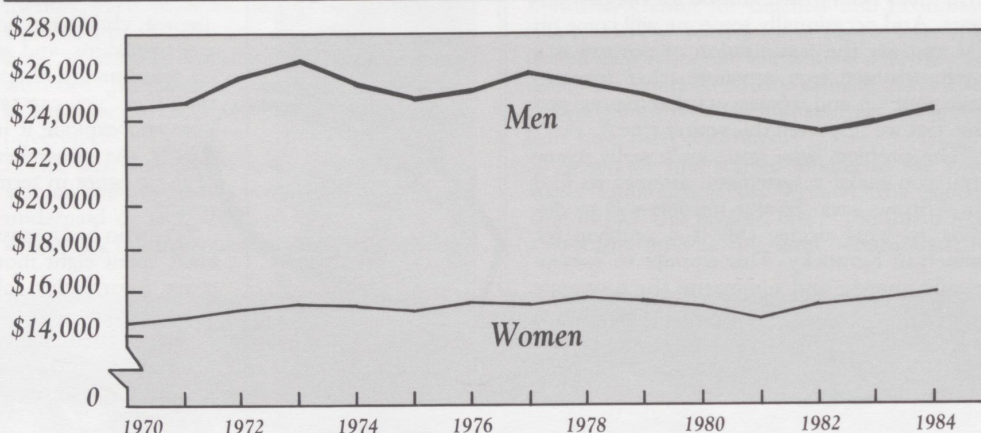
*continued on page 8*



Carol Straus, Business and Economic Research



Figure 1 **Median Income of Year-Round Full-Time Workers, by Sex**  
(1984 constant dollars)



Source: Department of Commerce, Bureau of the Census, Current Population Report, Money Income of Households, Families, and Persons in the United States, U.S. Government Printing Office, Washington, D.C.

it was an "exhausting process," she felt that a general overall awareness of the issues was important in developing a more specific understanding of how these issues affected women in Kentucky. Although the process itself fell into a routine, some of the discoveries Zoe made were anything but dull. "Sometimes when I'd come across some particularly outrageous set of circumstances or case study, I would jump up from my desk and go running through the Center saying, 'Will you look at this!' Some of the findings are terribly depressing and made me angry, but that just made me want to work harder."

In the report the 37 statistical tables were generated by Straus, who has a B.A. in Mathematics and is nearing completion of her Ph.D. in Sociology. "I've been interested for some time in what is called 'Social Demography,' looking at the size and composition of a population, how it is changing and how it will probably change in the future. I have a long-standing interest in women's issues and have worked extensively with census data, particularly micro data, which we needed for this kind of analysis," Straus says.

In analyzing the major factors contributing to disproportionately high poverty rates for women, the researchers placed restricted job opportunities at the top of the list. Straus and Zoe found that high rates of poverty are, to a large extent, a reflection of women's disadvantaged position in the labor market, where they tend to remain in low-wage occupations. The family-wage system in the United States con-

**Poverty rates for women vary greatly throughout Kentucky. They are lowest for Jefferson, Fayette, and Kenton counties. They are highest in the Kentucky River and Cumberland Valley areas of eastern Kentucky.**

tinues to rest on the assumption that women come into the labor force as secondary workers, working for money not essential to the family's support. This assumption reinforces the segregation of women into low-paid, low-skilled clerical and service jobs.

"Women are consistently relegated to certain kinds of jobs that don't lead anywhere,



that don't have medical or retirement benefits," Zoe says. A related problem, according to Straus, is that in American society there seem to be "appropriate" and "inappropriate" jobs for women. "Among staff of almost every institution," she says, "you see both men and women doing cleaning chores, but you don't see many women painters or skilled maintenance people. And women are much more likely to be programmers and men systems analysts."

Historically, Zoe says, the work that men do has been valued more highly than the work women do. She cites an example from the Kentucky Boone County School District, where the female-dominated job of substitute teacher is compensated at the rate of \$47 a day compared to the male-dominated job of substitute janitor which pays \$54 a day. "That's one of those findings that literally made me jump out of my chair," Zoe says.

A second factor that contributes to the feminization of poverty in Kentucky is lack of pay equity. Despite the Equal Pay Act of 1963, Zoe says, women still earn only about 68 cents for every dollar earned by men in the same job. For women in the 25-34 age group with postgraduate college degrees, the earnings ratio is higher: 78.2 cents for every dollar earned by men. These women with five or more years of

*The poverty rate for black women in Kentucky is 35.9%, and for families headed by black women with at least one year of college, the rate is over 33%.*

college who have narrowed the earnings gap still earn considerably less (based on 1980 data) in every profession surveyed than men with comparable educations. For example, female secondary teachers in Kentucky earned \$16,419 compared to \$20,446 for men. There are similar differences for elementary teachers and social workers, and much greater differ-

“Why should the new English professor (more likely a woman) be paid \$22,000, while the new Engineering professor (more likely a man) is paid \$32,000?”

ences in such traditionally lucrative occupations as medicine, law, and accounting. Straus and Zoe found that a male manager or administrator, with a mean annual earnings of \$38,915, made almost twice as much as a woman with a comparable education.

Pay equity is inextricably linked with the notion of "comparable worth." This concept, Straus explains, is rooted in the idea that the pay scale should be based on what kind of training and skills and dedication to the job are required, rather than on traditional pay scales which tend to underpay women or underpay people in traditionally female jobs. "Why should a child care worker (who is more likely to be female) be paid less than a cab driver (who is more likely to be male)?" she asks.

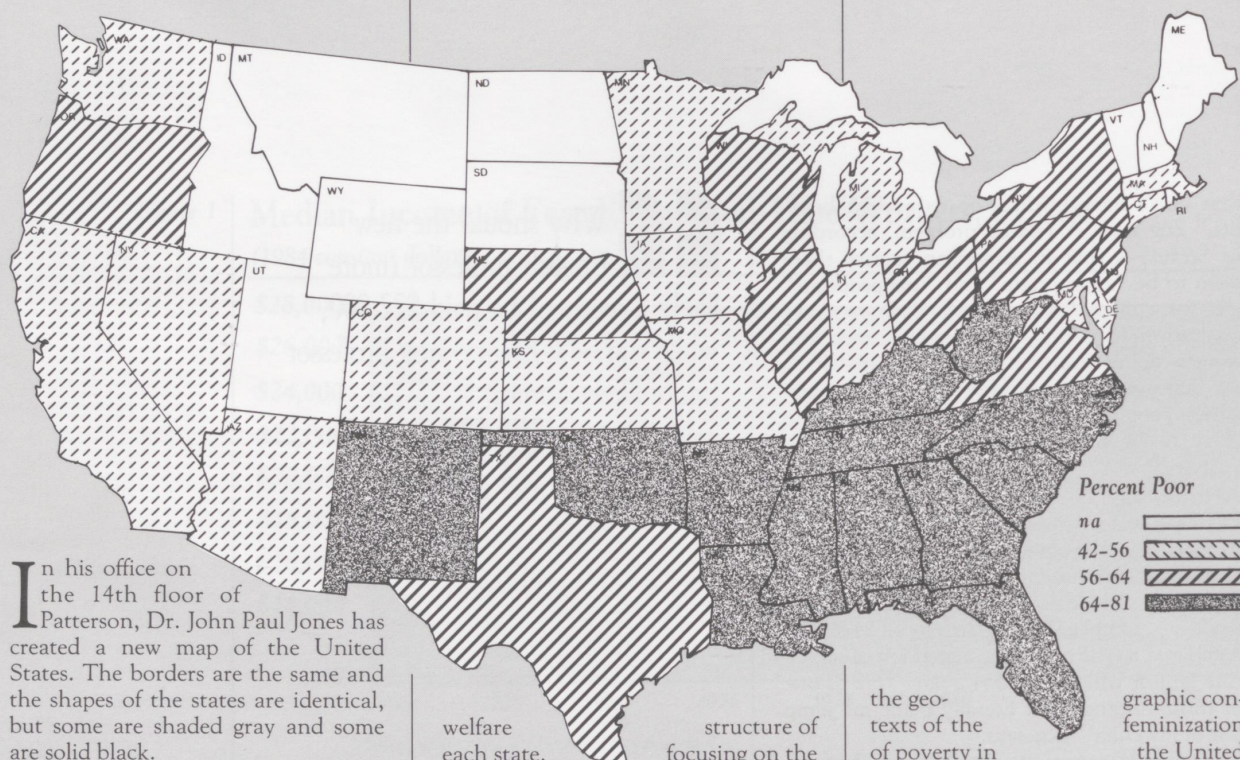
University hiring practices provide her with another example. "Let's say we have two newly hired assistant professors at X University. Both graduated with doctorates from the same college, well-known for turning out top-

*continued on page 12*

Despite the Equal Pay Act of 1963, women still earn only about 68 cents for every dollar earned by men in the same job.



## Poverty Among Women: Mapping the Welfare "Disincentive"



Percent Poor

|       |  |
|-------|--|
| na    |  |
| 42-56 |  |
| 56-64 |  |
| 64-81 |  |

In his office on the 14th floor of Patterson, Dr. John Paul Jones has created a new map of the United States. The borders are the same and the shapes of the states are identical, but some are shaded gray and some are solid black.

Jones points to one of these states: "Mississippi," he says, "80."

This "80" refers to the percentage, the highest for any state in the U.S., of poor black women raising families with no husband present. Jones, an assistant professor of geography at the University of Kentucky, recently published an article in *Economic Geography* which focuses on the spatial pattern of black female poverty in the United States. The central question he addressed was whether or not state-to-state variations in welfare benefits and/or labor force characteristics contribute to an explanation of female poverty.

"I was intrigued by the 'work versus welfare' argument concerning poverty rates," Jones says. "Conservative theorists for years have said that women are withholding a portion of their work effort to obtain public assistance funds from the state—that welfare payments cause a 'work disincentive' and therefore lead to higher levels of poverty. I wanted to find out if this was true."

In his study Jones examined the

welfare each state, focusing on the maximum monthly amount allotted a woman supporting a family by herself. Jones evaluated this information in the context of state labor market characteristics—the types and availability of jobs for black women and the state's average wages, for example—to determine whether or not the work disincentive effect of welfare was operating.

"In only five states (California, Wisconsin, New York, Massachusetts, and Connecticut) were welfare payments generous enough to create a disincentive for poor black women to join the labor force," Jones says. "In all other states, payments can be increased without welfare competing with jobs." He adds that in many Southern states an increase of as much as \$350 a month could be given to a family without this additional income causing a work disincentive. Jones emphasizes the point that in none of the states do welfare payments enable a family to rise above the poverty level.

This study provided the basis for Jones's current research project on

the geo- texts of the of poverty in States. In this project, funded by the National Science Foundation, Jones is working with Co-PI Dr. Janet Kodras of Florida State University.

"We used census materials for 1970 and 1980," Jones says, "and plan four scales of analysis—the 50 states, and metropolitan, suburban, and rural counties." From the census tapes, the researchers collected detailed occupational characteristics for the different regions and for families headed by white and by black women.

"Just as the work disincentive argument had some validity for five states, we want to see what arguments relating to work and the poverty of women hold up in different geographical areas. Geographers should have a heightened awareness of the impact of locality, how local context can create a pattern," Jones says.

One argument focuses on labor market restraints that women, in general, face. Women tend to be occupationally segregated (98 percent of all secretaries are women, for ex-



ample), are more likely than men to work for minimum wage, tend to get paid less than men for the same work, and are more likely to be involved in temporary and part-time employment. Jones and Kodras are interested in how these conditions are expressed geographically.

A second alternative argument involves what Jones calls the "family formation thesis," the changing characteristics of family structure that lead to poverty for many women. The tremendous increase in the divorce rate in the U.S. in the 1970s, the large increase in out-of-wedlock fertility, and the smaller pool of eligible black males capable of supporting a family are cited as three explanations for the growing feminization of poverty.

"These dynamics have created the potential for the feminization of poverty, but don't necessarily explain it," Jones says. "They only explain the pool of potential women who may live in poverty. The feminization of poverty has to be explained in terms of work-income opportunities for women."

In trying to determine the complex set of reasons for growth in the number of women in a particular setting who live below the poverty line, the researchers are looking at these competing explanations to determine which are the most plausible for each region. One finding is that labor force characteristics explain a high percentage of variation in female poverty growth in urban settings. Jones reports that in urban settings there tends to be a considerable growth in service and clerical jobs open to women. These jobs, though, are often part-time and pay relatively low wages, so women working in them remain below the poverty level.

Jones says that he and Kodras are finding a significant difference in the black female population. Although black women in service jobs tend to remain poor, as do white women, black women in clerical jobs more frequently rise out of poverty. "The implication," Jones says, "is that clerical occupations are a kind of ladder up for black women but not for white

women within the same urban context." He says that his "best guess" at an explanation is the effectiveness of affirmative action programs in affecting public sector hiring practices. "In the government hiring process, affirmative action is not just a catchword; it's an actual fact of employment. These jobs—in education or with local, state, or the federal government—tend to be more stable, less subject to cyclical employment, and offer higher wages," Jones explains.

One other preliminary finding involves the growth of low-wage factory labor in rural areas; where this growth has occurred, there are large numbers of women living in poverty. "That's consistent with the structure of the rural labor market," Jones says, "since in many states, North Carolina, for example, the starting wage is

still \$3.35 an hour." This situation, he adds, can create the feminization of poverty. The choice for women in this setting is not between finding high-paying jobs or receiving generous welfare payments. "It's a double-bind," he says; "a woman making a decision in today's 'Burger King' economy isn't deciding between being poor or not being poor. She's deciding between working and being poor or not working and being poor."

In looking at geographical context, Jones adds, researchers challenge those who debate the causes of poverty feminization as if the arguments hold true in all situations and places. "By examining variables in different situational contexts," Jones says, "we'll be able to demonstrate which arguments are valid in some places and which are more valid in others."

“A woman making a decision in today’s ‘Burger King’ economy isn’t deciding between being poor or not being poor. She’s deciding between working and being poor or not working and being poor.”



John Paul Jones, Geography

Figure on facing page: Percent below poverty level among black, female-headed families with own children less than 18 years old, 1979.



*The poverty rate for females in Kentucky is 18.9%, compared to 13.8% for the United States.*

notch students. At X University both must teach classes, meet with students, take part in committee meetings, and do research. Both will work the same amount of hours each week. Why should the new English professor (more likely a woman) be paid \$22,000, while the new Engineering professor (more likely a man) is paid \$32,000?"

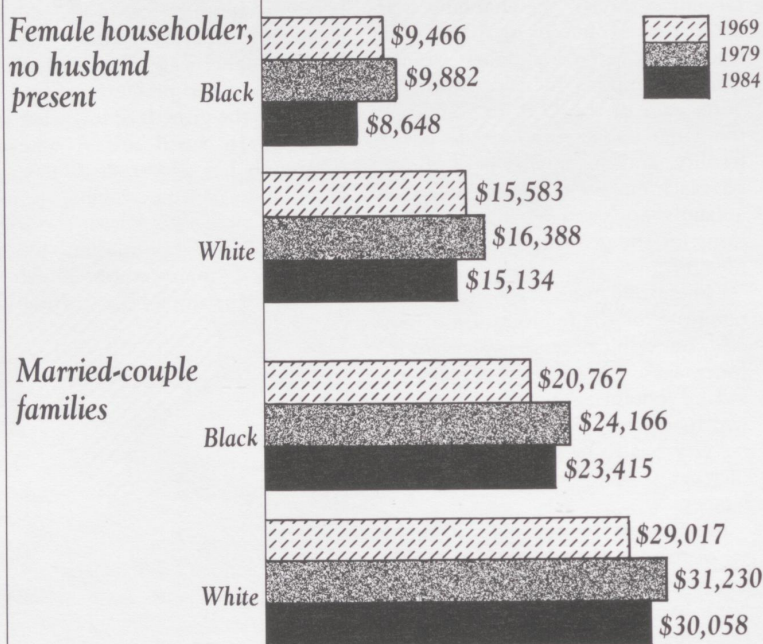
A third reason why many Kentucky women are having financial difficulties is that child-support payments are either set too low or the enforcement system is not stringent enough. Together, child-support and alimony payments do not approach the economic support of husband/fathers of married-couple families, and account for only about 10 percent of the total income of the white single mother and 3.5 percent of the income of the black single-mother families. And over half of the millions of mothers who are entitled to child support do not receive anything at all from the absent spouse.

*It has been estimated that the basic services of the homemaker would run about \$46,000 a year in the open market, yet these services have not been recognized or valued in the divorce courts.*

"Children cost money," Straus says, "lots of money. But judges are sometimes reluctant to set a child-support award higher than they think the father can comfortably deal with, feeling perhaps that it's better to have it lower than have the father give up entirely supporting his children." She adds that many women who attempt to have the courts enforce child-support payments have an especially difficult time because they have to hire an attorney—and they are unlikely to be able to afford to do so—in order to locate the father.

The problem is complicated by the fact that sometimes a marriage breaks up because the husband cannot support the family in the first place. A man who has lost a job or has an inadequate income to support a family before a divorce is not likely to suddenly have a large enough income to support them after leaving. Also, whenever there is a divorce, it takes

Figure 2 Median Family Income  
(1984 constant dollars)



Source: Department of Commerce, Bureau of the Census, Current Population Report, Money Income of Households, Families, and Persons in the United States, U.S. Government Printing Office, Washington, D.C.

“More and more people are starting to get this, that these aren't just women's issues— they are children's issues, family issues.”



**“**Women are consistently relegated to certain kinds of jobs that don't lead anywhere, that don't have medical or retirement benefits.**”**

more money to maintain two households than the previous one.

“More and more people are starting to get this,” Zoe says, “that these aren't just women's issues—they are children's issues, family issues. A big reason why there are so many women living in poverty is that there are so many men out of work and living in poverty too.” She mentions that this is, in part, a result of our changing economy—Kentucky shifting from an industrial base to more of a service economy. “Twenty years ago a man could work at a factory and earn a living wage—that's becoming less and less possible in Kentucky.”

Because of a lack of funds from the state to support existing programs, Zoe sees even tougher times ahead for thousands of Kentucky women. “We have a displaced homemaker's law here in Kentucky that allows the state to set up programs to serve displaced homemakers, to help them re-enter the work force, but we have no state funds. We have good programs—40 or 50 of them around the state—all basically funded from the Job Training Partnership Act and the Carl Perkins Act, but no state funds allocated. And, in my opinion, it's just basic to economic development to educate your work force, keep people off of welfare, allow people to get the tools to be able to earn a living wage,” Zoe states.

In addition to funding for existing programs, what else can be done to lessen the poverty of

*At 24%, the poverty rate for families headed by white females who have completed four years of high school is nearly four times the rate of 6.2% for families headed by similarly educated males.*

women in Kentucky? “Whether we're talking about a woman, a man, or a child who will one day be an adult,” Straus says, “the key is the same—education. People with little education—men or women—will have lower earnings, with very few exceptions. There are a few self-made millionaires, but they are very much the exception.”

Straus feels that the most effective way to enhance economic development in Kentucky is through adequate funding of all levels of education in the state. “Experiences of other

states clearly indicate that economic growth is a result of capable people who can think and act logically,” she says.

Zoe hopes that a war on poverty feminization will be fought on other fronts as well, stating that she would like to see Kentucky's comparable worth statute enforced. She explains that the statute prohibits discrimination in wages for work done by women and that Kentucky is considered an “early adopter” of the statute because it was passed in 1966. However, there has yet to be any leg-

*Understaffed child support enforcement departments have workloads in excess of 1000 cases per worker in many regional offices in Kentucky.*

*continued on page 14*





isolation introduced or funds appropriated to implement actual comparable worth in the state. "Perhaps it will take a lawsuit before women in Kentucky receive equal pay for equal work—it could come to that," Zoe says.

"I'd like to see Kentucky have some child-support enforcement with some teeth in it," says Straus. "I think children deserve the support of their parents and thousands of Kentucky children aren't getting it." Straus emphasizes the point that she is referring to the system of collection and not the efforts of people who are working in child-support

enforcement. "Staff workers are absolutely swamped," she says. "In many regional offices around Kentucky, one staff worker is assigned to over 1,000 cases."

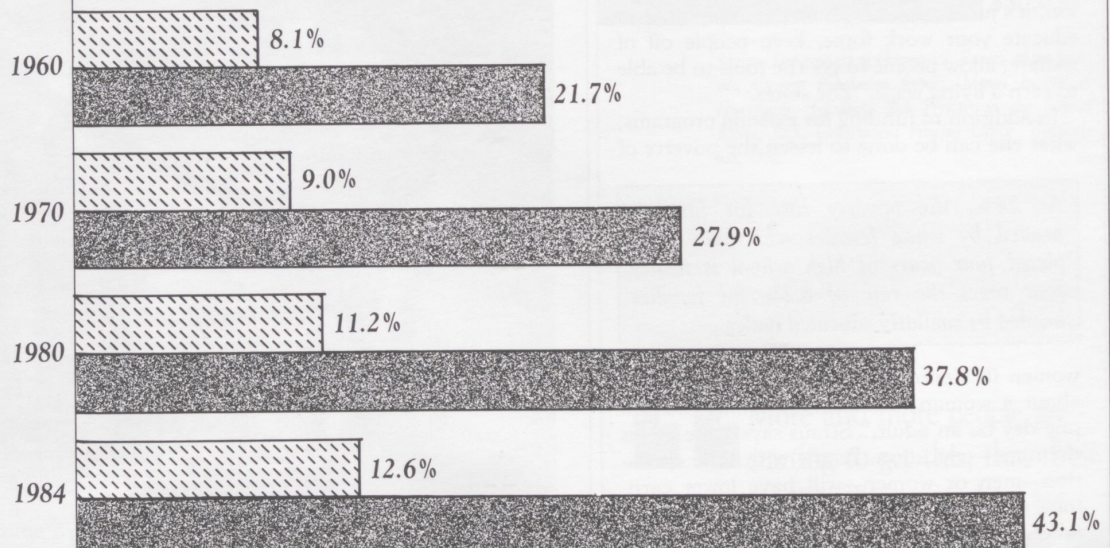
**The child support enforcement caseload in Kentucky increased by 62% from 1981-1985.**

In their report the researchers state that the way the state court system operates is a crucial element in the enforcement process. In Kentucky, \$2.68 is collected per \$1 spent on child-

Figure 3

### Percentage of Families Maintained By Women, With No Husband Present

White  
Black



Source: Department of Commerce, Bureau of the Census, 1960, 1970 and 1980 Censuses of Population, General Population Characteristics, U.S. Summary, U.S. Government Printing Office. Also, Current Population Reports, Household and Family Characteristics: March 1984.



“Perhaps it will take a lawsuit before women in Kentucky receive equal pay for equal work—it could come to that.”

support enforcement. In Michigan, \$7.62 is collected for every \$1 spent, and all payments are made through an organization called the Friend of the Court. Michigan also uses new automated computer systems that facilitate the tracking and collection process.

*At \$207 per month for a mother and two children, Kentucky's welfare benefits under Aid to Families with Dependent Children (AFDC) are about one fourth the poverty level for a family of three.*

“Kentucky could have a similar system, but it would require commitment,” Straus says. “It would require judges who take child support more seriously. It would take law enforcement energy and administrative work. I’d like to see the state have a system in which it’s just very routine for child support to be paid, efforts made to ensure that it’s being paid, and enforcement when it’s not.”

At least two other important changes would greatly help women in the work force, according to Zoe—more convenient and less expensive child care facilities, and maternity leave. “The cost of child care is staggering,” Zoe says. “A woman supporting two children in a typically female job as a secretary may make only \$10,000 or \$12,000 a year even with several years’ experience. If she has to pay \$300 or \$400 a month for child care in order to keep the job, what is left can’t possibly cover basic needs.”

A solution, she says, is for businesses to become more concerned with the problem and to make a child-care facility part of the plan of operation. “The Toyota plant is a good example,” Zoe states. “With this brand new building about to be built, you could work the idea of a child-care facility into the negotiating process: ‘We’re going to give you this many acres and this tax break and you’re going to put a child-care facility in your building.’ This was a complete oversight, and it’s because

people just aren’t thinking about child-care problems.”

Maternity leave is also a problem for working women in Kentucky. One hundred seventeen countries guarantee a woman maternity leave for childbirth, job protection during her leave, and the provision of cash benefits. The United States is the only industrialized country with no statutory maternity leave. “In some places in the U.S. if a woman leaves to have a baby, she isn’t even guaranteed her job when she comes back, or she loses seniority during her period of leave if she is allowed back,” Zoe says.

She contrasts this work policy with that of Italy, where a woman is entitled to five months of paid maternity leave at 80 percent of her wage in addition to six months at 30 percent of her wage; and her job is held in both cases. “It’s extremely important,” Zoe says, “to have family support structures in place so that parents can maintain participation in the labor force while having a family.”

In documenting these various obstacles that single working women must try to overcome, Straus says that the question, to her, shifted from why so many women are poor to why more women are not poor. “The answer has to be because women work so hard,” she says. “Thousands of women in Kentucky have several jobs at low wages, they constantly have to scramble to find child care, and they do work that is physically painful. They do what they have to do to get by.”

“In doing this research, I was surprised by the number of poor women who work. Some of them work full-time, year-round; more of them work part-time or part of the year, probably because full-time, year-round jobs aren’t available to them. The jobs most readily avail-

*Kentucky's poor include over 66,000 more females than males.*

*continued on page 16*

Over half of the millions of mothers who are entitled to child support do not receive anything at all from the absent spouse.



able are in services—working in restaurants or hotels, for example. These jobs typically have erratic hours and aren't full-time jobs with benefits," Straus explains.

She says the finding that seems to surprise people the most is the number of poor women who are married. For married white women, the poverty rate is 11.3 percent; for married black women the rate is 14.8 percent. "People tend to think of poverty among women as a divorced mother problem or an elderly widow problem," Straus says. "The unfortunate truth is, there's a high proportion of poverty in Kentucky among married couples and their families."

Straus says that, for her, the most surprising finding was that in Kentucky divorces occur at a greater frequency when all the children in the family are females than when some of the children are male. "The fact that there are significantly more poor girl children than poor boy children absolutely amazed me," she says. Straus admits that it is difficult to tell what reasons stand behind the numbers, but that there is probably a range of causes. "I suspect it ranges from an unconscious evaluation of male children as more important than female children, to the blatant, 'You are a useless woman—you've provided me with no sons' attitude," she says. "Whatever the reasons, it signifies that economic differences start very early."

What has the public reaction been to this study? "The commission was very pleased with it," Zoe says. "We got tremendous coverage in local newspapers and phone calls from newspapers all over the state." One reason for such

*The 1980 Census showed that about one in eight Americans was poor but that about one in six Kentuckians was poor.*

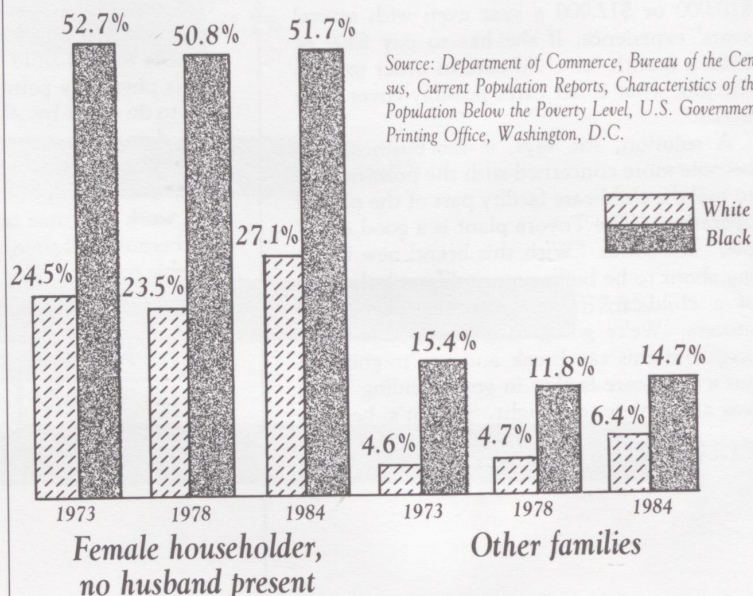
active response, she says, is that no one had ever seen a thorough statewide study of the poverty of feminization. For the first time, the problem could be clearly assessed.

"One of the great things about working in an office like this is the opportunity to directly affect public policy," Zoe says. "And if you have a background as I do—wanting to make a statement, wanting to make the world a better place—it's a very positive way of doing that." Every Kentucky legislator was sent a copy of the report, "the hope being," Zoe says, "that new legislation will result in programs targeted for women living in poverty."

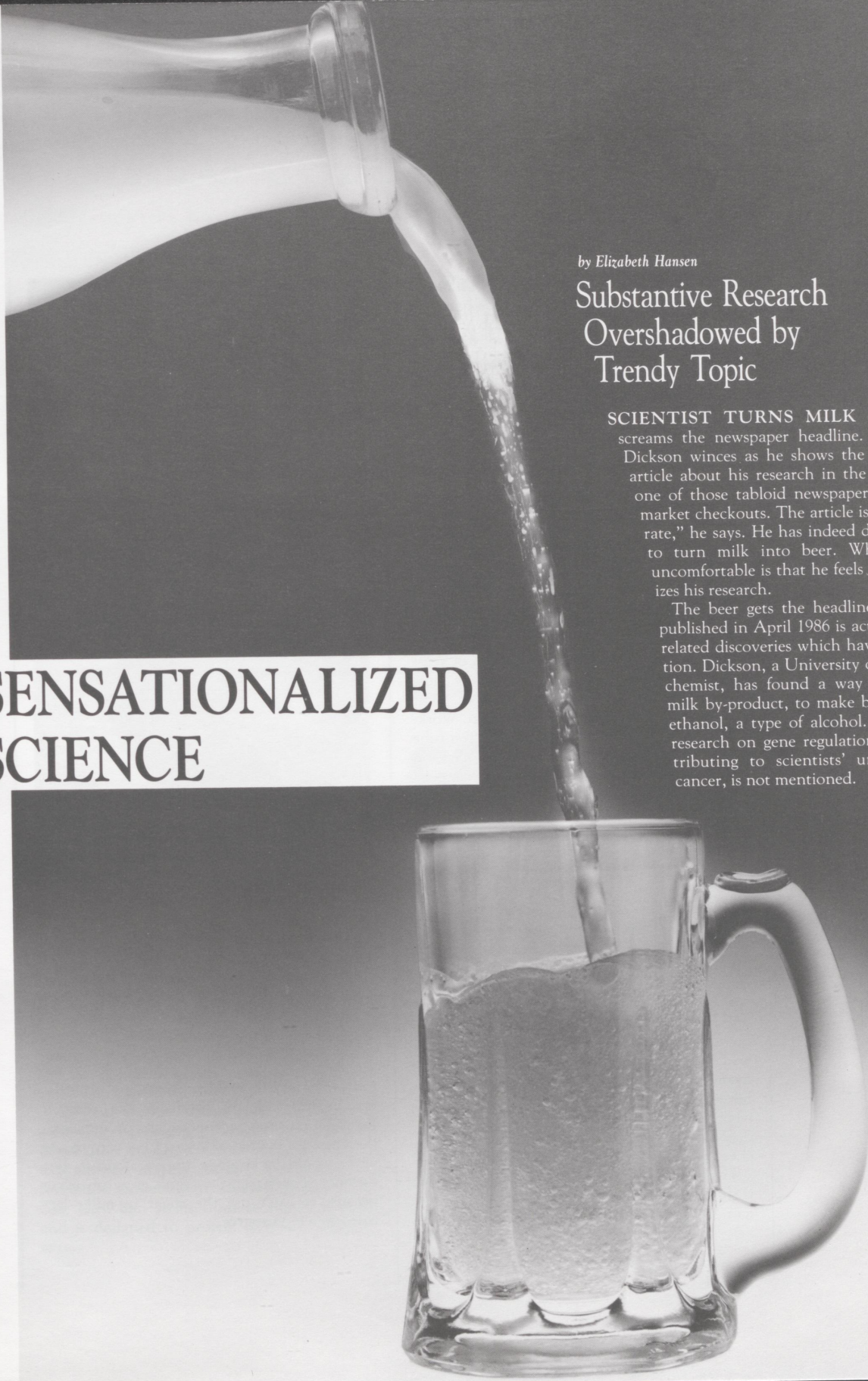
"The report is not good news—there's no good news in it," Straus says. "But now people grappling with the economic problems of women know how serious the problems are. We hope, in that way, that the report is useful and re-affirming—that we have provided some direction for people who are putting forth their best efforts to solve this human problem." ■

Figure 4

### Poverty Rates of Families, by Race and Type of Family







## SENSATIONALIZED SCIENCE

by Elizabeth Hansen

### Substantive Research Overshadowed by Trendy Topic

SCIENTIST TURNS MILK INTO BEER screams the newspaper headline. Dr. Robert C. Dickson winces as he shows the interviewer the article about his research in the *National Examiner*, one of those tabloid newspapers sold at supermarket checkouts. The article is "basically accurate," he says. He has indeed discovered a way to turn milk into beer. What makes him uncomfortable is that he feels the story trivializes his research.

The beer gets the headline, but the story published in April 1986 is actually about two related discoveries which have wider application. Dickson, a University of Kentucky biochemist, has found a way to use whey, a milk by-product, to make baker's yeast and ethanol, a type of alcohol. His 13 years of research on gene regulation, which is contributing to scientists' understanding of cancer, is not mentioned.

continued on page 18



It's the beer the interviewer wants to talk about.

Commercial production of beer from fermented whey is "not feasible," Dickson says bluntly. Even if it were, "I wouldn't stand to have my name associated with it. I want to be considered a serious scientist."

Dickson speculates that beer made from whey would taste very different from current beers. "People ferment everything in the world. Unless it has some really good, unique flavor, it's not going to sell," he says.

No companies have expressed an interest in making beer from whey, but several national and international companies—Dickson "would rather not say" which ones—are interested in making baker's yeast and ethanol from whey.

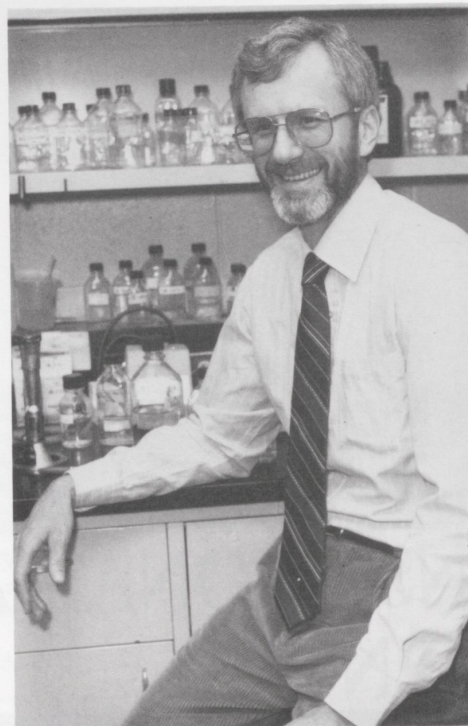
It's the process of scientific discovery Dickson wants to talk about.

For years Dickson has used a strain of yeast called *Kluyveromyces lactis* to study how genes function within cells. He uses yeast because any of its genes can be isolated. Working with a tiny amount of matter in a test tube no larger in diameter than a pencil, Dickson and his colleagues modify information a gene carries and then return the mutant gene to the organism—in this case, the yeast. The scientists then observe how the organism behaves.

"From that, we can learn something about how the gene normally functions—what it does for the cell," says Dickson, an associate professor in the College of Medicine.

When he began using yeast for his gene regulation research, he "wasn't even aware that disposal of whey was a big problem." But as he attended professional meetings and talked with colleagues and representatives from the dairy industry, he learned that there is no economical way to dispose of whey—the thin, watery part of milk left over after cheese is made. "You can't pour it down the drain," Dickson says, because 100 kilograms of liquid whey is a pollutant equal to the sewage produced by 45 people. Making a kilogram of cheese produces nine kilograms of whey.

The yeast Dickson uses in his basic research is similar to *Saccharomyces cerevisiae*, a common yeast used in the baking and brewing



*Robert C. Dickson, Biochemistry, was recently named a University Research Professor for 1988-89 by the UK Board of Trustees. The professorship is one of four given each year to recognize outstanding research achievements.*

industries and in making ethanol. Currently, the baking industry produces the yeast it needs by growing *Saccharomyces* on molasses, the cheapest source of sugar. One way to use whey would be to grow the yeast on it, but normally *Saccharomyces* can't grow on whey because it can't use the sugar in milk—lactose—as a food source.



Dickson began thinking about genetically engineering a type of *Saccharomyces* that could use lactose. In 1984 and 1985, he and a post-doctoral fellow, Dr. K. Sreekrishna, took two genes from *Kluyveromyces* and put them into *Saccharomyces*. One of those genes allows the lactose to be drawn from inside cells so that it can be used. The other produces a protein that breaks lactose into glucose and galactose. The yeast can then use these as a food source.

That's as far as Dickson has carried the process. He has published his findings and in 1985 the university applied for a patent for the yeast strain he developed. (UK should learn within six months if the patent has been granted.) Dickson has never actually produced beer or ethanol from the process, "but I know it could be done," he says.

Up to this point, Dickson has been using laboratory yeast for his experiments. The next step will be to put the genes into several commercial strains of yeast to see which works best in a large-scale operation. He will do some experiments along those lines in the next few months.

"In developing a commercial strain, its flavor and the amount of ethanol produced are important considerations," Dickson says. Anticipating the interviewer's next question, he adds, "It might be possible to develop a commercial strain that could be used to produce beer, but I'm certainly not interested in doing it."

Instead, the experiments will focus on baker's yeast and ethanol production. A post-doctoral fellow from Brazil who is working with Dickson is interested in ethanol as a fuel. Ethanol can be added to gasoline to make it less costly, and in a country such as Brazil where almost all gasoline has to be imported, the development of an economical additive could be significant.

Another use for ethanol is as an additive in alcoholic beverages produced in countries other than the United States. The practice is not allowed in this country, but ethanol is present in many imported beverages sold here. The U.S. ban stems from economic reasons and is designed to protect distillers, Dickson says.

Should someone else perfect the process and market beer made from fermented whey, would he drink it?

"I don't know," he says, stroking his graying beard. "It would depend on how it tastes."

Dickson's discovery that could help solve the dairy industry's whey-disposal problem was a logical offshoot of research he was doing. The same is true of another discovery he made that also may benefit the dairy industry.

The 44-year-old scientist explains:

A large percentage of the world's adults cannot drink milk or eat dairy products without developing indigestion, diarrhea and other types of gastric distress. The reason is lactose intolerance—the intestinal lining no longer produces the enzyme that converts lactose into glucose and galactose which the body can then use. "As people grow older, their bodies make less and less beta-galactosidase (the enzyme). The gene that codes that enzyme stops functioning. We don't know why."

“The problem with cancer is that the cells keep growing; they don't stop.”

One way to get around lactose intolerance is to treat milk with the enzyme beta-galactosidase, but that can be costly for milk producers. Dickson is working on developing a cheaper source of the enzyme by using genetic engineering to create strains of the *Kluyveromyces lactis* yeast that make increased amounts of the enzyme. The enzyme then could be purified and added to milk.

"Of course, the other way to treat lactose intolerance is to figure out how to turn the gene back on in the human intestine so that it once again produces the enzyme," Dickson says. That is a much more complex problem and one that he is not studying at this time, even though it is related to his basic gene regulation research.

It's Dickson's basic research that may well

*continued on page 20*



Michael Witte and Yuan-Di Chang, both doctoral students at UK, are working with Dickson in his research on gene regulation. Witte, a native of Richmond, Indiana, received his undergraduate degree from Purdue University. Chang is from Taipei, Taiwan and received her bachelor of science degree from National Taiwan University.



be the most significant. "What I do is considered important to cancer research," he says in his quiet, soft-spoken way. To emphasize the point he tells the interviewer that he will move his lab from the Department of Biochemistry to the new Dorothy Enslow Combs Cancer Research Building this spring. During the past ten years his gene regulation research has been funded by grants totaling \$750,000 from the National Institutes of Health.

Perhaps it is because of the implications of his basic research that Dickson is distressed by what the media choose to emphasize.

He talks about what he undoubtedly would stress.

Regulatory proteins turn on or off the activity of genes. In order to do that, the proteins have to be able to recognize and then bind to a specific piece of DNA—the genetic material. "A lot of our effort is in determining how a particular protein recognizes a certain piece of DNA," Dickson says.

Although Dickson and his two graduate students, Michael Witte and Yuan-Di Chang, are using the genes in yeast, the same process occurs in other organisms. For example, once an egg is fertilized by sperm and begins to develop, "at many key steps protein-binding or non-binding to DNA is critical in the developmental process," Dickson says. "If it [a protein] fails to bind, the organism usually dies, or if it doesn't die it is an abnormal

organism."

Gene regulation is important in cell growth, he says. "The problem with cancer is that the cells keep growing; they don't stop."

Dickson finds his research on how proteins bind to DNA exciting. He first experienced the excitement of scientific research in an introductory biology class at University of Redlands in Redlands, California. There, he was allowed to do independent research and "I decided I wanted to do this for the rest of my life," he says. He received his Ph.D. in molecular biology from the University of California at Los Angeles in 1970 and held three post-doctoral appointments at California schools before coming to Kentucky in 1975. His work has received a faculty research award from the American Cancer Society.

"I get really excited by the process of trying to discover new things and doing experiments," Dickson says.

What has been his most exciting discovery?

He is silent, thinking.

The interviewer is certain turning milk into beer will not be high on his list.

"That's really a hard question to answer. I don't have a specific answer." He chuckles. "I hope the most exciting is yet to come."

What would he like to discover?

"I've stopped having goals like that. I try to make significant contributions to the field I'm working in." ■



# WHEN SUBATOMIC WORLDS COLLIDE

## UK Physicists Explore Structure of Most Basic Particles

by Jeff Worley

**W**hen asked what he does in the laboratory, the physicist tells the story about an old eccentric watchmaker:

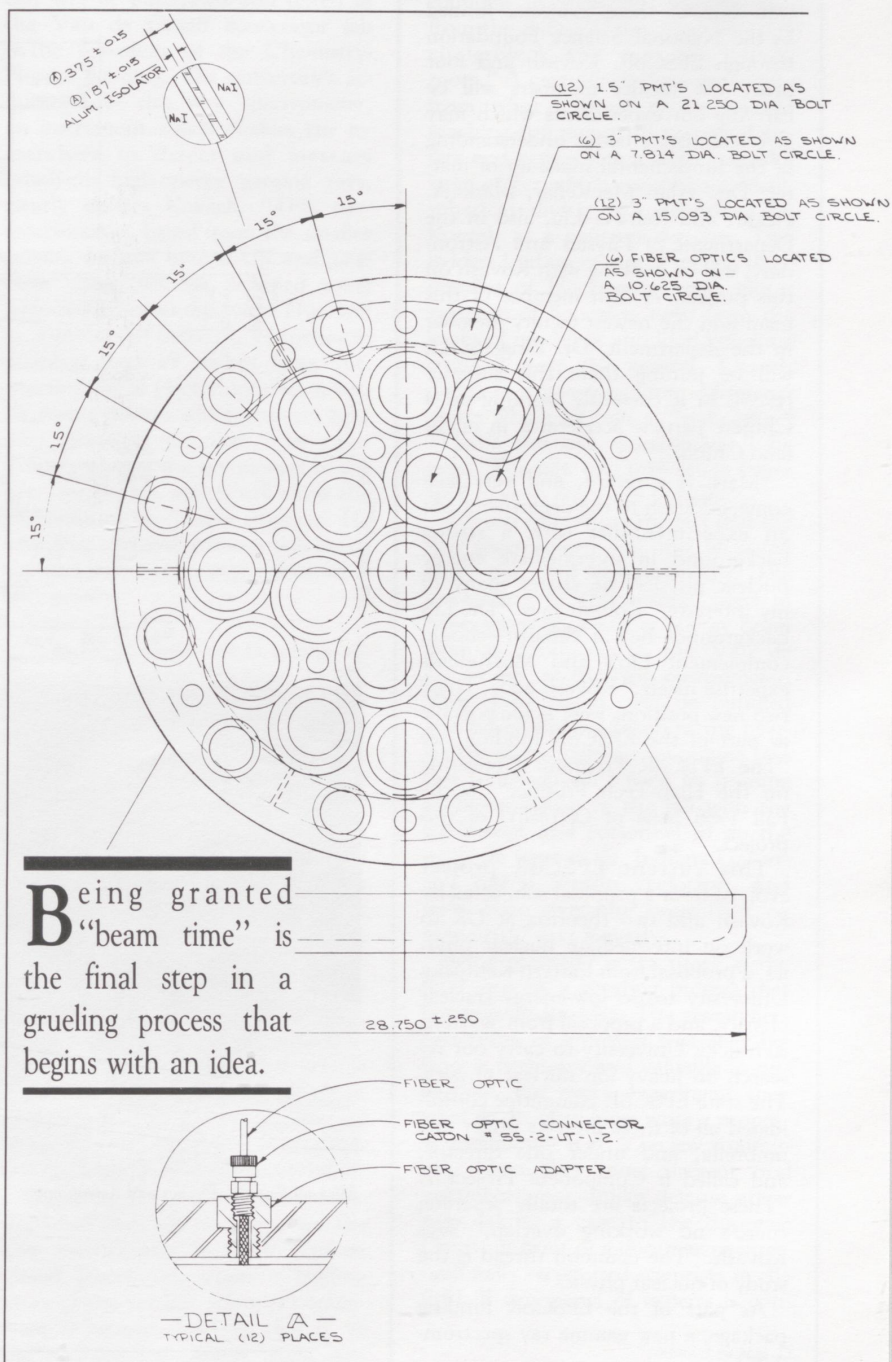
Near the front of the 20-story building, the old man gathers his new students around him and shows them the wonderfully crafted Swiss watch. He tells them to wait at the bottom of the building while he climbs to the top floor. Once there, he extends his arm from a window and drops the watch; it shatters on the concrete below. "Now if you want to find out how that watch was made," he tells the perplexed novices when he re-joins them, "pick up all the pieces and begin."

This isn't a story about craftsmanship, but it does illustrate the challenge—and plain hard work—involved in attempting to understand basic components and their interactions.

Now instead of the pull of gravity twenty floors below the watchmaker, think of a beam of protons zinging through a vacuum in a metal pipe, for the Swiss watch substitute a thin piece of carbon called the "target." And instead of the watchmaker's students' search-and-find mission, imagine the much neater system of a magnetic tape collecting exploded electrical impulses, or gamma rays. This rough analogy, the nuclear physicist says, will give us some sense of what he does in the laboratory.

If you were to pass by the University of Kentucky Van de Graaff laboratory in the basement of the Chemistry-Physics building, you might see Dr. Michael Kovash huddled around a computer with several other researchers, "reading out" one of these magnetic tapes. Kovash, an associate professor of physics and astronomy, is currently involved in several funded projects which involve close collaboration between theorists and experimentalists.

continued on page 22



**B**eing granted "beam time" is the final step in a grueling process that begins with an idea.

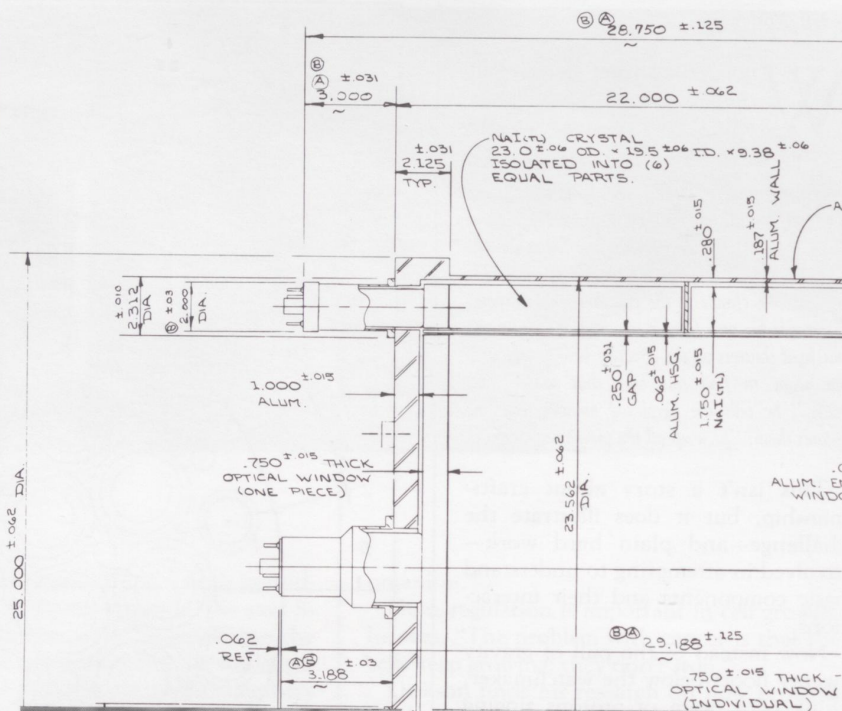


In one of these projects, funded by the National Science Foundation through EPSCoR, Kovash and four other UK faculty members will be carrying out experiments which may give scientists a better understanding of the fundamental make-up of matter. Drs. Alan MacKellar, Mark A. Pickar, and Keh-Fei Liu, also in the Department of Physics and Astronomy, will be working with Kovash on this project. A fifth member of this team and the newest faculty member in the department, Dr. Bing-An Li, will be joining them this summer [1988]; Li is currently working on a Chinese particle accelerator in mainland China.

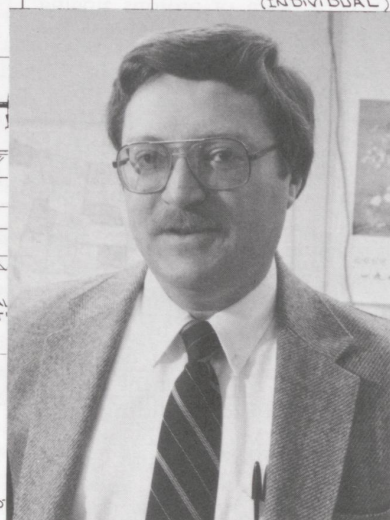
"Mark is a recent, and very welcome, addition to the department. As an experimentalist with a strong background in intermediate energy nuclear physics, he shares many of my interests," Kovash says. "Dr. Li's background—he's a theorist—should complement Liu's and MacKellar's expertise nicely," Kovash adds. These two new positions were made possible as part of the EPSCoR funding [see "The EPSCoR Program: Pioneering on the High-Tech Frontier" in the Fall 1986 issue of *ODYSSEY*] of this project.

This current EPSCoR project evolved from a proposal submitted by Kovash and two theorists at UK to work on intermediate nuclear physics, a proposal from Eastern Kentucky University to do low-energy nuclear physics, and a proposal from Western Kentucky University to carry out research on heavy ion nuclear physics. The state EPSCoR committee consolidated all of these projects under one umbrella, and under one director, and called it Component Project 7. "These projects are totally separate; there's no working overlap," says Kovash. "The common thread is the study of nuclear physics."

As part of the EPSCoR funding package, a new gamma ray spectrom-



Michael Kovash, Physics and Astronomy

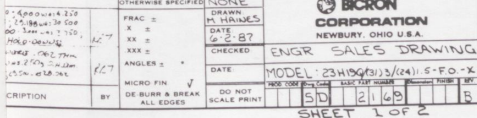


Mark A. Pickar, Physics and Astronomy

|     |       |       |
|-----|-------|-------|
| UD  | 11/11 | 2.188 |
| A   | 12/15 | 2.188 |
| REV | DATE  |       |



"



Grown?

The researchers look forward to the day when they will be able to test the new spectrometer in UK's Van de Graaff laboratory, where a baffling array of the nuclear scientist's equipment is housed—baffling, that is, to the non-scientist. Metal pipes, sur-

Being granted "beam time" is the final step in a grueling process that begins with an idea. The researchers first think of a project that they believe is necessary and valuable to undertake. For every experiment they want to do, they must write a proposal and submit it to a review committee. Then they must present oral arguments, not unlike defense attorneys taking a case to the Supreme Court, in front of a dozen or so internationally recognized scientists in the field. If this panel of experts is con-

23 ODYSSEY



## Catching a Few Rays: Graduate Student James Trice

There are two things you notice right away about Jim Trice. The first is his thick, shaggy, reddish-brown beard. The second is his tendency to choose his words very carefully, a precision that is perhaps characteristic of someone who has spent years measuring and studying subatomic interactions.

He was tugging slightly on his beard now, searching the ceiling for just the right words to explain how he became interested in nuclear physics.

"I sort of grew up around it," Trice says. "My mother's a mathematician and my dad was an experimental physicist for General Electric. They didn't pressure me to go into physics; it just happened that way." Trice, though not pushed in this direction, now finds himself almost literally following in his father's footsteps: His father, whose name is also Jim, earned his M.S. in Physics in the 1940s at the University of Kentucky.

Jim Trice, at 33, is nearing completion of his research, which will provide the data for his dissertation. He began his Ph.D. work four and a half years ago and hopes to be finished in the summer of 1989.

Trice's current research project focuses on the astrophysical process by which heavier elements are built up. One step in that process involves the combining of a helium nucleus with a carbon nucleus to form oxygen 16, an important step, Trice says, in the overall astrophysical process. In his research at UK, he is using the Van de Graaff accelerator, which energizes a focused helium beam that bombards a small carbon target. When the helium hits the carbon nucleus, the result is sometimes the absorption of the helium and the formation of oxygen 16. This interaction causes the emission of a gamma ray; the gamma rays detected (he calls these "real events") form a pattern which Trice then analyzes.

As part of his training as a physicist, Trice also takes part in experiments conducted at higher energy research labs, such as the Indiana University Cyclotron Facility. "I have worked closely there with Dr. Kovash," Trice says, "who sets

up the electronics and has everything planned out beforehand." Trice explains that typically the team of UK researchers works with collaborators from other universities who have similar research interests in order to share the expense of using the facilities. "We work in eight-to-twelve-hour shifts, taking data and making sure we are getting the right energies," Trice says. He mentions that although there is "a lot of sitting around," the work is far from boring. "You have to keep looking at the data, analyzing as much of it as you can to make sure things are working."

After his shift, Trice goes back to a motel where the researchers stay, he "eats and sleeps a bit," then returns for the next shift. "It does get to be pretty exhausting," he says. "It's a lot of hard work, but I enjoy it—I wouldn't do it if I didn't enjoy it."

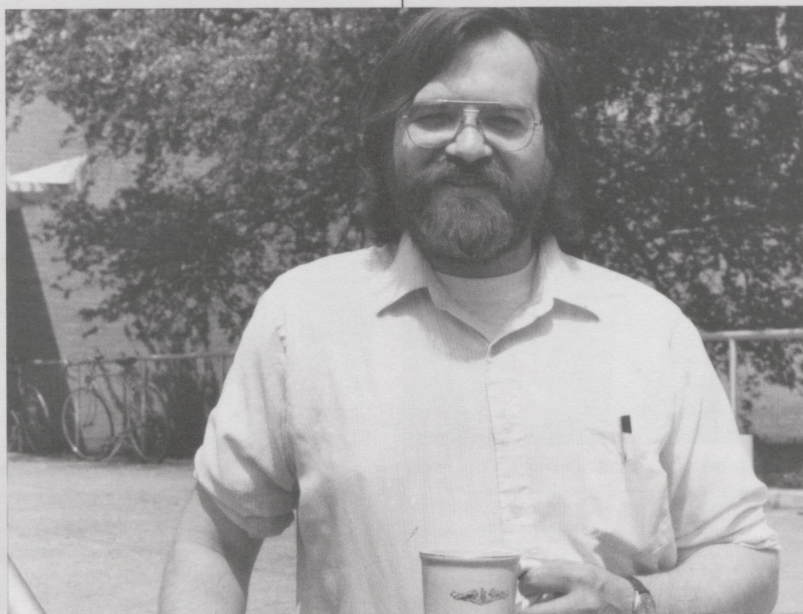
A former job, he says, prepared him to maintain intense concentration over long periods of time—he was a submarine officer in the U.S. Navy. "I did my undergraduate work in physics at Penn State on an ROTC scholarship," Trice explains, "so after graduating I owed the Navy five years." He chose submarine duty because he thought that he would learn more by working on a submarine

than by doing anything else. "Also," he says, "I wasn't keen on flying. In order to be a pilot in the Navy you have to be slightly insane."

Trice was a lieutenant on the *Sculpin* (a sculpin is a spiny, large-headed fish), which he characterizes as "an old fast-attack sub, one of those 'hunter/killer' types." During his first three years on the sub, he visited Italy, Spain, Greece, Norway, Scotland, St. Croix, Bermuda ("we *didn't* disappear in the Bermuda Triangle"), and Nassau.

Trice spent his last two service years in a California shipyard, as an assistant nuclear engineer officer, working with a nuclear reactor. "That was a *lot* of work," he says, tugging a favorite thicket of beard. "I would usually be in charge of the reactor for 24 hours, and there were times when I didn't get to sleep for 36 hours. So I'm used to working long stints."

Trice, who thinks of himself as "not a very typical graduate student," would like to do post-doctoral work after finishing his doctorate. "Though I've learned a lot and enjoy being here, I probably won't stay at UK since I think it's good to get as wide an exposure to ideas as possible," Trice says.



Jim Trice, Physics and Astronomy



Graduate students Maozhi Wang and Fan Hu, from mainland China, and undergraduates Buxton Johnson, from Owensboro, Kentucky, and Kevin Ternes (seated), from Bowling Green, Kentucky, are part of the research team that travels to Bloomington, Indiana and other laboratories that produce high-energy proton and photon beams the UK physicists need to run their experiments.



vinced that the project is worthy, they award beam time.

"If we ask for and are granted 200 hours of beam time, we schedule that time and are ready to start the second the clock starts ticking," Kovash explains. "Then we go 24 hours a day, in Bloomington, for example, until the allotted time runs out." The Bloomington facility is one of less than a dozen labs in the world which have the equipment the UK researchers need to run their experiments. They have also traveled to Boston, Los Alamos, New Mexico, Vancouver, British Columbia, and as far away as Switzerland.

Typically, according to Pickar, four faculty members and three or four graduate students work 18 hours a day until the equipment is in place and operating properly. Then the group works in eight-to-twelve-hour shifts. " 'Grueling' isn't a strong enough word for it," Pickar says, "but the facilities are totally over-subscribed—you have to stack experiments head to tail just to get everyone through." The reason for such tight—and hectic—scheduling is a lack of available beams.

Once all of the equipment is in place, what is it that these physicists hope to discover? "We are involved in intermediate energy nuclear physics, asking the question, What can we learn about nuclei and nuclear physics from an understanding of the most fundamental particles? We are trying to understand the connection between the larger structures, the nuclei, and smaller, more elementary particles such as quarks," Kovash says.

In order to do this, the researchers fix a target, such as a thin piece of carbon about half the size of a matchbook cover, at one end of the beam-pipe. In a vacuum the beam travels through the pipe, focused to a diameter of 1/8 of an inch to 1/16 of an inch along the way by powerful magnets that surround the pipe. When

the proton beam strikes the target, protons and neutrons are released; more importantly to the researchers, occasionally two nuclei will fuse and give off one quantum of energy, one gamma ray. This photon travels off and the researchers detect it. By looking at what becomes a radiation pattern, they can infer the nature of the reaction that has taken place.

In discussing this radiation pattern, Kovash uses an analogy between the nucleus and WBKY's radio antenna on the UK campus. The antenna is operated by an oscillator at 90 megahertz, and the pattern of radiation being emitted is determined by the way in which electric currents are driven inside that antenna. "The same thing happens in the nucleus. When we cause a reaction to occur by striking a target with a beam, we generate currents inside the nucleus. The pattern of emission of radiation in this case is one photon at a time—not a whole bucketful like that which comes out of the antenna," he explains. These photons, electrical impulses of light, register on magnetic tapes, which the researchers bring back with them once the experiments are finished.

"Analyzing these tapes is extremely time-consuming," says Pickar. "We read these data, which appear as numbers, look at them one by one, and recombine them, trying to determine which were high-energy gamma rays and which were not." Pickar adds, "It usually takes us a year after an experiment is concluded to analyze all the data." Though this analysis is tedious it is also exciting, leading the researchers closer to understanding the make-up of the nucleus.

Although Kovash is extremely pleased to have the EPSCoR support, he is also anxiously waiting to find

out whether or not a current proposal, made to the National Science Foundation, will be funded. The goal of this project is the building of a Science and Technology Center at the University of Kentucky. The Center would be available to experimentalists around the world, offering state-of-the-art equipment and technical expertise. The grant would enable UK researchers to install new accelerators capable of producing high-energy photon and proton beams for testing and calibration purposes.

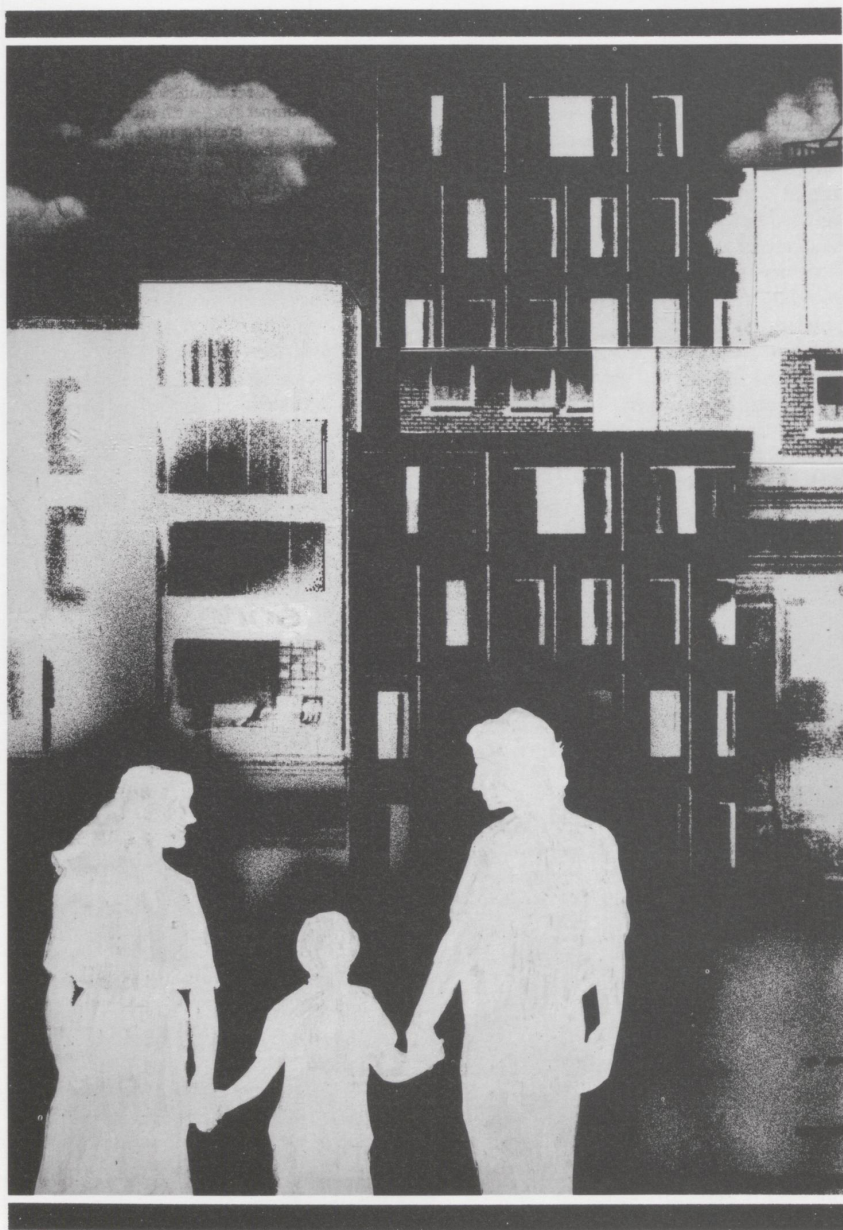
"There are a large number of physicists around the country and around the world who work as we do, developing equipment and techniques for experiments. Then they have to load up everything on a truck and drive to one of ten or so labs where beams are available. The proposed Center at UK would be unique—we would provide the beam, other necessary equipment, and the manpower to build and maintain the equipment," Kovash says.

The proposed planning grant—written by the four researchers working on the current project and by Dr. Marcus McEllistrem, professor of Physics and Astronomy—would allow the physicists to develop a comprehensive proposal by January of 1989.

"The EPSCoR project allows us to continue and extend the work we've already begun," Kovash says. "With the new faculty members and new equipment we can take on projects that are more complex, larger, and intrinsically more interesting. We can come closer to finding out about the proton's structure, to answering fundamental questions about structures from which everything was created." ■



# THE DISSATISFACTION REACTION



by Jeff Worley

Out by the curb your garbage cans are buzzing with life. During the past week, two dozen or more bluebottle flies have made themselves at home in the contents. Every morning you call the city office and every morning a voice assures you that the sanitation truck will be by "this afternoon—for sure." The only thing you're sure of is your anger about to boil over.

How a person responds to such a situation and why he responds as he does are questions that have intrigued University of Kentucky Political Science Professor William Lyons. With funding from the National Science Foundation, Lyons and Co-PI Dr. David Lowery, now at the University of North Carolina, spent 18 months measuring citizens' responses to dissatisfaction with local government services. Lyons' interest in this project stemmed from previous research he had done in the fields of urban government and politics, in particular voter reactions to government proposals to annex or consolidate metropolitan areas.

"This recent project interested me because of my previous work and because David [Lowery], a very sharp junior faculty member then in the department—unfortunately for us the University of North Carolina made him an attractive offer—shared my interest in this area. He had been involved in research dealing with how people react when they are unhappy with their job," Lyons says.

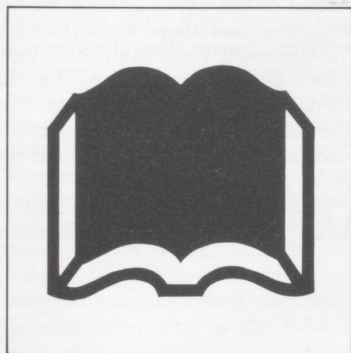
In sketching a brief history of research on job dissatisfaction, Lyons explains that economist Albert Hirschman, in his book *Exit, Voice, and Loyalty: Firms, Organizations, States*, classified three types of reactions to dissatisfaction: exit, leaving the organization; voice, actively attempting to improve conditions; and loyalty, passively but optimistically waiting for conditions to improve. Psycholo-



gist Caryl Rusbult, who taught at UK until 1986 and had been doing collaborative work here with Lowery, found a fourth category of reaction—neglect (passively allowing conditions to worsen). Lyons says that he and Lowery wanted to see if they could apply this model of dissatisfaction to people who are unhappy with local government services.

A starting point for the researchers was what Lyons terms “public-choice literature,” an established model which posits an ideal system for maximizing satisfaction with government services. Public-choice literature rests on the foundation of individual choice—a citizen selecting from among a number of significantly different small governments in an urban area. Some units of local government in urban areas, for example, offer services that other governments do not. According to public-choice theory, individuals make decisions about where to live within an urban area on the basis of which local government tax and service package they most want.

“We put in for an NSF grant, hoping to get enough funding to do surveys in six different urban areas located in various parts of the U.S., but that would have been incredibly expensive,” says Lyons. Funding was approved, however, for research in two urban areas—Lexington and



Louisville. Five neighborhoods in Lexington and five matched areas in Louisville, Kentucky were surveyed. These ten neighborhoods, according to Lyons, became an ideal laboratory to test the accuracy of the public-choice model.

Louisville-Jefferson County contains over 90 incorporated municipalities (separate cities), making it a prototype of a public-choice system. Louisville-Jefferson County citizens have a wide range of governments and, therefore, governmental services to choose from. The Lexington-Fayette County setting, on the other hand, has a decade-old consolidated city-county government which provides most general services (courts, jails, libraries, police and fire protection) to everyone. The only variation for Lexington-Fayette County residents is the choice of a different combination of such urban services as refuge collection, streetlight installation and maintenance, street cleaning, and sewer maintenance.

“We used census data to choose the paired sites,” Lyons explains. “We matched areas in Louisville with areas in Lexington that had identical characteristics, controlling for traditional variables—age, income, gender, race and education. One of these sets of neighborhoods, for example, consisted of predominantly younger couples with young children; another set was made up of older citizens.

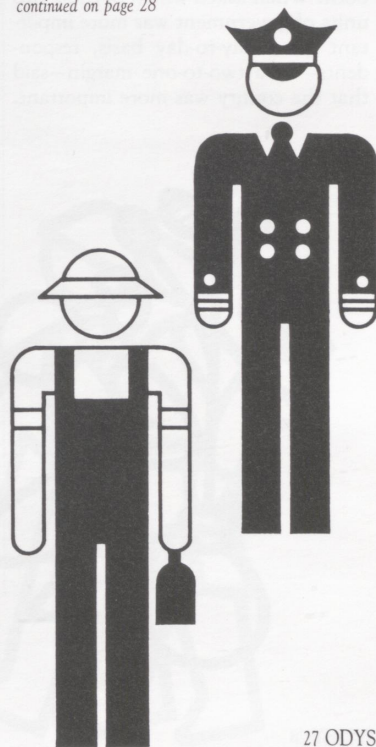
“Once we had paired these ‘social worlds,’ as we call them, five in Louisville and five in Lexington, we were ready to test the effects of these two environments—one which meets the test that the public-choice people would argue is necessary and one that doesn’t. Now presumably, the people who lived in these Louisville neighborhoods should have been more attached to them, more satisfied—all those things which public-choice advocates would predict.”

After these sites had been selected and paired, UK Survey Research

Center staff began to make random telephone calls to people in these paired Louisville and Lexington neighborhoods. Residents were asked about general dissatisfaction with local government, then about the performance of the government in supplying basic services. The respondents were guaranteed anonymity. “We had approximately 300 telephone interviews in each of the ten sites, so we’re talking about several thousand people taking part. That’s what makes the research so meaningful: up to this point no one had been able to afford to do that kind of direct confrontation with the theory,” Lyons says.

A major finding in this survey is that many of the public-choice expectations were not supported. “Psychological attachment” to the environment, according to the public-choice model, should have been

*continued on page 28*





# THE DISSATISFACTION REACTION

greater for people living in the various Louisville sites as compared to their Lexington counterparts because the governmental units are smaller and therefore presumably more responsive. "What we found, instead," says Lyons, "is that attachment is slightly stronger in every one of the Lexington neighborhoods. I think this demonstrates that it is possible for consolidated government to be responsive to particular neighborhood needs." In the measurement of dissatisfaction between the paired sites, there was no consensus, though respondents in three of the five Louisville sites were found to be more dissatisfied with governmental services than their counterparts in Lexington.

Another result, this one very surprising to Lyons, had to do with measuring city/county loyalty. Residents of small cities in Louisville also live in the county—and pay taxes to both. When asked which of these two units of government was more important on a day-to-day basis, respondents—by a two-to-one margin—said that the county was more important.

"This statistic did surprise us," Lyons admits. "This response could be due to the fact that many of these small cities don't have their own police department, so they have to rely on county police. Also, county allegiance, more of a Southern phenomenon, might account for some of the responses." He adds that this finding is, again, contrary to the public choice model of "local attachment."

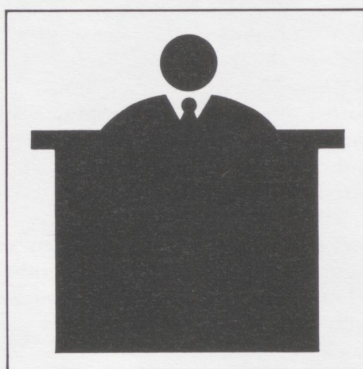
In characterizing responses to dissatisfaction, Lyons and Lowery also found it necessary to modify the exit, voice, loyalty, and neglect model when applied to governmental as opposed to job or interpersonal situations. In particular, "loyalty" was seen more by the researchers as a position taken by those who were relatively satisfied than a response to dissatisfaction with governmental services. "Loyalty in a governmental context seems to get bound up with

notions of civic duty," Lyons notes. "Those who are dissatisfied tend to choose from among voice, neglect, exit, or a variation on the exit theme—privatization."

Which of these responses is chosen depends on such things as whether respondents have high or low investments in their community and many or few alternatives in terms of other governmental units in the area with a tax-service package more to their liking. "For example, those who elect to 'privatize'—to go outside government by having private security systems installed in their homes or to hire security guards—represent a growing and significant category of people," Lyons explains. "Unlike the more traditional notion of exit, or leaving one governmental jurisdiction for another, the only form of investment that really seems to count for privatizers is home ownership. Social and psychological investments have little impact on decisions whether or not to privatize, and the lack of these types of investments in a neighborhood is almost a prerequisite for the typical exiter."

The move toward privatization is definitely becoming more common, according to Officer George Doyle, alarm liaison of the Lexington Police Department. Doyle reports that after a slight 11 percent increase in reported new residential alarm systems from 1985 to 1987 there has been a 20 percent increase in the last 12 months. "Some of the newer systems are less expensive and there seems to be a 'do-it-yourself' trend in the U.S. right now," Doyle says. "Add to that the rising fear of crime and the belief that the police can't effectively protect private property, and the increase can be accounted for."

Inadequate protection of another kind—the protection of children—is





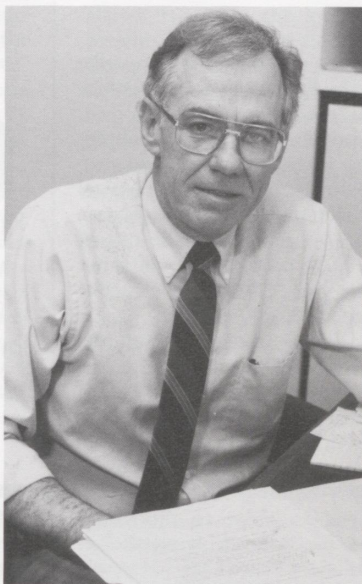
perhaps the most common concern of those who call the Lexington Citizens Advocate office. "A large number of complaints we get," says Donna Carmen, Administrative Office Assistant, "have to do with vacant houses not being properly boarded up and in bad disrepair. Neighbors worry that curious kids who play around such houses will fall through a porch or have a ceiling cave in on them."

Another typical phone call concerns neighbors violating zoning ordinances. "I got a call last week from someone claiming his neighbor was selling paint out of his house, running a business, in effect. The problem was, this neighborhood wasn't zoned for business."

Lyons says that one result of their research on citizen dissatisfaction is that social scientists may re-think the concept of "exit"—dissatisfied citizens moving from a political district. "Public choice theorists in the past have based this aspect of their theory on some fairly dubious premises. One of these is that a consolidated local government, by its nature, doesn't offer its citizens significantly different tax packages. Another is that if people have lots of choices, they will act upon these choices, the underlying assumption being that mobility is costless. But 'voting with your feet' can be extremely costly."

When Lyons and Lowery asked whether residents intended to move in the next two years because of dissatisfaction with their tax package, there were "hardly enough responses to do any statistical analysis," Lyons states. "This type of exit just wasn't there. This assumption of perfect mobility just doesn't work—moving because you are hacked off at your garbage collection is a pretty dramatic step, especially if you have lived in your house for awhile," he adds.

Aside from testing a widely held theory concerning citizen reactions to dissatisfaction, what is the value of



*William Lyons, Political Science*

such a project? "From the perspective of a psychologist, the increase in knowledge in itself is important," says Rusbult. "Beyond that, the findings are clearly politically applicable. Any local office seeker wants to know how and why potential constituents react as they do to the services government provides. A candidate who understands this can then think about how the system can be made to satisfy more people."

"Our research can change the way some elected officials think about the relationship between individuals and their government," says Lyons. "These findings can sensitize public officials to the fact that a large, centralized government like we have in Lexington can be responsive to the people's needs by keeping a variety of tax packages available." ■

**“** This assumption of perfect mobility just doesn't work—moving because you are hacked off at your garbage collection is a pretty dramatic step. **”**





# ON-SCREEN HUNT FOR A HIDDEN KILLER

by John Fritz

**L**ike a thief in the night, it can strike without warning. Everyone is a potential victim: the infant, toddler, teen, young adult, and senior citizen. The frightening reality is that your physician could pronounce you to be in "generally good physical shape" and, on the walk from the doctor's office to your car, you could become one of the estimated 500,000 people who will suffer from a stroke this year. Of those new stroke victims, an estimated 150,000 will die.

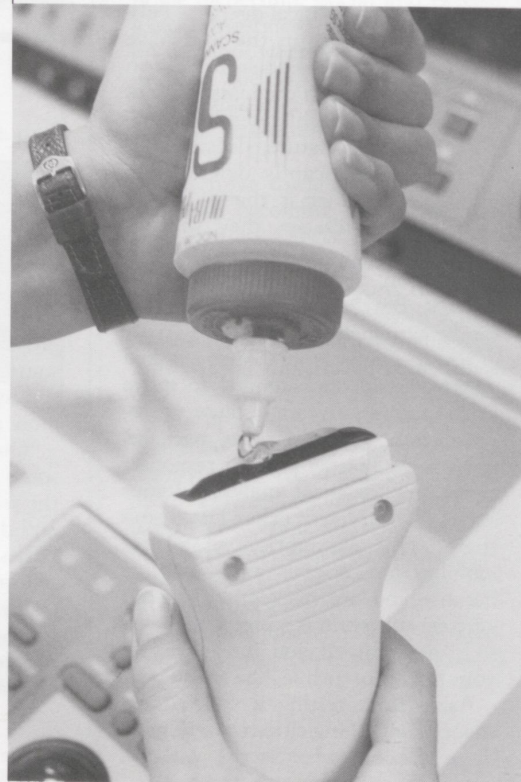
To learn how doctors can diagnose and prevent strokes, Dr. Robert J. Dempsey, associate professor of neurosurgery at the University of Kentucky, is using an amazing instrument called the Quantum Angiodynograph (duplex imager). The duplex imager combines ultrasound imaging technology with Doppler physics phenomena in order to produce a computer-generated color "moving picture" of a patient's blood flow.

"Let me show you," Dempsey says and stands in front of the duplex imager. He squeezes out some Aquasonic-100 gel onto the tip of the "transducer," which looks like a wand and serves as the computer's hand. The clear aqua blue gel is a water-soluble substance which transmits the ultrasound waves from the wand across the skin. The computer interacts with the patient by sending and receiving data from the wand through a cable. Dempsey continues the demonstration, placing the wand to the side of his throat just above the collar. On the computer monitor a simulated moving picture of blood flowing through his carotid artery appears instantly. Blood flowing away from the brain is blue and blood flowing toward the brain is red. On the screen the parallel rivers of blood flow in opposite directions. Dempsey makes the rivers disappear by removing the magic wand from his neck.

Using the computerized duplex instrument, doctors can see what is going on inside the working artery. If the artery is blocked by plaque, blood flow will be altered. The "flow" on the screen will become narrow. The greater the size of the plaque, the narrower the passageway of the artery and, consequently, the more abnormal the blood flow.

**“** The potential for this newest technology may be infinite as we develop what may become the new ‘gold standard’ in evaluating arterial occlusive disease. **”**

*When a patient is brought into the UK Vascular Laboratory, Vascular Technologist Marcie Hauer squeezes a clear, aqua blue gel onto a "wand-like" transducer and*





The duplex imager is being used in conjunction with a similar instrument called the duplex scanner to perform "noninvasive" examinations of the extra-cranial carotid artery (the major artery located in one's neck). The duplex scanner has two types of wands. One style has a wedge-shaped top; the other has a dome-shaped top. The wedge-shaped wand gives a broader view of the artery section, while the dome-shaped wand magnifies a selected part of the artery.

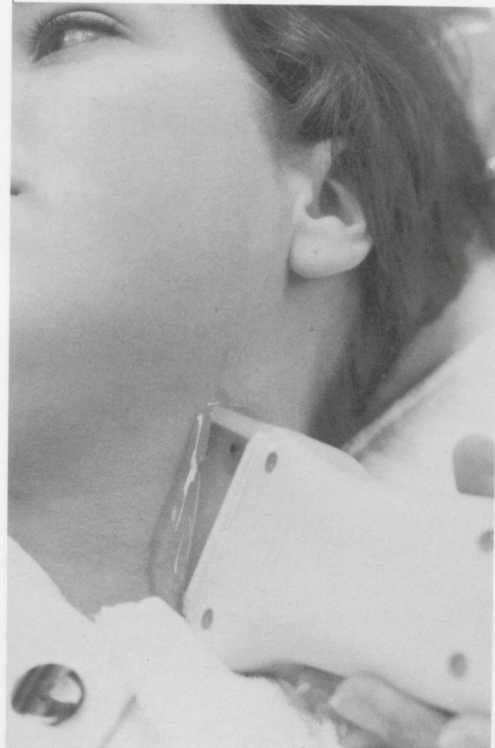
The duplex scanner, unlike the duplex imager, projects a black and white image of the artery; this projection, Dempsey says, "will help doctors detect nearly all carotid artery bifurcation lesions. The ability of this new technique to determine the severity of disease

allows its use in the long-term follow-up of patients with known carotid artery disease," Dempsey states. The duplex scanner is designed to detect plaque build-up in the artery, but does not simulate blood flow like the duplex imager does. Together, these duplex computers will be used by the cerebrovascular laboratory staff to evaluate patients who are participating in a special stroke research program called the Asymptomatic Carotid Atherosclerosis Study (ACAS).

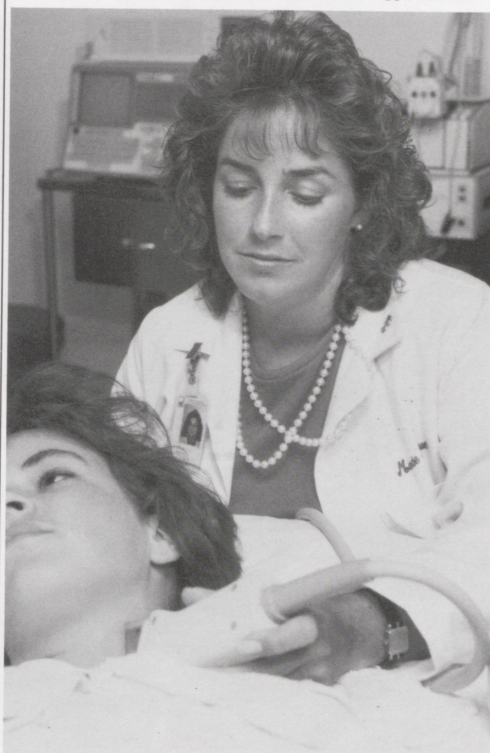
Dr. A. Byron Young, chairman of the Department of Surgery, and Dempsey are the co-principal investigators involved in the ACAS stroke research at the University of Kentucky Medical Center. The program began in January of 1988 and is being funded by

*continued on page 32*

*also onto the patient's neck. As she places the wand on the side of the patient's throat, a simulated "moving" picture of the blood flowing to and from the brain*



*appears instantaneously on the monitor of the Quantum Angiodynograph. Blood flowing away from the brain appears blue and blood flowing to the brain appears red.*





## ON-SCREEN HUNT FOR A HIDDEN KILLER

“The procedure is so comfortable, some patients fall asleep during the examination.”

an \$11.6 million grant from the National Institute of Neurological and Communicative Disorders and Stroke. The ACAS program was developed by medical researchers at Bowman Gray School of Medicine (Winston-Salem, North Carolina) who are coordinating data collection for the study. This job will be no small task, because the research program is highly sophisticated and the funds are being spread out over a seven-year period among 15 research institutions in the United States.

UK hopes to recruit 100 patients for this special stroke research. Ms. Artie Norton, R.N. and neurosurgery research coordinator, has informed central and eastern Kentucky physicians about the stroke program through

*Using this new non-invasive procedure, doctors can determine whether or not the artery is blocked by plaque—a condition that can lead to stroke.*





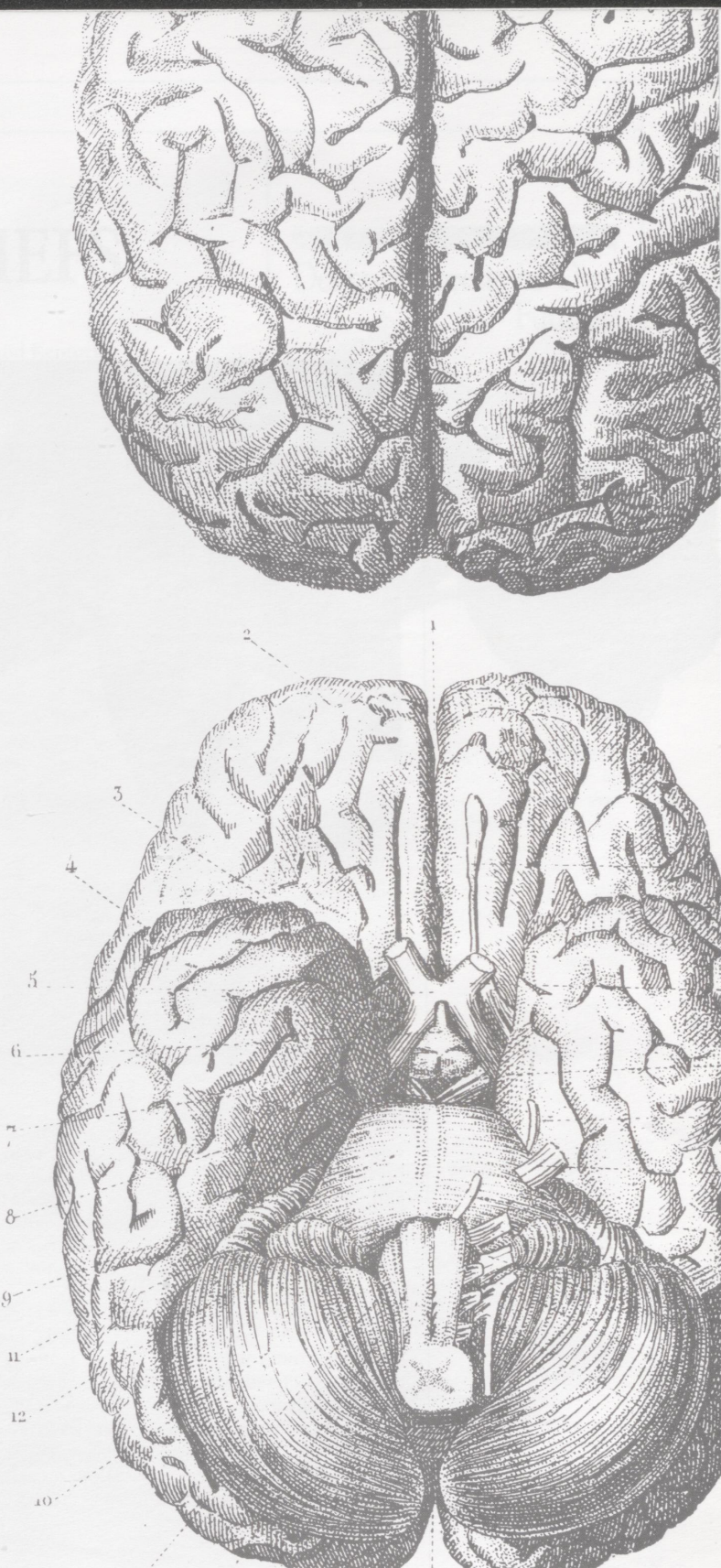
a newsletter which asks for patient referrals. Outlying doctors are already referring patients who have symptoms such as chronic hypertension, transient ischemic attacks (TIAs—occurrences of interrupted blood supply to the brain), or migraine headaches. After duplex-imaging and routine examination by UK neurosurgeons, those patients who meet particular criteria of the study will be invited to participate in the stroke research. The patient's reward will be, hopefully, a decreased risk of stroke through preventive measures (either surgery and medication, or medication alone) and an opportunity to help further medical research. Patients for the ACAS study must be willing to adhere to a strict schedule of medical supervision. Follow-up examinations will be conducted periodically for the next five years.

Of the 100 patients selected by each participating research center, half will be treated for their medical condition by a surgical procedure (carotid endarterectomy) and aspirin while the remaining patients will be treated with aspirin only. The ACAS study randomly assigns the patients to either group. Through this procedure, the 15 participating institutions hope to determine which treatment plan yields the better results for the patients.

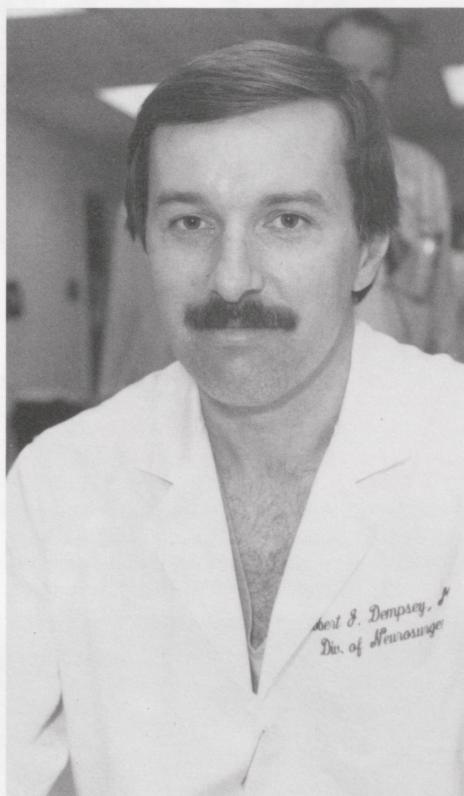
Young explains that the carotid endarterectomy is an operation in which the neurosurgeon removes plaque that obstructs normal blood flow in a patient's carotid artery. He says that this operation has become the generally accepted treatment for 60 percent lesion obstructions (plaque) and TIAs as a matter of routine. The symptoms of a TIA are loss of vision in one eye, slurred speech, or lost motor function. TIAs may last for only one minute or up to 24 hours, according to Dempsey.

Stroke can occur without any warning. "One reason for this," says Dempsey, "is that many potential stroke victims are asymptomatic—they do not exhibit any symptoms that prompt them to seek medical treatment. Nevertheless, some patients' risk of having a stroke is thought to be as great as that of patients who do have symptoms such as TIAs." Symptoms of a major stroke include unconsciousness, paralysis or weakness on one

*continued on page 34*







Robert J. Dempsey, Neurosurgery

side of the body, partial blindness, difficulty in breathing and in swallowing, loss of bladder and of bowel control, and loss of speech. Symptoms of a minor stroke include minor impairment of speech or memory, weakness or numbness in an arm or leg, loss of vision in one eye, confusion or loss of balance.

"Other patients suffer from minor strokes as seen on a CAT scan, but remain asymptomatic," continues Dempsey, "never realizing they have suffered a stroke. In the past it has been virtually impossible to accurately identify asymptomatic people who were at risk of having a stroke. That's where the new duplex imager and scanner play a critical role in this ACAS study." Before such instruments were

available, patients had to undergo expensive and invasive angiography examination of their arteries to determine whether they were stenotic, or blocked. But with the duplex instruments, the carotid artery bifurcation (where the artery divides into two branches) can be evaluated in 30 to 45 minutes; the patient remains fully clothed and the procedure is comfortable.

Here's how the procedure works. The patient lies on his back on a medical examination table in a room where the duplex computers are kept. During the examination, one table lamp and the dim glow of the screens are the only sources of light. The cerebrovascular technician places an ultrasound wave-conducting gel on the duplex wand. Then she places the palm-sized wand over the patient's carotid artery and slowly moves it along the length of the artery in order to obtain readings from different angles. The technician watches the image of the artery on two monitors; one is an ultrasound video image of the artery and the other is a graph of the signal being transmitted by the sonar waves. "The procedure is so comfortable," Marcie Hauer, a vascular technologist, says "that some patients fall asleep during the examination."

"The potential for this newest technology may be infinite as we develop what may become the new 'gold-standard' in evaluating arterial occlusive disease," Young says. "Duplex instruments allow physicians to see whether there is plaque in a person's artery easily, quickly and inexpensively. Also, plaque build-up over a period of time can be determined."

A more comprehensive examination of the clinical and applied basic research in the area of ischemic heart disease is critical if progress is to be made in treating stroke patients. Without the availability of computerized ultrasonic duplex instruments, the ACAS study may never have gotten off the ground. The research results will be forthcoming after completion of the five-year study and may affect the way stroke is treated by physicians from then on. ■



## RESEARCH BRIEFS

### Flash Back

For UK's Dr. Eugene Bradley, turning a page in the Winter 1988 *ODYSSEY* was like turning a corner and stepping into his boyhood past.

"I recognized that girl in the photograph right away," Bradley, professor of electrical engineering and physics, says. "And she's standing in the side yard of the house where I grew up!"

The photograph of a young girl in a white dress holding a bouquet of flowers is one of the objects in Ms. Linda Butler's larger photograph which also shows peeling wallpaper and a fireplace mantel. Butler's photo essay, titled "Country Places, Forgotten Spaces," focuses on similar images

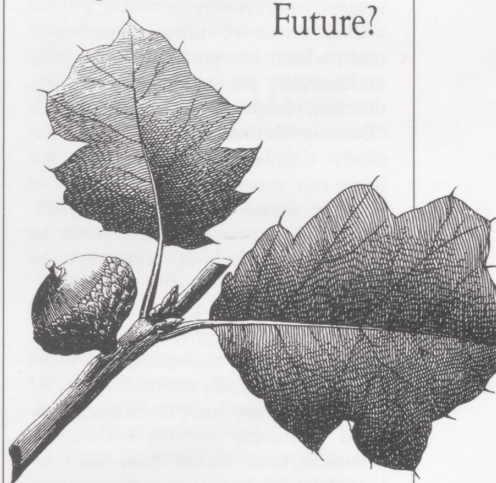
of Japan and Kentucky.

"When I first turned the page, I must have stared at that old photo for 15 seconds," Bradley says. "It was taken by my father at our house on the corner of Jackson and Dudley in Georgetown, probably in the late '20s or early '30s." Bradley says that the house has since been torn down and a fraternity house now occupies the lot.

Bradley's father, Eugene, was a well-known photographer who patented several photographic processes and won national prizes for his work. His collection of photographs, taken from 1900 to 1960, is now part of Special Collections at the University of Louisville.



### Designer Forests in Our Future?



Mighty oaks from tiny acorns grow. But in 40 years, giant oaks may be grown from a single leaf—and may mature in half the time these durable giants now take.

Through genetic engineering these trees might grow faster, taller, and thicker, and might be grown with a natural resistance to diseases which now threaten them, according to C. S. Prakash, a post-doctoral research associate in the UK College of Agriculture.

Prakash can now grow hundreds of cottonwood trees from a single leaf. A small piece of leaf the size of this letter "o" placed in a dish of nutrient "jelly" can be made to grow a new leaf, a new root system, or both. And through careful nurturing, the cloning process can result in a whole tree, genetically identical to the tree of the original leaf. "Any part of the tree, theoretically, can be made to grow into a whole plant if the proper nutrient recipe and cultural conditions are used," Prakash says. He is currently testing these cottonwood plants for resistance to leaf-rust disease.

Why are Prakash and others at UK working on cloning cottonwood trees instead of oak, walnut or pecan? "Frankly, it's easier," says Dr. Bart Thielges, chairman of UK's Forestry Department. "For some reason, some

*continued on page 36*



## RESEARCH BRIEFS

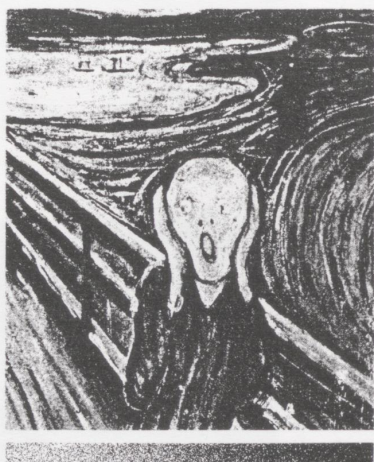
hardwood trees, including most nut trees, are more difficult to clone than others. More research is needed to understand just why."

One result of using cottonwood trees, which are grown commercially in Kentucky primarily for paper production, might be an early payoff. "Because this disease system is relatively simple," Thielges says, "we hope our research will enable us to find the answer to a number of problems which could be applicable to other plants such as pine, corn or wheat."

Thielges points out that because the cottonwood grows naturally in Kentucky, it is convenient to compare the genetically unstructured wild ones which may have naturally developed immunity systems with those domestic trees which have been selected for their fast-growing properties. Through genetic engineering, it could be possible to transfer wild tree genes resistant to disease to those fast-growing domestic varieties and develop a tree with the desirable characteristics of both.

"The potential value is enormous for developing genetic information which could be used to improve corn, wheat or pine systems," Thielges says.

—Jerry Robbins



EDVARD MUNCH, *The Scream*, 1893.

### Relief from Dentalphobia

When the dentist turned to reach for the needle, the patient jumped out of the chair and bolted from the room. She ran through the waiting room, past the receptionist and out the door. She ran half a block—the large paper napkin still chained to her neck—and hid inside a convenience store.

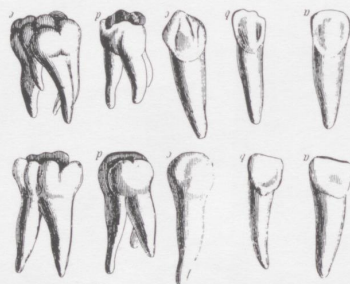
Although this is an extreme case of dentalphobia, the fear is common, according to Dr. Timothy Smith, co-founder of the Dental Fear Treatment Clinic at the University of Kentucky. "If you're apprehensive about going to the dentist, you're not alone," Smith says. "Studies have shown that approximately three-fourths of the U.S. population suffer from some degree of dental anxiety or fear and that up to 28 percent are extremely fearful."

With a grant from the American Fund for Dental Health, Smith is in the second year of a project designed to alleviate this fear. The project, which includes a network of ten dental practices in a four-state region, involves teaching dentists methods of dealing with fearful patients. The methodology of the treatment program was developed by Dr. Robert Kroeger, a lecturer in the Department of Oral Health Science at UK.

In the first session of this program, a patient identified as fearful by a dentist or staff member talks with a

dental assistant or dental hygienist about specific fears or anxieties (without any dental equipment present) and watches a video tape of a dental appointment. The patient sees the dentist interacting with a nervous patient who shows what can be done to lessen his fear—raising a hand when there is pain, asking for a brief rest, or using headphones to block out the sound of the drill, for example. Kroeger calls this the first step in a process of "systematic desensitization," the gradual exposure to dental treatment so that fear can slowly be overcome.

During the follow-up session, the patient watches a video tape of a particularly stressful action, an injection, perhaps, and is shown how to use a relaxation response (alternately tensing and relaxing each major muscle group in the body) to reduce the stress. Another method used to control fear is "guided imagery." "In this exercise, we ask the patient to vividly imagine a tranquil, happy scene such as a warm, sandy beach or a quiet walk in a forest in springtime," Smith says. "Through this imaging, the pa-



tient's mind is distracted from the dental treatment and is focused instead on relaxation." Also during this session, the patient is scheduled for a "low-stress" appointment, such as having his teeth cleaned.

The most effective technique a dentist can use, Smith says, is explanation. "Fear of the unknown is a major source of the anxiety," he says. "We teach dentists to take a minute or two before getting started and tell the patient what they're going to do and what it's going to feel like. It's so obvious that this makes people feel more



## RESEARCH BRIEFS

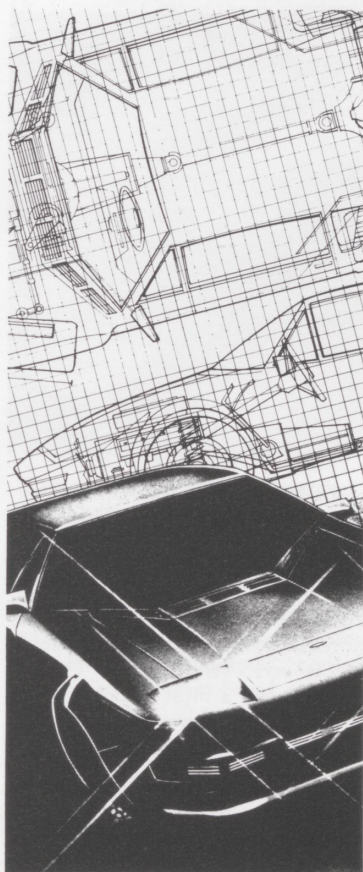
relaxed and involved with their treatment—I wonder why medical providers and other professionals don't do more of that." Smith adds that in this process patients are encouraged to ask questions, to be more assertive.

The "heart of the method," Smith states, is to replace the anxiety and stress response with the relaxation response. "Some people have avoided going to the dentist for so long, they don't realize modern dentistry is a whole lot less stressful than it was 25 years ago," he says. Smith adds that two-thirds of fearful patients report a childhood incident causing emotional anxiety about going to the dentist. "I treat quite a few '40s and '50s people who, as children, were always 'white-knuckled' in the dentist chair—back when it wasn't all that common for dentists to anesthetize before going to work."

Although Smith has only begun to analyze the results from the participating dental practices, he says that preliminary findings show the method is effective for many fearful patients. "Dentists report that patients who used to be so hard to work on are now easy to work on. Before, these dentists would dread seeing them come in the door because they knew the patients would be squirming all over the chair. Now they come in and go to sleep," Smith says.

For information about the Dental Fear Treatment Clinic, contact Dr. Smith at (606) 233-6510.

—Jeff Worley



### To Buy or Not to Buy: That Is the Question

After carefully considering purchase price, styling, fuel economy, resale value, maintenance cost, riding comfort, roominess and handling, the 65-year-old man decided he'd buy the brand new Venture.

*Venture?*

"Well, it *sounds* like it might be the name of a car, and we wanted to make this task as realistic as possible," says Mitzi Johnson, UK post-doctoral fellow in the Department of Behavioral Science.

In the fall of 1987, Dr. Johnson and research assistant Mary Pietrukowicz conducted a study of memory and

decision-making with young and older adults. The researchers worked with 36 Sanders-Brown Research Center volunteers who met the age and health requirements for the study. These retirement-aged volunteers were screened to approximate the educational level and health status of the 36 college-age participants recruited from Psychology 100 classes at UK.

The central decision-making task involved volunteers' comparison of information on six fictitious cars and the participants' subsequent decision about which one they would purchase. Instructions and tasks were presented to each person by a portable lap-top computer which captured the amount, type, and sequence of the information accessed.

"I was primarily interested in answering two research questions," Johnson says. "First, are older adults more likely than younger adults to make cautious decisions? Second, are older adults more likely than younger adults to employ strategies and experience to compensate for possible information processing declines? The popular conception is that when we get to be 65 or so our memory starts failing and it's harder to make decisions—that we become more cautious or conservative."

The results of the study showed that there was no difference in total decision time between the two age groups, but that younger adults used twice as much information as older adults to make a decision. This sample, Johnson says, shows that the older participants were more efficient decision-makers.

"The older group tended to use what we call an 'elimination by aspects strategy'—looking at one characteristic for each car, purchase price, for example, and then eliminating some of the cars on that basis. The younger group much more often employed an 'intra-alternative strategy,' examining all of the features of

*continued on page 38*



## RESEARCH BRIEFS

one car, then going on to the next." The first approach, she says, is more efficient because a buyer can eliminate those characteristics that are unimportant and narrow the field of possibilities.

Johnson, just incidentally, was shopping around in Lexington recently for a new car. Which of these strategies did she use?

"I gave up on new cars myself," she says. "I got an old VW bug."

### UK Advisors Help Thai Farmers Lay Groundwork for Agricultural Development

In 1980 approximately half the population of 14 million in Northern Thailand were classified by the Thai Census Bureau as living in "absolute poverty." Annual incomes per capita ranged from only \$6 to \$10 a month as a result of stagnant or declining crop yields, and attempts to increase crop yields by increasing acreage led to the destruction of over 50 percent of the forests in the area.

"The farmers live on the food they grow and they often have to save any surplus in case of drought the following year. Very little is left to be sold," says John Ragland, professor of agriculture at the University of Kentucky. Dr. Ragland headed a team of four long-term advisors during the seven-year project.

The Northeast Rainfed Agricultural Development (NERAD) Project, which began in 1981, was designed to help farmers in the agriculture-based area of Northern Thailand. The project was headed by Dr. H. F. Massey, director of the UK International Programs for Agriculture. Massey and the team of research advisors from UK developed various methods of improving crop yields without increasing acreage.



A major problem was with the natural infertility of the soil. "Thailand is located in a tropical belt which surrounds the planet," says Ragland. "These areas are so weathered out, exposed for so many millions of years to relentless heat, that the remaining soil is very, very infertile. Outside nutrients are a must if yields are to be increased." However, the soil responded poorly to nitrogen fertilizers which can ordinarily double crop yields.

As a possible solution to this problem, the NERAD team used a green manure crop (*Sesbania Rostrata*) which thrives under almost any environmental condition and has the capacity to respond to the fertilizers. When it is plowed into the soil before planting, it releases a fertilizer (phosphorus and potassium) that provides the crop with the nitrogen it needs.

A second advancement brought about by the project resulted from the production of fish along with rice in rainfed paddies. Tambon agents (similar to UK's county agents) reported that rice yields were greater in paddies where fish were being raised. The reason for this is not thoroughly understood. "The scientists were skeptical about the discovery at first," says Massey, "but when similar findings were reported throughout the area, they took a closer look."

NERAD researchers also designed wells to provide water for dry-season vegetable production, developed tech-

nologies to control disease in native chickens and organized group buying of production inputs. Of all these improvements, Massey feels the most important accomplishment of the project is the higher level of communication between the farmers and the bureaucracy: "The project was designed using a bottom-up method in order to find out what the villagers wanted as opposed to what the bureaucracy thought they needed."

Although the project officially ended in July of 1987, Massey hopes to have a continuing relationship with Northeast Thailand. "We will be monitoring the effects of the program over the next few years," he states. "We also hope to continue research in the area to help maintain economic development, and a proposal has been made to this effect."

—Laith Alkhoja

### What Those Whispering Pines Are Saying

James P. Dunn, a UK doctoral student in entomology, reports that trees send signals not only to one another,





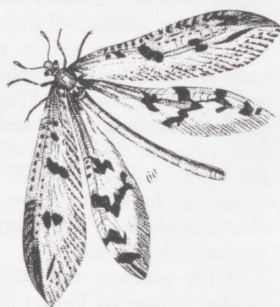
## RESEARCH BRIEFS

but to eavesdropping insects as well.

According to earlier research findings, trees react to insect attacks by, among other things, changing the formulation of chemicals in their leaves. This alteration makes the leaves less tasty and, in some instances, less digestible by insects.

As the new mixture of chemicals in the leaves is released into the air, the theory goes, neighboring trees begin to alter the make-up of their leaves, as though they had been "warned" of the presence of dangerous insects.

Dunn has shown that at least one type of insect seems to tune in to the chemical communication. The insects "listen" for a signal that a tree is sick, or stressed, and then they attack it.



### Teaching Mine Safety

You are the driller and helper working in the #5 intake air entry at the face of a 5-entry system. The coal height is 28 inches. Heavy smoke suddenly sweeps down on you from the intake air entries. You must decide what to do to warn others, to get to the assembly point, and to get out. The problem is complicated when one of the miners is unaccounted for.

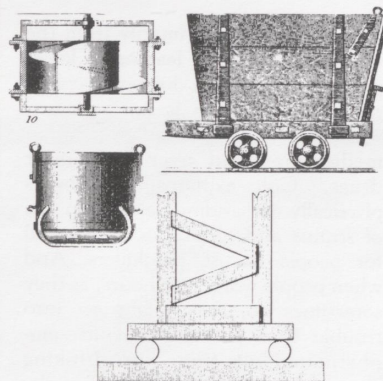
This training problem is one of 36 simulation exercises developed last year by members of the BRASH group at the University of Kentucky. The purpose of this training is to teach and test self-rescue and accident prevention skills to miners.

The Working Group on Behavioral Research Aspects of Safety and Health (BRASH) is not an individual project, according to BRASH head

Dr. Henry P. Cole of the Educational and Counseling Psychology Department; it is a group of people working together toward common goals. "BRASH includes people from different academic departments and from different disciplines, who volunteer to work on problems related to mining and mining research," Cole says. "After collaborating for a number of years, we decided we needed some kind of formal organization and name so that funding agencies would understand the make-up of the group, that its focus is a common interest in behavioral research, safety, and health." The major portion of BRASH's budget is provided by agencies outside of the university.

The simulation problem exercises, which Cole says the miners see as "interesting and exciting," are currently being disseminated nationally by the Institute for Mining and Minerals Research and the National Mine Health and Safety Academy. These exercises were developed, field-tested, revised and field-tested again based on data collected from 120 sites and 4,000 miners. "Most of these exercises deal with underground mine emergencies, asking the miners to deal with problems before they get out of hand," Cole says. "And if they make an error during the exercise, they die on paper instead of in real life."

In addition to these paper and pencil exercises, the UK group has developed training activities that show miners how to effectively use safety equipment. One of these activities involves a step-by-step procedure for miners to follow if they need to use



the standard breathing apparatus called the "Self-Contained Self-Rescuer" in order to escape from explosions, fires, and gas inundations. The method includes the videotape showing of a trainer using the equipment, the trainees' evaluation of the trainer's actions in the film, and hands-on performance trials by the trainees.

"This study has had quite an impact," Cole says. "In fact, it's led to a change of legislation in the code of federal regulations. Last year in the U.S., all underground miners in the country had to be trained on the new procedures we developed here at UK with technical assistance and funding from the U.S. Bureau of Mines." Cole adds that the researchers, with a five-year grant from the National Institute for Environmental Health Studies, are now using similar simulation exercises to train hazardous-waste workers.

Future projects include a study on drug abuse in the mining industry. The industry is interested in the re-

*continued on page 40*





## RESEARCH BRIEFS

sults of the study primarily from the standpoint of abuse leading to lower production and to higher accident risk. "The problem is not so much with illicit drugs as with prescription medications and over-the-counter drugs," Cole explains. "Mining is physically demanding, leading to lots of strains and sprains, so it's typical for people to use painkillers. And when people work long hours, as they sometimes do, they might get into trouble from using stimulants—amphetamines—or from just drinking too much coffee." Funding from the Bureau of Mines is supporting initial work on this project.

### The Pig Computer Model

When Dr. Tim Stahly talks about "a successful and popular animal model," he isn't referring to Spuds MacKenzie. Stahly, a professor of animal science, is referring to two animal computer models, specifically pig computer models, which he is working on as a member of the animal modeling group at the University of Kentucky.

"The name 'animal modeling group' is an informal designation we have used to identify an effort by several UK faculty members," Stahly says. These UK researchers are currently involved in developing pig computer models that will simulate the animal's response to nutritional, environmental, and genetic factors. Working with Stahly on this project are research specialist Tom Bridges, Dr. Larry Turner, and graduate student James Usry, all in the Department of Agricultural Engineering. Bridges and Turner, an assistant professor, are Co-PIs with Stahly.

Stahly describes the first phase of the project as the planning stage, in which the conceptual outline of the pig computer model is being developed. "We began by laying out the circuit board," Stahly says, "'dividing' the pig's body into component

parts. In this organizational phase we are looking at the simulation of physiological details to see what kinds of changes lead to what kinds of results." The researchers, for example, are altering the simulated intake of dietary amino acids to see if that change makes a certain "computerized" muscle larger or not.

In order to maximize accuracy of the model, they are using established data concerning the pig's physiological responses to a specific metabolic action, eating grain, for example. After the known chemical process is "translated" into the logic of the computer program, the researchers make a simulation run with the computer, predicting a response and statistically determining if the computer's prediction correlated positively with actual experience. "If your run predicts the same data that was determined in previous established studies, then you can have confidence that the computer is accurately predicting a real-life situation," Stahly says.

This intensive research stage will be followed by field testing of a second model which will utilize some information from the first, but will be designed for more general, commercial applications. "Using this second model, we'll be able to help people in agribusiness and farming make better management decisions in caring for and housing their animals," says Stahly. "The farmer could use this model to decide which crops will pro-

duce the best feeds to optimize the quality of pork he's producing." Stahly adds that by inserting specific factors into the computer model about his farm or pork operation, the farmer will be able to determine the rate or quality of pork he will produce and the cost of production.

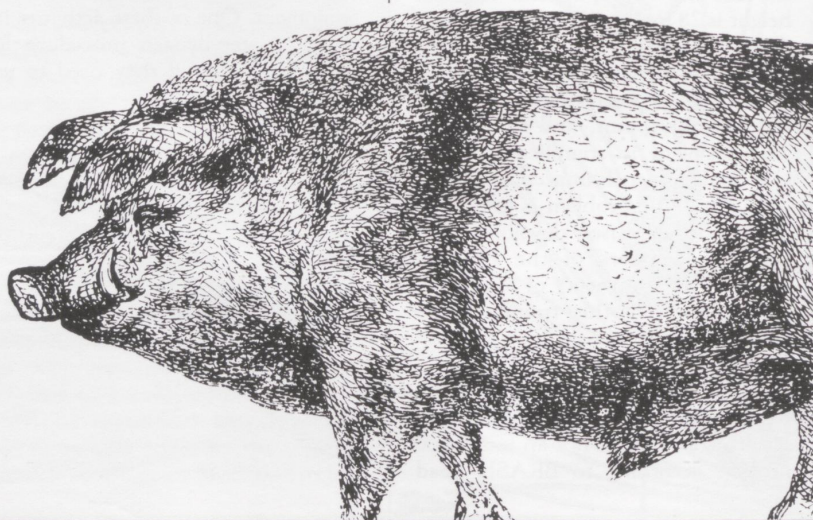
In his research, why has Stahly decided to use the pig, rather than some other animal? "First of all, pig computer models with this predictive capability are not available anywhere—this is the only one being developed we know of. Also, the pig is economically important in Kentucky, in the U.S. and internationally, a significant animal in terms of agricultural production," Stahly says.

Another reason, Stahly adds, is that the pig is very similar to the human animal. "Let me explain what I mean by that," he says. "Pigs and humans are anatomically similar in several ways, so that if we understand the digestive and metabolic processes of the pig, for example, we should be able to apply most of this information to human processes."

Stahly predicts that this project, funded in part by Purina Mills Incorporated, will be completed and the results published in early 1990.

—Jeff Worley

(Sources for Research Briefs include *The Ambassador* and *The University of Kentucky College of Agriculture NEWS*)





# DIRECTORY

University of Kentucky

Lexington, Kentucky

Addresses of UK faculty,  
staff and students  
featured in this issue of  
ODYSSEY

Area code is (606)

**Eugene Bradley**  
Electrical Engineering  
685 Anderson Hall  
40506-00461  
Ph. 257-1775

**Tom Bridges**  
Agriculture Engineering  
115 Agriculture Engineering  
Bldg.  
40506-00751  
Ph. 257-9320

**John M. Carney**  
Pharmacology  
MS683 Chandler Medical  
Center  
40536-00840  
Ph. 233-5849

**Yuan-Di Chang**  
Biochemistry  
102 Tobacco & Health Research  
Bldg.  
40536-00840  
Ph. 233-5549

**Henry P. Cole**  
Educational and Counseling  
Psychology  
205 Dickey Hall  
40506-02052  
Ph. 257-7873

**Robert J. Dempsey**  
Neurosurgery  
MS107 Chandler Medical  
Center  
40536-00840  
Ph. 233-5862

**Robert C. Dickson**  
Biochemistry  
MS603 Chandler Medical  
Center  
40536-00840  
Ph. 233-6052

**James P. Dunn**  
Entomology  
S225 Agriculture Science  
Center-North  
40506-00916  
Ph. 257-7450

**Marcie Hauer**  
Special Diagnostics  
C545 Chandler Medical Center  
40536-00848  
Ph. 233-5119

**Mitzi Johnson**  
Behavioral Science  
102 College of Medicine Office  
Bldg.  
40536-00861  
Ph. 233-6075

**John P. Jones**  
Geography  
1453 Patterson Office Tower  
40506-00270  
Ph. 257-6950

**Michael Kovash**  
Physics & Astronomy  
373 Chemistry-Physics Bldg.  
40506-00551  
Ph. 257-1150

**Robert Kroeger**  
Oral Health Science  
M-130A Chandler Medical  
Center  
40536-00840  
Ph. 233-6510

**Bing-An Li**  
Physics & Astronomy  
373 Chemistry-Physics Bldg.  
40506-00551  
Ph. 257-4741

**Keh-Fei Liu**  
Physics & Astronomy  
393 Chemistry-Physics Bldg.  
40506-00551  
Ph. 257-4849

**William Lyons**  
Political Science  
10 Administration Bldg.  
40506-0032  
Ph. 257-5872

**Alan MacKellar**  
Physics & Astronomy  
177F Chemistry-Physics Bldg.  
40506-00552  
Ph. 257-6722

**H. F. Massey**  
International Program for  
Agriculture  
N324 Agriculture Science  
Center-North  
40506-00910  
Ph. 257-1711

**Marcus T. McEllistrem**  
Physics & Astronomy  
383 Chemistry-Physics Bldg.  
40506-00552  
Ph. 257-3403

**Artie Norton**  
Neurosurgery  
MS102 Chandler Medical  
Center  
40536-00844  
Ph. 233-5333

**Mark A. Pickar**  
Physics & Astronomy  
CP383 Chemistry-Physics Bldg.  
40506-00552  
Ph. 257-8896

**Mary Pietrukowicz**  
Behavioral Science  
116 College of Medicine Office  
Bldg.  
40506-00861  
Ph. 233-6034

**C. S. Prakash**  
Forestry  
213 T. P. Cooper Bldg.  
40506-00731  
Ph. 257-5994

**John Ragland**  
Dean's Office  
S-327 Agriculture Science  
Center-North  
40506-00910  
Ph. 257-2795

**K. Screekrishna**  
Biochemistry  
102 Tobacco & Health Research  
Bldg.  
40506-02361  
Ph. 233-5549

**Timothy Smith**  
Oral Health Science  
M-130A Chandler Medical  
Center  
40536-00840  
Ph. 233-6510

**Timothy Stahly**  
Animal Sciences  
610 Agriculture Science Center-  
South  
40506-02151  
Ph. 257-7524

**Carol Straus**  
Ctr. for Business & Economic  
Research  
302B Mathews Bldg.  
40506-00473  
Ph. 257-7678

**Bart Thielges**  
Forestry  
106 T. P. Cooper Bldg.  
40506-00731  
Ph. 257-7596

**Jim Trice**  
Physics & Astronomy  
177 Chemistry-Physics Bldg.  
40506-00552  
Ph. 257-6722

**Larry Turner**  
Agriculture-Engineering  
209B Agriculture Engineering  
Bldg.  
40506-00751  
Ph. 257-7412

**James Usry**  
Agriculture Engineering  
125 Agricultural Engineering  
Bldg.  
40506-00751  
Ph. 257-5658

**Michael Witte**  
Biochemistry  
102 Tobacco & Health Research  
Bldg.  
40506-02361  
Ph. 233-5549

**Byron Young**  
Neurosurgery  
MS108 Chandler Medical  
Center  
40536-00844  
Ph. 233-5864

**Lucinda Zoe**  
Ctr. for Business & Economic  
Research  
301 Mathews Bldg.  
40506-00473  
Ph. 257-7676

## Back Cover Photo

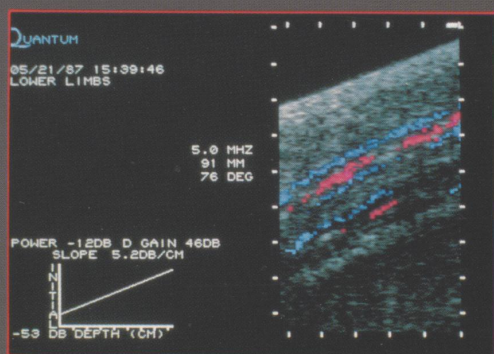
*A safe, painless method for detecting potential stroke victims is available at the UK Medical Center with the Quantum Angiodynograph duplex imager. Shown here is the imager's monitor simulating the blood inside an artery flowing to and from the brain. See article titled "On-Screen Hunt for a Hidden Killer," page 30.*



## ODYSSEY

University of Kentucky Research Foundation  
Kinkead Hall  
University of Kentucky  
Lexington, Kentucky 40506-0057

NONPROFIT ORGAN.  
U.S. POSTAGE PAID  
PAID  
LEXINGTON, KY.  
PERMIT NO. 51



### *Also in this issue:*

On-Screen Hunt for a Hidden Killer  
The Feminization of Poverty  
Sensationalized Science  
When Subatomic Worlds Collide